Public Comment Submittal from Tami Thatcher to the U.S. Department of Energy and National Nuclear Security Administration (NNSA) regarding the Draft Environmental Impact Statement for the Surplus Plutonium Disposition Program (Draft SPDP EIS) (DOE/EIS-0549)

Comment submittal due February 14, 2023, to SPDP-EIS@NNSA.DOE.gov

Background

The Department of Energy's National Nuclear Security Administration (NNSA) is involved in nuclear weapons development and production and is seeking to "disposition" 34 metric tons of surplus plutonium. This Draft Environmental Impact Statement for the Surplus Plutonium Disposition Program (Draft SPDP EIS) (DOE/EIS-0549) includes the disposal of 34 metric tons of surplus plutonium from nuclear weapon pits and also from non-pit surplus plutonium.

The NNSA is focused on dilute and disposal of just 34 metric tons because of an agreement with the Russian Federation made in 2000. There is over 61.5 metric tons of acknowledged U.S. surplus plutonium. Disposition, now defined as "disposal" in the Draft SPDP EIS, of 34 metric tons of surplus plutonium, still leaves over 27 metric tons of surplus plutonium to be used or diverted for nuclear weapons, enough for thousands of nuclear weapons. In addition, the DOE wants to import surplus plutonium into the U.S. for the Versatile Test Reactor.

Previously, about 33 metric tons of surplus plutonium was to be made into Mixed-Oxide (MOX) fuel and used in commercial nuclear power reactors. The cost of the MOX fuel fabrication facility, partially constructed at the Savanah River Site (SRS), spiraled out of control and in addition, no U.S. nuclear plants wanted the fuel. The Department of Energy cancelled the MOX fuel fabrication facility in 2018. Burning the surplus plutonium in U.S. reactors has now been ruled out as a means of "dispositioning" the surplus plutonium.

This Draft SPDP EIS plan evaluates disposal of 34 metric tons of an unspecified amount of pit and of non-pit surplus plutonium. Less pit plutonium would be disposed of, if more non-pit plutonium is disposed of. The total amount of surplus plutonium would not exceed 34 metric tons, in this draft EIS.

This draft SPDP EIS largely involves plutonium pit disassembly and non-pit plutonium disposition at either the Los Alamos National Laboratory (LANL) or the Savannah River Site (SRS) or a combination of both. The surplus plutonium would then be shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico for disposal.

Expanded nuclear weapons pit production for new weapons is also currently planned to increase at both LANL and SRS. Congress has mandated production of 80 pits per year, with 30 pits per year at LANL and 50 pits per year at SRS, by 2030. It is already acknowledged that the SRS site will not meet than production goal and this can be expected to put even more pressure on LANL. No new plutonium production, via nuclear reactor plutonium production, is planned.

This draft SPDP EIS acknowledges some pit disassembly work that is done at LANL already and also the heat source plutonium-238 work at LANL for space missions.

Comment Summary

The Department of Energy's National Nuclear Security Administration (NNSA) has issued, last December 2022, its latest draft Surplus Plutonium Disposition Program Environmental Impact Statement (DOE/EIS-0549). [1] The Draft SPDP EIS includes the disposal of 34 metric tons of surplus plutonium from nuclear weapon pits and also from non-pit surplus plutonium.

In this draft SPDP EIS, the NNSA falsely asserts that adding work scope to the already struggling Los Alamos National Laboratory (LANL) would be done "without impact to other [LANL] programs."

The NNSA in a November 2022 hearing conducted by the Defense Nuclear Facilities Safety Board [2] explained its tardy or cancelled safety upgrades at LANL by saying that in the U.S. it is difficult to get work done, and hiring and retaining workers is extremely difficult at LANL. Read more in the Environmental Defense Institute newsletters for December 2022 and January 2023 "Recap of the egregious safety shortcuts at LANL" at www.Environmental-Defense-Institute.org

At the November hearing, the NNSA explained that it was accepting accident radiological doses to the public from an accident at LANL's PF-4 that far exceeded what Department of Energy requirements would normally allow. Normally, safety class systems would be required to assure that doses to the public remained below 25 rem. A 25-rem inhalation dose to the public would involve an obscenely high release of radioactivity that would remain in the environment basically, forever. **But the DOE and NNSA invoked the "exigent circumstances" processes to allow doses to the offsite public to exceed a whooping 3000 rem.** A radiation inhalation dose exceeding 400 rem is typically considered lethal.

The excuses for accepting such high accident consequences to the public (and also lethal doses to an undetermined number of the 1000 workers at LANL's PF-4) included that the NNSA found it hard to procure a few needed seismically restrained gloveboxes. And NNSA found it inconvenient to implement meaningful limits on the material-at-risk (MAR), implement meaningful combustible loading controls, or complete other long-needed safety upgrades.

However, the NNSA excused its lack of safety by assuring the DNFSB and those attending the meeting that the NNSA "was working very closely with the Department of Defense."

The NNSA's latest surplus plutonium disposition draft EIS states that the added work scope for LANL will require additional gloveboxes, additional workers, and scheduling shifts of workers 24 hour a day, 7 days a week. With the already expanding nuclear weapons pit production work, the added plutonium disposition work will most certainly

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[1] Department of Energy's National Nuclear Security Administration, Surplus Plutonium Disposition Program Environmental Impact Statement (DOE/EIS-0549), issued December 2022. Public comments accepted until February 14, 2023. See https://www.energy.gov/nepa/articles/doeeis-0549-draft-environmental-impact-statement-december-2022 and https://www.federalregister.gov/documents/2022/12/16/2022-27152/notice-of-availability-of-draft-environmental-impact-statement-for-the-surplus-plutonium-disposition

[2] Defense Nuclear Facilities Safety Review Board website at dnfsb.gov, November 16, 2022 meeting on the Los Alamos National Laboratory, see meeting agenda, videos, exhibits for cleanup and increased pit production and other information on the dnfsb.gov webpage https://www.dnfsb.gov/public-hearings-meetings/november-16-2022-public-hearing.

create significantly more safety problems at the already overloaded plutonium facility, PF-4, at LANL.

The draft EIS includes a variety of options, "sub-alternatives," in its "preferred" option. The weapons pit disassembly work could be conducted only at LANL, only at the Savannah River Site, or a combination. Similarly, the non-pit surplus plutonium work could be conducted only at LANL, only at the Savannah River Site, or a combination, even though the non-pit material is already at SRS.

The November 2022 hearing exhibits by the DNFSB pointed out that the public is located only about 0.6 miles from LANL's PF-4 facility while the nearest offsite public is located about 6 miles from the facilities at SRS. There are roughly 690,000 people within 50 miles of SRS and roughly 990,000 people within 60 miles of LANL. The 2022 draft EIS states that there are 343,000 people living within 50 miles of PF-4, which gives a false portrayal of the significance of the size of the communities surrounding LANL.

The draft EIS fails to provide any status of the documented safety analyses which continue to be tardy as well as technically indefensible, or of the status of long-awaited safety upgrades at LANL's PF-4. In fact, the draft EIS simply points to a biased, inadequate and out-of-date 2015 Final Surplus Plutonium Disposition Supplemental EIS, Appendix D. The 2022 draft surplus plutonium disposition EIS simply does not include basic information about the many facility accidents or the assumptions made, but points to the tangled and out-of-date material in the 2015 EIS.

The 2015 EIS had generally found it more reasonable to chose assumptions to hack and slash the leak path factor used in the DOE's safety analyses by a factor of ten to reduce the accident consequences. The reality is that the DOE's safety analyses leak path factors would probably be more realistic and appropriate if increased by a factor of 10!

The failure to provide needed accident analysis assumptions in the December 2022 draft EIS creates significant ambiguity when trying to sort out what was assumed by searching in the 2015 EIS. The 2015 EIS Appendix D analysis of human health effects and the accident consequences at LANL and SRS gave DOE's documented safety analysis results from over a decade ago, and also gave the reduced consequence estimates as deemed more appropriate by the 2015 EIS authors. Then the December 2022 EIS appeared to pick and choose sometimes the older DOE consequences and sometimes the reduced 2015 consequence estimates, all without explanation. The adjustment of values in the 2022 EIS makes it all the more difficult to compare to the 2015 EIS. And an up-to-date status of LANL upgrades and cancelled safety upgrades is simply not provided in the 2022 draft EIS.

Many statements, used by reference to the 2015 EIS, assert that DOE's rigorous safety requirements would be met and would assure low radiation doses to the public. But, in light of NNSA's recent use of the "exigent circumstances" processes at LANL to accept far higher accident risks and to continue to delay or outright cancel needed safety upgrades shows that these statement in the 2022 Draft SPDP EIS are fiction and simply not true.

Nuclear safety basis documentation for DOE nuclear facilities is relied upon for the protection of workers, the public and the environment. The fact is that LANL is decades behind in developing documented safety analyses that are Code of Federal Regulations 10 CFR 830, "Nuclear Safety Management" compliant for Department of Energy nuclear facilities, decades behind in completing nuclear facility safety upgrades and also decades behind in addressing its already existing nuclear waste problems is not addressed in this 2022 Draft SPDP EIS.

The status of completed safety upgrades, planned safety upgrades and canceled safety upgrades is completely lacking from the 2022 Draft SPDP EIS. The 2022 Draft SPDP EIS points to the 2015 EIS's Appendix D, that is completely inadequate because it was out-of-date when issued in 2015, seven years ago.

For LANL, in 2022, they still have not prepared and submitted for approval nuclear safety basis documents that would meet the intent of 10 CFR 830 for cleanup of existing above-ground waste. LANL lacks the plans and processes, as well as the safety analyses for needed LANL waste exhumation and disposal of problematic legacy radioactive (transuranic) waste. The 2022 Draft SPDP EIS ignores the realities of the accident risks from transuranic waste storage and the failure to adequately address the leach out of radionuclides and chemicals from already improperly stored waste at LANL.

This Draft SPDP EIS disposes of the 34 metric tons of surplus plutonium at the Waste Isolation Pilot Plant (WIPP) salt mine in New Mexico but without analysis of the already overcommitted WIPP for nuclear weapons related "defense waste." The 2022 Draft SPDP EIS ignores previous commitments to the State of Mexico. This Draft SPDP EIS adds a tremendous increase in the plutonium disposal at WIPP. And it does so, without any criticality analysis or repository safety analysis for the greatly increased amount and concentration of plutonium.

To recap, this Draft SPDP EIS proports to examine facility accident risks, yet it uses out-of-date Department of Energy documented safety analysis (DSAs), and biased and inadequate previous EIS accident analyses. The Draft SPDP EIS fails to provide an up-to-date status of completed safety upgrades, of current operations, or of currently acknowledged obscenely high risk acceptance to the off-site public near LANL.

Specifically, the NNSA has now acknowledged accepting mitigated offsite public radiation doses far exceeding 25 rem, in excess of 3000 rem. This is nowhere to be found in the Draft SPDP EIS nor its referral to the 2015 Supplemental EIS, the out-of-date and quite inadequate 2015 Final Surplus Plutonium Disposition Supplement EIS, Appendix D (DOE/EIS-0283-S2, Volume 2, April 2015) [herein referred to as the "2015 EIS"].

The NNSA has acknowledged at the November 2022 DNFSB hearing that it finds safety upgrades too inconvenient and it had recently used the "exigent circumstances" processes to allow radiation doses to the public in excess of 3000 rem. It is commonly considered that radiation doses exceeding 400 rem would be lethal within weeks of exposure. The Draft SPDP

EIS must explain why this information was omitted, yet it made it appear that all facility accident risks were included.

In summary, this Draft SPDP EIS is completely inadequate and further leads to inadequate protection of the public by omission of the truth, by inadequately addressing nuclear accident risks, by inadequately addressing the truth of past and ongoing nuclear contamination from routine operations, the unsafe transuranic waste storage issues and the long-overdue waste disposal and storage issues. The 2022 Draft SPDP EIS grows the problems faced by humanity, particularly by the people in New Mexico, from the Department of Energy and the NNSA's irresponsible stewardship, all while falsely claiming that DOE's requirements can be relied upon to assure public, worker and environmental safety.

The Draft SPDP EIS Must Provide Up-to-Date Accident Risks at LANL's PF-4

This draft SPDP EIS completely obscures the serious safety problems existing at LANL. The safety problems at LANL for large airborne radiological releases have been known for at least two decades. The risk to workers at LANL's PF-4 facility and to the public is so inaccurately portrayed in the draft SPDP EIS it must be completely scrapped and redone.

This draft SPDP EIS incorrectly understates the radiological accidents associated with any operations burdens at LANL. This draft SPDP EIS is technically indefensible, incomplete and inadequate. Perhaps the authors did not notice it, because they simply assumed that the 2015 EIS (Appendix D) was adequate and they didn't know the status of operations and safety upgrades at LANL.

The draft SPDP EIS does not include an up-to-date status of operations and of safety upgrades or of the continued tardiness in obtaining 10 CFR 830 compliant documented safety analyses for LANL operations.

The doses to the offsite public from an accident at LANL don't just exceed 25 rem, the level at which DOE was required to provide adequate safety systems. This doses to the offsite public do not just exceed 100 rem. The radiation doses to the public actually, according to the DOE and NNSA in November 2022, actually exceed 3000 rem, from the Pu-238 heat source operations conducted in gloveboxes that are not seismically restrained from tipping over.

This sham of an EIS fails to acknowledge that actual deferment or cancellation of needed safety upgrades at LANL's PF-4. It relies on out-of-date documents and improvised and un-scrutinized assumptions that are simply guesses as to ways to lower the stated estimates of accident consequences.

At LANL, many needed safety upgrades have been deferred, have needed rework, or have simply been cancelled because NNSA considered it too inconvenient and too expensive to protect workers, citizens and property in New Mexico.

Even before the additional surplus plutonium disposition work, NNSA had deemed it too difficult to require seismically restrained gloveboxes or to implement stringent combustible

loading controls or to make meaningful reductions in the amount of material at risk (MAR). NNSA is putting the public at risk in New Mexico.

This draft SPDP EIS does not include an updated status of the safety upgrades that have been recognized as needed at LANL. Instead, this draft SPDP EIS points to the 2015 EIS that is now over 7 years out of date. This SPDP EIS must include an up-to-date status of safety upgrades and operations. New safety deficiencies have been found since the 2015 EIS was written.

The 2015 EIS and the draft SPDP EIS argue that the documented safety analyses (DSAs) are just too conservative and therefore accident consequences from DOE-approved DSAs may need to be reduced in order to be more "realistic." Given the pressure on reducing conservatism in DOE DSAs, the biased and technically indefensible assumptions tossed in by EIS authors to whack down the accident consequences is hardly reliable. See Table 1 below for a comparison of the plutonium-equivalent grams of material at risk (MAR) and the estimates of the grams released. In the first accident in the table, with 2.6 million grams of plutonium-equivalent, it is assumed that only 2.36 grams PuE is released, far lower than had been stated in DOE's safety basis, of 82 PuE.

Table 1. Example of LANL material-at-risk and source term, grams of plutonium mixture.

Accident, Frequency	**Scenario**	**MAR, grams PuE**	**LPF**	**Source Term or Release, grams Pu 2015 EIS**	**Source Term or Release, grams Pu 2022 EIS**
Design-basis earthquake with spill, Extremely unlikely (1.0E-4 to 1.0E-6 per year)	Bounding safety-basis scenario	2,600,000	0.05	82 PuE	2.36 PuE
	Guesses by 2015 EIS	2,600,000	0.005	2.0 PuE	2.36 PuE
Design-basis earthquake with fire, Extremely unlikely (1.0E-4 to 1.0E-6 per year)	Bounding safety-basis scenario	2,600,000	0.18	169 PuE	4.72 PuE (0.424 rem)
	Guesses by 2015 EIS	2,600,000	0.005	1.8 PuE	4.72 PuE
Beyond-design-basis earthquake, collapse and fire, facility inventory	?	12,000,000	0.3 to 0.5	362 PuE (for 35 MT throughput) (18 rem to MEI)	2370 PuE (122 rem to MEI)

Accident, Frequency	Scenario	MAR, grams PuE	LPF	Source Term or Release, grams Pu 2015 EIS	Source Term or Release, grams Pu 2022 EIS
Extremely unlikely *** to beyond extremely unlikely (1.0E-5 to 1.0E-7)					

Table notes: 2015 Final Surplus Disposition Supplemental EIS, DOE/EIS-0283-S2, April 2015, Appendix D. MAR = material at risk; LPF = leak path factor; damage ratio and airborne release fractions not disclosed in Table D-9 of 2015 EIS; PuE = plutonium-239 dose-consequence equivalent for the mixture. MEI = maximally exposed individual of the public. The noted "beyond-design-basis earthquake" is actually an extremely unlikely event rather than what is normally considered a beyond design basis event, that would be below 1.0E-6/yr frequency. The draft Surplus Plutonium Disposition Program EIS, DOE/EIS-0549, December 2022, Table D-3 values include the modification to 2015 values for FGR 13 PuE values. The assumed annual through-put assumed is not stated in Table D-3 of the 2022 draft SPDP EIS.

No accident scenarios at LANL that are included in the 2022 draft SPDP EIS include the now acknowledged higher radiological dose consequences of heat source Pu-238 operations.

An August 2022 letter from the DNFSB to DOE states that the National Nuclear Security Administration (NNSA) has accepted **the extraordinarily high mitigated offsite dose consequences range from 490 to 3175 rem, via the "exigent circumstances processes."** Typically, radiation doses above about 400 rem are considered lethal. Vast areas would become permanently uninhabitable and citizens will die because of the extraordinary and irresponsible lack of adequate safety mitigations.

So, let me repeat, the 2022 Draft SPDP EIS accident analysis is not bounding and is not truthful. There is not only great complexity, there are factual disconnects between the 2022 accident analysis and the 2015 EIS, Appendix D that has been adopted into the 2022 Draft SPDP EIS.

Delayed Safety Analysis and Safety Upgrades at LANL

NNSA has now been tardy for two decades and has failed to provide updated and 10 CFR 830 compliant documented safety analyses.

NNSA, has made improvements to the PF-4 building at LANL to prevent its collapse in a modest earthquake. They have also seismically upgraded specific gloveboxes, but only those that hold molten materials.

Safety upgrades identified as needed at PF-4 since 2009 continue to be delayed or eliminated completely from project planning. [3]

I think there is reason to believe the delays in providing needed nuclear safety upgrades at PF-4 may continue beyond the now-stated 2026 timeframe (See Exhibits for the NNSA session, particularly Exhibit 30 from the November 2022 DNFSB hearing.) The permanent loss of lives and homes due to a large radiological release from PF-4 could be the result of NNSA's shortcutting safety. Radiological releases to the offsite public are unacceptable. Accident conditions will likely result in unacceptable worker intakes of radionuclides as well.

The NNSA did not provide a coherent status of LANL safety upgrade status at the DNFSB. An updated and complete status must be provided in the EIS.

The Department of Energy nuclear safety regulations do not require a coherent assessment of facility accident risk and that is not compensated for by whacking down the dose consequences with guesses about what leak path factor is more "realistic."

Over two decades ago, in January of 2001, the Department of Energy's Code of Federal Regulations 10 CFR 830, "Nuclear Safety Management" for Department of Energy nuclear facilities. DOE nuclear facilities were to have submitted a compliant nuclear safety basis to DOE by October 10, 2001. And these submittals were to include all types of facilities accidents, including seismically induced accidents and other natural phenomena hazards specific to the location of the facility.

And although many submittals were later than October 2001, LANL is setting records in tardiness in completing upgraded "documented safety analysis" for LANL's plutonium facility, PF-4 (as well as LANL's cleanup operations).

Some DOE nuclear facilities in the DOE Complex sought and achieved updated nuclear safety basis documents that met the intent of 10 CFR 830 and did so before 2005.

Other DOE nuclear facilities, such as plutonium facilities in Idaho at the Materials and Fuels Complex at the Idaho National Laboratory and at the plutonium facilities at the Los Alamos National Laboratory in New Mexico, did not prepare nuclear safety basis upgrades that met the intent of 10 CFR 830 and had not done so by 2011 and even now.

For LANL, in 2022, they still have not prepared an submitted for approval nuclear safety basis documents that would meet the intent of 10 CFR 830 for cleanup of existing above-ground waste. LANL lacks the plans and processes, as well as the safety analyses for needed LANL waste exhumation and disposal of problematic legacy radioactive (transuranic) waste.

[3] Los Alamos National Laboratory, *SSUP* [Safety System Upgrade Project] *Project Implementation Plan,* Revision 0, Los Alamos National Laboratory, Los Alamos, NM, March 2009

Continued Fiddling With Accident Severity Estimates in EISs and by DOE Does Not Assure Reliable Radiological Release Estimates

Nuclear safety basis documentation for DOE nuclear facilities is relied upon for the protection of workers, the public and the environment. At the Idaho National Laboratory, the facilities that were tardy in submitting upgraded seemed to search for clever ways to lower estimated worker and offsite public radiation doses. Year after year, they searched for ways to excuse themselves from making safety improvements and ways to avoid the inconvenience and cost of making safety improvements to mitigate accidents and prevent significant offsite radiological releases.

A similar thing seems to be continuing at LANL, even now, in the 2022 draft SPDP EIS. The analysis to obtain a desirable building leak path factor for PF-4 remains an ongoing effort at LANL. The objective is to achieve the lowest offsite public dose by "pencil whipping" the problem to claim that the offsite dose to the public is below 25 rem.

At the Idaho National Laboratory (INL), at its Materials and Fuels Complex (previously known as ANL-West), indefensible choices were made in the documented safety analysis in the selection of DOE handbook values (DOE Handbook, DOE-HDBK-3010-94). The airborne release fraction from the DOE Handbook is used to determine the amount of material that could become airborne during an accident. Technically indefensible choices made by INL's contractor Battelle Energy Alliance were approved by the Department of Energy when the choices lowered the estimated accident consequences. Despite considerable expertise around the DOE Complex, these problem plutonium facilities seem to prefer in-house teams dedicated to do whatever finagling possible to lower the estimated accident consequences (and likelihoods). The DOE's documented safety analyses are typically not made publicly available.

At the INL, technically indefensible estimates of accident likelihood were made and approved by the Department of Energy. The accident likelihood and consequence at the Materials and Fuels Complex Zero Power Physics Reactor facility, in 2011, had been low-balled in technically indefensible ways. Analysis of potential worker doses were not evaluated at any appropriate level of detail, yet the documented safety analysis was approved by DOE.

Technically indefensible choices made in the 2015 and 2022 surplus plutonium EISs have been made in order to lower the accident consequences. What is needed are safety upgrades at LANL's PF-4.

Needed Safety Upgrades at LANL's PF-4

At LANL, year after year, and actually for at least two decades, needed safety upgrades to protect the public have been talked about but very few changes made. There have been improvements to the seismic capability of the PF-4 building and to certain gloveboxes, but only to the glove boxes that handle molten material.

At LANL, completion of the improvements to the fire suppression system has been delayed to 2026 (see Exhibit 30 for the hearing). Completion of efforts to address aging components for the ventilation system have also been delayed to 2026 (also see Exhibit 30).

Despite some seismic bracing for some gloveboxes at PF-4, many, probably most gloveboxes at PF-4 remain vulnerable to seismic events because they are not seismically braced. And some of these gloveboxes handle powders or solutions of material.

It is telling that at INL, the dismantling of a Pu-238 glovebox shipped to Idaho from Mound — an empty glovebox — coincided with elevated detections of Pu-238 miles from the operation of preparing the glovebox for disposal, in 2018. DOE never has admitted to the source of the elevated environmental contamination.

The amount of material at risk, or MAR, is the amount of radiological material that is handled and can be involved in an accident leading to airborne release. And the NNSA has approved very large amounts of material at risk that will be allowed to be handled and in vulnerable conditions, despite the gloveboxes not being seismically braced and the fire suppression system not being seismically capable and the confinement ventilation system not being safety class or seismically capable.

And the DNFSB points out that even the relatively easy measures to help reduce the offsite public dose consequences were not taken. These measures include specific, meaningful and enforced combustible loading limits that were not put in place for high hazard heat source plutonium (Pu-238) work. These measures also include limiting the amount, (grams or curies) of material-at-risk allowed in unsafe configurations and this would have reduced the offsite public dose consequences but also were not put in place at PF-4.

The years of delays in making needed safety upgrades to protect workers, the offsite public and the environment display an erroneous LANL and NNSA group think that seismic events and other accidents won’t happen. Or is it related to a perverse discounting of the true harm to people’s health and lives from these events?

The DNFSB is allowed to make recommendations but has no authority to make DOE or NNSA act responsibly. The vigorous responses by the panelists at the November 2022 DNFSB hearing that included NNSA, LANL and its contractors were intended to defend the lack of progress in completing needed safety upgrades and acceptance of outrageously high levels of risk. The excuse making was extensive but the progress on needed safety upgrades was not.

While building structural improvements are said to have been made to LANL plutonium facility, PF-4, the Department of Energy allows meeting seismic performance category 3 (PC-3) for non-reactor facilities. The actual amount of plutonium that could be released and high likelihood of an accident at PF-4 would actually require, by technically appropriate rationale, meeting the more stringent PC-4 seismic performance category required of nuclear reactors.

And in reality, this Draft SPDP EIS ignores the fact that much of the equipment in PF-4, both safety related and non-safety related, it appears, will likely not survive a PC-2 seismic event. And also ignored is that non-safety equipment may be able to degrade the performance of safety equipment during a seismic event.

It can be easy for managers to be motivated to dismiss the importance of a large seismic event that may be very expensive to mitigate. But some of the safety measures are not so expensive and the DOE simply does not require itself to conduct comprehensive investigations for assessment of accident risk, especially seismically-induced accident risks.

Status of Safety Upgrades for PF-4

At LANL, the plutonium handling facility, PF-4, is expected to increase operations and staffing for weapons pit production, continue heat source plutonium (Pu-238) operations for defense and space missions, and other plutonium research.

At PF-4, safety deficiencies were certainly recognized by 2001, although a detailed plan was not published until 2009. [4] The safety upgrades are needed to protect the offsite public from a large airborne radiological release that would exceed 25 rem. Worker safety was not mentioned at the November 16 public hearing, but would also be affected by the inadequate documented safety analyses for cleanup of transuranic waste operations as well as PF-4 operations.

The heat source Pu-238 is used for National Aeronautics and Space Administration (NASA) missions and defense missions. [5] The plutonium glovebox work for the heat source (Pu-238) creates the risk of very high radiological releases to the offsite public and was stated in the hearing on November 16, 2022 as posing the offsite public radiation dose **roughly 200 times higher than for weapons pit production**.

During the November public hearing, the status of safety upgrades and prudent safety controls was not always clear. Certain upgrades may be in progress but yet not be slated to be completed until 2026. The 2022 Draft SPDP EIS is even less clear about the status of long-needed safety upgrades than the November DNFSB hearing discussion by NNSA.

At PF-4, remaining safety upgrades include needed fire barriers, fire sprinkler lines, and the removal of firewater lines to buildings that are not non-seismically capable of PC-3 events. The upgrade of fire suppression system power supplies from diesel generators and their often-deficient fuel supply lines, is also apparently needed.

[4] Defense Nuclear Facilities Safety Board letter to the Department of Energy, Secretary James Richard Perry, dated November 15, 2019, which transmits the DNFSB Staff Report "Safety Basis for the Plutonium Facility at Los Alamos National Laboratory," August 16, 2019, at DNFSB.gov

[5] Defense Nuclear Facilities Safety Board letter to the Department of Energy, Secretary Jennifer Granholm, dated August 11, 2022, which transmits the DNFSB Staff Report "Receipt and Repackaging of Large Amounts of Heat Source Plutonium at the Los Alamos National Laboratory Plutonium Facility," May 27, 2022, at DNFSB.gov

At PF-4, it has long been known that many gloveboxes still need safety upgrades for seismic restraint (rated to PC-3), including gloveboxes containing liquid solutions of plutonium and powders and other forms.

And at PF-4, remaining safety upgrades for the confinement ventilation system are needed, but may never be performed. If there was ever a DOE facility that needed a safety class confinement ventilation system, LANL's PF-4 is such as facility because (1) of the far greater than 25 rem offsite dose without it and (2) there are about 1000 workers in PF-4 now and that number is expected to grow.

A procedure to evacuate and to verify closure of the doors to the facility PF-4 facility would still be needed, in case this was a PC-4 earthquake or other adverse condition. But the closure of the doors at PF-4 would not be as important if a confinement ventilation system were collecting the airborne plutonium in HEPA filters rather than spewing it to the offsite public living near PF-4.

What happens if the door won't close due to structural damage or just a bad latch? What is odd about PF-4 is that while they are claiming that the structure has been upgraded to PC-3, this typically does not mean that the building would remain leak tight.

What happens if the HEPA filters are damaged, say by a fire in the building. Are the fans going blow the contamination out the stack? There is a need for systems that can detect what is happening and what areas are contaminated. There needs to not be reliance on the fortuitous failure of the fans, should they continue to be operable. And there is a need to monitor the door closure status and the need for effective radiological monitoring.

I am curious as to how the evacuating workers will know where the radiological releases are blowing to. And where will contaminated workers go to be decontaminated, chelated and lung counted?

The high levels of many decay products from Pu-238 and uranium tend to create the need for tailoring constant air monitoring systems to avoid alarming during routine operations. A constant air monitor set to alarm on high levels of plutonium-239 may not alarm on high levels of Pu-238 or of high levels of americium-241.

At the Idaho National Laboratory, the handling of americium-241 and its airborne spread in a laboratory was missed because the constant air monitor was set to alarm on Pu-239. And although the CAM did alarm on the Am-241, its error message of "poor fit" made the facility workers believe it was a false alarm. It was only weeks later when the filter for the air monitor were examined, that they realized there had been an elevated release that exposed workers.

The challenges of detecting the different plutonium isotopes and associated progeny and associated radionuclides that may accompany the plutonium should not be dismissed at PF-4, especially for the wide variety and evolving missions at PF-4.

Seasoned professionals trained to recognize and monitor ‘weapons grade’ pit plutonium-239 may not expect the radionuclide compositions present in ‘fuel grade’ materials that have higher plutonium-240, plutonium-241 and higher americium-241. Worker intakes of plutonium-241 were ignored in the 2011 plutonium event at INL, yet this can be a significant dose impact for ingrowth of Am-241 in the body after inhalation.

The multiple missions existing at PF-4 and the evolving and increased level of pit production and other missions at PF-4 will complicate the detection of radiological releases and the needed preparation for medical attention for workers who inhale various plutonium airborne materials.

And as with the radiological emergencies that have occurred at Idaho at MFC in 2011 and the four waste drums that popped their lids and expelled their contents due to incompatible materials in 2018, workers were put in harms way. Inadequate characterization of the waste materials in the drums was allowed, despite warnings that the materials could contain beryllium. Addressing beryllium in the waste was inconvenient, and so the incompatible materials had been deliberately ignored. And despite the unusual waste composition of unreacted uranium metal, less care rather than more care was taken with the unusual waste stream. Care was taken to not refer to the pyrophoric metal uranium as a pyrophoric material, however. My point is that accidents can happen without a seismic event and subsequent fire.

At the 2018 event at the INL cleanup project with four drums that ejected their contents (operated by Fluor Idaho), the radiological air monitor was so clogged with material it did not alarm. There was a fire alarm and emergency responders had no idea that they were responding to a radiological event. And once there, there were no personnel who knew what operations had been performed that day and no operations personnel with self-contained breathing apparatus qualifications.

Public Risks Far Higher Than Stated

Rather than provide clear and detailed status of safety upgrades or approved and compliant documented safety analyses, this draft SPDP EIS relies on an inadequate EIS from 2015.

LANL’s PF-4 accident consequences have greatly increased since 2015. The draft SPDP EIS should explain why the DOE still has not developed a 10 CFR 830 compliant DSA for PF-4, that is now two decades late, rather than blow bluster that the DOE’s DSA’s — that are not 10 CFR 830 compliant — are just deemed overly conservative by the anointed EIS authors.

The draft SPDP EIS must state the actual and up-to-date status of safety upgrades. It needs to not take credit for any safety upgrade that has not taken place. It needs to clearly explain its assumptions and exactly how it justifies the factor of ten or so reductions in accident consequences from the DOE-approved yet not 10 CFR 830 compliant DSA for LANL.

When the draft SPDP EIS states that for new facilities, such as they would build at SRS, fully compliant and up-to-date safety standards would apply. But at LANL, since its an existing facility, such non-compliance, even with existing DOE regulations is not described.

This draft SPDP EIS must state and explain that currently the DOE/NNSA is involving the "exigent circumstances" processes at LANL's PF-4 and cancelling previously committed to safety upgrades in order to conduct work with obscenely high accident doses to the public without seeking meaningful material-at-risk limits or other safety mitigations at LANL's PF-4.

The DOE/NNSA draft SPDP EIS is greatly understating the overall accident risks and individual accident risks at LANL's PF-4 facility.

When the draft SPDP EIS states that total facility inventory in PF-4 was included (in the beyond-design-basis earthquake with building collapse and fire), it made a false statement (Table D-3, for example). The draft SPDP EIS Table D-3 states the public dose as 122 rem at the site boundary, despite a far higher dose potentially occurring from heat source Pu-238 operations at PF-4.

It is now known that the accident consequences from a heat source Pu-238 accident are far greater than stated in the draft SPDP EIS. The draft SPDP EIS states that the maximum dose from LANL's PF-4 for the entire facility inventory of material at risk (MAR) would be 122 rem to the public, the "maximally exposed individual" (MEI) at the boundary. Yet, we know that the accident consequences to the person at the boundary of the LANL would be far higher, and above the dose considered to be fatal, or 400 rem. The heat source Pu-238 operations at PF-4 pose a potential radiation inhalation dose of over 3000 rem to the offsite public.

Deceptive Depiction of Department of Energy Enforcement of Regulations

What the draft SPDP EIS emphasizes about *overly conservative* Department of Energy DSAs, which are supposedly relied upon to protect workers and the public, simply isn't true. The reductions in radiation releases from potential accidents that the draft SPDP EIS puts forth are unjustified and inadequately reviewed or scrutinized. The draft SPDP EIS, as the 2015 EIS did, puts forth conjecture and hubris depicted as the more reasonable assessment of facility risk to the workers and public than the inadequate and non-compliant yet DOE-approved DSAs.

Discoveries of Potential Inadequacies in the Safety Analysis

When it is discovered that an accident at a DOE nuclear facility is more likely to occur or would have worse consequences than previously stated in the approved documented safety analysis, this is called a "Potential Inadequacy in the Safety Analysis" or PISA. There have been two dozen PISAs associated with LANL's cleanup operations. The LANL cleanup operations documented safety analysis has still not been upgraded to meet the 10 CFR 830 regulations issued two decades ago. Excuses that the older safety analysis are adequate yet just not "modern" display ignorance of the importance of adequate documented safety analyses to protect workers, the public and the environment. LANL's continued struggling with cleanup and backlog of shipments to WIPP is ignored in the 2022 Draft SPDP EIS.

In addition, the fact that LANL's improper and noncompliant packaging of transuranic waste caused the 2014 accident at WIPP involving chemical incompatibility and explosion of a waste drum in WIPP that caused its 3-year closure was not discussed.

In conclusion, LANL's continued failure to provide 10 CFR 830 compliant documented safety analyses for plutonium operations at PF-4 and for associated increased transuranic waste management for LANL cleanup operations puts workers and the public at risk. The increased work for surplus plutonium disposition adds to worker load and the workers needed for the increased waste generated by LANL.

Smaller PC-2 Seismic Events Should Not Be Ignored

The problem often overlooked is that the more frequent but less severe seismic events also need to be mitigated. Preventing the failure of equipment at the more likely PC-2 seismic event (less severe than the PC-3 or PC-4 seismic event) may be very important to worker and public safety.

This means that equipment, including gloveboxes, that is likely to topple or not function following a rather mild or moderate (PC-2) earthquake, and at the relatively high likelihood of a relatively mild PC-2 seismic event. **This means that the PC-2 seismic events need to be carefully considered for worker and offsite public protection, as well as larger seismic events (such as PC-3 or PC-4).**

Instead, decisionmakers may convince themselves that the worst earthquake, coupled with a fire, is "bounding" and not likely to occur. The mistake they make is to ignore the more likely but less severe seismic events. So, the NNSA accepts the bounding PC-3 seismic event when it should actually consider the more severe PC-4 seismic event, and they must aggressively work to mitigate the more likely PC-2 but less severe seismic events.

The earthquake level that would take out commercial power, with possible vulnerabilities at a switchyard ought to be estimated, particularly for older switchyard equipment. The adequacy of backup power for radiation monitoring, as well as fire suppression systems and confinement ventilation need to be considered. Few requirements for backup power for radiation monitoring have been enforced at DOE facilities for years.

Seismic Failure or Movement of Non-safety Equipment Should Not Be Ignored

The unrestrained large rolling tool boxes and other seismically unrestrained equipment at PF-4 indicates a lack of understanding and a lack of comprehensive accident scenario evaluation of seismic vulnerabilities at PF-4.

"Two-over-one" analyses have long been recognized in the nuclear industry and even by the DOE. The "two-over-one" analyses are the need to recognize when non-safety equipment can degrade safety equipment, and that would include impeding safe and prompt evacuation. Data on how fast workers can evacuate, when the workers are primed and ready for the drill has little meaning in a real event, no matter how deftly a panelist can avoid directly answering the question posed by the DNFSB.

Unwise Reliance on Integrated Safety Management to Compensate for Inadequate Nuclear Safety Analysis

At the Idaho National Laboratory, at MFC, unrealistic assumptions regarding worker evacuation and doses to workers were made, despite many unheeded recommendations to provide more thorough evaluations of worker safety. At INL, the philosophy was adopted that rigorous "Integrated Safety Management" of work processes would compensate for the inadequate nuclear safety basis or documents referred to as "documented safety analysis" or DSAs.

In practice, at INL's MFC, the documented safety analysis that was known to not meet the intent of 10 CFR 830 but this documentation was used and in fact relied upon to train workers and nuclear facility management. And the technically indefensible safety basis was effective in providing false reassurance to workers and work planners and radiological control personnel.

When these DOE nuclear facilities take years or decades to attempt to upgrade their documented safety analyses, why would DOE expect that adequate nuclear safety expertise would somehow become abundantly available for ad hoc work planning?

At INL, technically indefensible calculations that underestimated the potential accident radiation doses also can and did mislead facility managers as well as work planners at INL's MFC for handling plutonium materials.

Integrated Safety Management would not typically initiate a seismic analysis or putting needed safety upgrades in place. The safety analysts who are years behind on completing the safety analysis upgrades are not necessarily available or qualified to assist with work planning.

The draft SPDP EIS should explain that facility managers, operations personnel and radiological control people are all trained and qualified on, inadequate safety analyses for LANL.

The accident at the Idaho National Laboratory on November 8, 2011 at the Materials and Fuels Complex (MFC), at the Zero Power Physics Reactor (ZPPR) where defective plates were handled in a malfunctioning fume hood, involved the DOE-approved yet inadequate documented safety basis for the facility. [6] The draft SPDP EIS must explain why the lessons learned from the INL's MFC accident at the ZPPR are not understood around the DOE Complex. This SPDP EIS must explain why no technical analysis supported the particle sizes of plutonium material inhaled. This SPD EIS must explain why plutonium-241 inhalation is still ignoring the americium ingrowth in the body, and so many of the other lessons that should have been learned by the 2011 plutonium inhalation event at the INL.

[6] U.S. Department of Energy Office of Health, Safety and Security Accident Investigation Report, *Plutonium Contamination in the Zero Power Physics Reactor Facility at the Idaho National Laboratory, November 8, 2011*, January 2012. See page 14, page E-6, and E-8.

Technology Review Out-of-Date and Inadequate

It must also be pointed out that the technology review for the SPDP EIS is extremely out-of-date and technically inconsistent with other current DOE actions and promotions and investments by DOE. By this draft SPDP EIS, out-of-date and technically inadequate information does not explain DOE's push for sodium-cooled reactors or the Versatile Test Reactor. In fact, by this SPDP EIS, these would be ruled out (and they should be ruled out). But these plutonium reactors have in fact not been ruled out as DOE continues to provide incentives and funding support for them.

The proposed materials testing reactor, the Versatile Test Reactor, being promoted by DOE would be a sodium-cooled, fast-neutron-spectrum test reactor to test how materials withstand intense neutron bombardment that would be encountered in fast-neutron reactors. [See the *Draft Versatile Test Reactor Environmental Impact Statement* (DOE/EIS-0542).] [7] According to the technology review in the draft SPDP EIS, the VTR would not be viable.

GE Hitachi Nuclear Energy is working with the Idaho National Laboratory on the VTR conceptual design based on its PRISM reactor, which was based on the Experimental Breeder II reactor. [8] The EBR II which was operated by Argonne National Laboratory – West at the Idaho site which is now the Materials and Fuels Complex at the INL, although the EBR II has been dismantled.

Basically, the technology review in the draft SPDP EIS is excuse-making and not based on an adequate and up-to-date review.

Wildfire Risk and the Increased Risk of Release from Outdoor Storage or Indoor Storage of Drums

Wildfire risks at LANL are claimed to be addressed by removal of brush and vegetation. And yet, the standoff areas appear to be far too small to protect facilities. (See DNFSB exhibits 2 and 9 for the EM session of the November 2022 hearing.) The consequences of the higher number of waste drums, the difficulty managing the storage and/or shipping of an increased number of waste drums must be addressed by the EIS.

EIS Must Describe the Long Backlog of Transuranic Waste Cleanup at LANL and How New Programs Will Adversely Affect the Backlog of Shipments Already Slated for WIPP

Regarding above-ground transuranic waste, the status in November 2022 was that LANL has 2200 transuranic waste drums with 450 waste drums deemed shippable to WIPP. Of the 450 waste drums, about 170 waste drums have been certified as meeting the criteria for WIPP. The remaining 1550 transuranic waste drums — and this does not include buried waste — require

[7] Public Draft Versatile Test Reactor Environmental Impact Statement (DOE/EIS-0542) at https://www.energy.gov/ne/downloads/public-draft-versatile-test-reactor-environmental-impact-statement-doeeis-0542 (Announced December 21, 2020)

[8] Press Release, GE Hitachi, "GE Hitachi and PRISM Selected for U.S. Department of Energy's Versatile Test Reactor Program," November 13, 2018. https://www.ge.com/news/press-releases/ge-hitachi-and-prism-selected-us-department-energys-versatile-test-reactor-program

remediation. LANL has goals of sending 30 to 40 shipments of perhaps 17 drums per shipment to WIPP each year.

The processes and facilities for remediation of above-ground waste drums at LANL do not exist. And the processes and facilities for addressing the buried waste at LANL do not exist. The amount of buried waste at LANL was not discussed.

The now planned expansion of nuclear weapons pit production will greatly add to amount of newly generated waste. LANL officials refused to disclose the current amount of LANL's newly generated waste from existing operations. Now the addition of surplus plutonium disposition in the draft SPDP EIS would add tremendously to LANL's workload and waste creation.

Again, it cannot be emphasized enough just how inadequate the draft SPDP EIS is, when it falsely claims that the added surplus plutonium disposition work will not impact other LANL programs. LANL's waste programs for legacy and the waste from current operations is already deeply behind.

Hiring new workers is already challenging at LANL and it takes time to train workers and even longer for workers to mature and understand their safety roles. Attrition is high, with worker attrition acknowledged to be 25% at LANL's cleanup project (from the November 2022 DNFSB hearing). Increased pit production work at LANL will require even more workers. Now NNSA wants to add to that, the surplus plutonium disposition work in the draft SPDP EIS. The importance of a mature and well-trained workforce in preventing accidents at nuclear facilities cannot be overstated.

Inadequate Assessment of Repository Safety at WIPP

The ease at which the Department of Energy and NNSA have sought to undermine its own agreements with the State of New Mexico regarding the number of years of operation and the total waste emplaced at the WIPP facility is also egregious and yet typical of the DOE is its focus on always making more nuclear weapons without bothering to actually evaluate the availability or cost of "disposition" or long-term storage.

While deep geological disposal of plutonium might be the best alternative we are aware of, the DOE has a long history of inadequate geological assessment of radionuclide migration from the repository and of criticality risks in the repository.

The DOE was actively promoting borehole disposal of Idaho's radioactive calcine material despite state's such as North and South Dakota prohibiting the research or the disposal of it.

The DOE was actively promoting surplus plutonium disposal at the proposed but never constructed Yucca Mountain disposal facility, claiming the criticality risk was negligible or acceptable, without ever calculating what that criticality risk actually was. It turned out that the criticality risk from surplus plutonium (as well as higher burnup fuels being used in U.S. nuclear reactors) was very high.

The criticality risk of surplus plutonium, at the Waste Isolation Pilot Plant (WIPP), needs to be fully addressed and peer reviewed. The "criticality over packs" or CCO's the DOE would

shove surplus plutonium into and dispose of into WIPP may be helpful in the short-term but do not assure adequate repository safety in the near or distant future.

The National Academies of Sciences (NAS) released a review of the DOE's surplus weapons plutonium disposal plan in May 2020. [9] [10] **The NAS found that disposal of the surplus weapons plutonium at WIPP was viable, but "would fundamentally change the nature of the geologic repository, which raises social, environmental, and technical questions."** The review by NAS does not include technical review of essential elements: pre- and post-closure ability of the WIPP repository to contain the waste or for criticality safety.

An estimated at 5.36 metric tons of plutonium had already been disposed of at WIPP as of September 30, 2019, according to the NAS review. This apparently includes 3.2 MT of surplus plutonium already disposed of. But the NAS review also stated that there was 4.8 MT of surplus plutonium "material" from Rocky Flats disposed of at WIPP (see page 73 of NAS review) that is not included in the 48.2 MT of surplus plutonium nor does it seem to be included in the WIPP disposal figure as of September 30, 2019.

To recap, the NAS review to determine the viability of the DOE's plan to dispose of vast amounts of additional waste, different chemical form, hazard level, concentration, and affect on the repository — was performed by pressing the "I believe" button on the repository performance and safety, without scrutinizing these essential aspects of the plan.

The NAS report does provide some clarity on limited aspects of the plan; however, the review's sweeping proclamation of "viable" should be withdrawn because the review was not conducted at the level of technical detail needed to make such a sweeping proclamation.

Let me also point out that this NAS review put on display a complete ignorance of radiation health at the most basic levels. The NAS report incorrectly states on page 17 that the federal drinking water maximum contaminant level (MCL) for total alpha radioactivity is 0.15 picocuries per liter. **The MCL for gross alpha in drinking water is 15 picocuries per liter.** Then the NAS review proceeds to compare the acute lethal quantity of plutonium to the drinking water MCL, presumably to show how safe vast amounts of plutonium in drinking water would be, as long as cancer risk, birth defects and other health effects are completely ignored. The NAS reviewers also imply that the half-life of plutonium-239 is indicative of the end of radionuclide trickle-out concerns. There is also no discussion of the inadequacy of regulations for the repository which do not apply for the duration of time the waste is radiotoxic. The regulations are arbitrarily limited to 10,000 years.

This NAS review and particularly the NAS webpage for the report should include the disclaimer that no attempt was made to assure the validity of DOE's assertions of safety, pre- or

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[9] *National Academies: Disposing of surplus plutonium at WIPP viable*, webpage, May 4, 2020, https://www.ans.org/news/article-142/national-academies-disposing-of-surplus-plutonium-at-wipp-viable/

[10] *The National Academies of Sciences, Engineering and Medicine,* "Review of the Department of Energy's Plans for Disposal of Surplus Plutonium in the Waste Isolation Pilot Plant," April 2020. https://www.nap.edu/catalog/25593/review-of-the-department-of-energys-plans-for-disposal-of-surplus-plutonium-in-the-waste-isolation-pilot-plant

post-closure, of the WIPP repository from DOE's plan to greatly increase the waste emplaced in WIPP and to include vastly higher amounts of surplus weapons plutonium.

The surplus weapons plutonium will require down-blending (or diluting), which could take place at the Savannah River Site or at Los Alamos National Laboratories (LANL) in New Mexico, prior to disposal at WIPP.

The Plutonium Management and Disposition Agreement (PMDA) requires the U.S. and Russia to each dispose of 34 metric tons of surplus plutonium by blending the plutonium with uranium oxide to make "mixed oxide" MOX fuel to be used in nuclear reactors. But the MOX fuel fabrication facility under construction in South Carolina at the Savannah River Site was canceled in 2018 due to escalating construction costs and lack of any U.S. utility wanting the MOX fuel.

The plan to dilute and dispose of 34 metric tons of surplus plutonium at WIPP is estimated to take 31 years and $18.2 billion to complete. But despite being considered a viable solution, the NAS report highlighted concerns over not meeting the requirements for plutonium disposition as agreed to with Russian, statutory and expansion of physical capacities at WIPP, and the life extension needed for WIPP. It is also a concern that the dilution processes have not been demonstrated at the scale that will be required. And the security requirements to verify disposal of the weapons plutonium have not been developed.

The NAS report (Chapter 5.2) acknowledged that the Department of Energy had included disposal of surplus weapons plutonium in the inventory for the environmental assessments of Yucca Mountain, in the form of MOX and/or vitrified high-level waste. No funding has been provided for Yucca Mountain since 2010. The DOE had also announced its deep borehole disposal demonstration program, also discussed for plutonium disposal, was terminated in 2017.

Assessment of the capacity of WIPP to confine the waste is expected to be managed by Sandia National Laboratory. This is the laboratory that finagled the models of radiological releases so successfully for the Yucca Mountain License Application to the U.S. Nuclear Regulatory Commission.

For the disposal of spent nuclear fuel, high-level waste and surplus plutonium slated for the Yucca Mountain repository, there were years of hand-wringing over the difficulty of meeting post-closure radiation dose limits from the trickle-out of groundwater laden with radionuclides from the dissolving radioactive waste.

But something would happen to drastically lower the Department of Energy's trickle out problem and 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 from a couple hundred millirem 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.

The problem of the estimated high radionuclide trickle out from Yucca Mountain ended when Sandia took over the modeling of radionuclide trickle out and elected to squash the assumed water infiltration rates through the proposed Yucca Mountain repository. **A review of**

Sandia's modeling for Yucca Mountain that yielded estimates of low radiation doses from water contamination from the trickle out of radionuclides found that the Sandia models were technically indefensible. [11]

That 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, by Sandia, 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 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. [12]

And the other problem that the Department of Energy made disappear, with regard to the disposal of surplus plutonium at the proposed Yucca Mountain Repository, was that of criticality concerns.

The Department of Energy's originally envisioned inventory for Yucca Mountain had included 2 percent enriched commercial spent nuclear fuel and the residual vitrified waste from reprocessing at West Valley. It was expanded substantially when the Navy ceased reprocessing the high enriched naval and DOE research fuels by 1992 and it meant that now these fuels would require disposal. And it was another substantial change when the DOE identified the surplus weapons plutonium, potentially for disposal at Yucca Mountain.

Two scientists from Los Alamos National Laboratory would explain how the plutonium-239 posed a particularly high criticality risk at Yucca Mountain. [13] [14] The Department of Energy has continued to argue that while criticality is possible at Yucca Mountain, it is sufficiently unlikely and of unimportant consequence if it does occur. [15] But the risk of criticality posed by the disposal of surplus weapons plutonium (and spent nuclear fuel) at Yucca Mountain is substantial and not to be casually dismissed, no matter how emphatically the DOE tries to arm-wave the risk

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

[12] Letter from Council for the State of Nevada to Secretary of the U.S. Nuclear Regulatory Commission, State of Nevada's Supplement to its June 4, 2008 Petition Asking the NRC to Reject DOE's Yucca Mountain License Application as Unauthorized and Substantially Incomplete, July 21, 2008. The letter cites the review of DOE's infiltration model performed at DOE's request by ORISE (Oak Ridge Institute for Science and Education). ORISE provided the results of this independent review to DOE on April 30, 2008. http://www.state.nv.us/nucwaste/news2008/pdf/nv080721nrc.pdf

[13] C. D. Bowman and F. Venneri, Los Alamos National Laboratory, *Underground Autocatalytic Criticality from Plutonium and Other Fissile Material*, LA-UR 94-4022, 1994.

[14] C. D. Bowman, Los Alamos National Laboratory, *Underground Supercriticality from Plutonium and Other Fissile Material*, LA-UR-94-4022A, 1994.

[15] Rob P. Rechard et al., Sandia National Laboratory, *Consideration of Criticality when Directly Disposing Highly Enriched Spent Nuclear Fuel in Unsaturated Tuff: Bounding Estimates*, May 1996.

away. **And in addition, the criticality risks remain after 10,000 years, yet there is no regulatory requirement to assess or limit the criticality risk after 10,000 years, either at Yucca Mountain or WIPP.**

The lack of technical credibility by the Department of Energy in its Yucca Mountain License Application speaks volumes about the technical credibility of DOE's assessment of WIPP repository performance. The disposal of surplus weapons plutonium at WIPP, perhaps up to 48.2 metric tons of plutonium, has caused a renewed look at the potential for criticality accidents at WIPP and more detailed assessment than the sweeping screening arguments used for WIPP in the past. New criticality safety assessments for WIPP have noted that measures such as boron carbide additives or load management may be needed for the disposal of surplus weapons plutonium, yet the NAS review points out there has been little transparency or scrutiny of the criticality assessments. Complicating the problem is that WIPP drums are known to be overloaded with more plutonium (and fissile gram equivalents) than is officially assumed and this was verified by the extensive contamination caused by explosion of a single drum in 2014. The Idaho National Laboratory has also streamlined the waste verification of what's in the drums shipped to WIPP to the point of actively ignoring neutron reflecting material, beryllium.

The tendency for the Department of Energy to force its repository performance analyses and criticality analyses to obtain the desired answers for both pre-closure and post-closure assessment, which it did to a technically unjustifiable extent for the Yucca Mountain License Application to the NRC, means that the DOE's performance assessment for WIPP cannot be trusted. The State of New Mexico must insist on a very thorough and independent review of the proposed expanded WIPP mission.

The NAS review stated that the Department of Energy also wants to use WIPP to dispose of spent nuclear fuel reprocessing waste from its operations at the Idaho National Laboratory and Hanford; greater-than-class-C and greater-than-class-C-like waste; and additional future pit production waste (see pages 64 and 65 of the NAS review). Not mentioned were the DOE's desire to dispose of naval spent nuclear fuel at WIPP or the direct disposal of commercial nuclear spent fuel which the DOE has continued to study.

The observations documented in the 2020 NAS review are worth reading but must not be regarded as a comprehensive review of the impacts on WIPP repository performance or safety nor should the NAS conclusion that the DOE's plan is viable be accepted.

It must be understood that DOE has no credibility when it comes to assessing geologic repository safety and adequacy.

To actually properly and safety dispose of surplus plutonium and to do it and other operations at LANL and SRS and do it safely would be a proper and responsible act. But this sham Draft SPDP EIS assures quite the opposite.

Deficient Worker Safety Analyses

The draft SPDP EIS fails to state the number of workers impacted, injured and/or killed by an accident at PF-4. There may be about 1000 workers at PF-4 or more. In an evacuation, the wind direction can and does change at Los Alamos National Laboratory. How will chelation and

other medical assistance be provided to perhaps hundreds of workers with serious plutonium inhalation doses?

The accident at the Idaho National Laboratory in 2011 involved 16 workers and that completely overloaded the INL. There was not enough chelation IV treatments. The need for nasal swabs, urine analysis and lung counts for a modest event at PF-4 would be a serious problem. Apparently, the solution is to not mention it. Tell the vomiting workers that they have the flu. That's what DOE did in Idaho.

The Department of Energy at INL had for years recognized that worker safety for workers in the workroom at the MFC ZPPR facility regarding the plutonium inhalation hazard had not been properly addressed. [16] Yet year after year, this was not addressed. Despite the problem in the safety analyses of the lack of defensible radiological dose consequences to in-facility workers being identified as recently as 2005, as of 2011, no in-facility dose evaluations for the Zero Power Physics Reactor facility had been conducted.

The Department of Energy, who approved of the unverified assumptions and inadequate analyses in the ZPPR safety analyses, would later, after the 2011 plutonium inhalation event, continue to direct blame to the workers in the facility who were doing exactly what they were directed to do. The training material developed after the 2011 plutonium inhalation event would be directed to those workers rather than to the management of the facility at INL's MFC, the safety analysts or the radiological control management. [17] The fact that DOE did not correctly and comprehensively provide lessons learned from the 2011 plutonium inhalation event at INL's MFC to the DOE Complex is also telling of the delusional safety culture prevalent within DOE.

The draft SPDP EIS does not address the number of workers affected by an accident and those numbers may be very large, far over a dozen workers. Table 4-6 of the draft SPDP EIS for worker doses only addresses routine operational doses to workers.

The draft SPDP EIS given the dose for a single worker at PF-4. There may be 1000 workers or more in the PF-4 building. There has been no attention given to realistic evacuation and

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[16] Robert Boston et al., Department of Energy, "Department of Energy Review of the Materials and Fuels Complex Documented Safety Analysis," Conference preprint, circa 2006. This paper states that in 2005 (when Battelle Energy Alliance took over ANL-W), it had been found that Materials and Fuels Complex documented safety analysis reports did not meet the safe harbor provisions of 10 CFR 830 Subpart B, Nuclear Safety Management Rule and upgrades would be a multiyear process. The problems identified include the use of mitigated accident evaluation rather than unmitigated and the lack of in-facility work dose consequence analysis. The ZPPR risk ranking is prioritized as the second highest of 7 facilities. The paper describes how the safety analysis process was to intentionally defer to the future any problems such as references that cannot be found to support the accident analysis or quality or seismic capability of structures, systems and components. Reliance was to be placed on rigorous "Integrated Safety Management."

[17] Department of Energy, Radiological Safety Training for Plutonium Facilities, DOE-HDBK-1145-2013, March 2013. This training material only faintly addresses the hydride problem with ZPPR fuel, the radiological control failures, the years of safety analyses errors, the misuse of the DOE-HDBK-3010 guidance and fails to address that management refused to act to protect workers from an identified expected event. The problem of underestimating the amount of buildup of radioactive powder and the health harm is not actually addressed by this terribly inadequate document which grossly misrepresents causes and consequences of the November 8, 2011 accident at the Idaho National Laboratory's Zero Power Physics Reactor facility.

emergency responder scenarios. How much chelation agent does LANL have on hand? How will workers evacuate to seek medical attention? What is it, to the NNSA, to have dozens or hundreds of workers at PF-4, permanently injured from a preventable plutonium inhalation event? Well, it seems to matter very little to the NNSA. And the draft SPDP EIS does not give any discussion of how many dozens or hundreds of workers may have their lives shortened, their unborn children harmed, their bone marrow and immunity impaired, and other adverse health effects from plutonium and americium inhalation.

Incorrect Statements of Plutonium-241 Hazard and Dose Consequences

Few reviewers of this draft SPDP EIS will look at the 2015 EIS. But among the false statements referenced in the 2015 EIS is that: "plutonium-241 is less hazardous."

The 2015 EIS acknowledges is "The relative inhalation hazard of americium-241 is higher than that of plutonium-239. As a result, the relative hazard of plutonium (and americium-241) materials is highly dependent on the composition of the plutonium isotopes, and more importantly, on the amount of americium-241 in the mixture."

The 2015 EIS and the 2022 draft SPDP EIS do not include that plutonium-241 decays to americium-241 inside the body after inhalation. Radiation dose assessments, since 2011 and before and probably since, have omitted to account for ingrowth of americium-241 from the plutonium-241 inhaled. It is inexcusable that in 2022 the NNSA and DOE put forth an EIS that does not reflect this well-known understanding. This is especially important for plutonium mixtures of higher plutonium-240 and hence, higher plutonium-241 composition.

In fact, the higher the amount of plutonium-240, which is higher than 6 percent or perhaps higher than almost 9 percent, in weapons grade plutonium, increases the amount of plutonium-241. Over time, americium-241 ingrowth occurs in the stored material. But once inhaled, the decay of plutonium-241 to americium-241 also continues, as plutonium is highly retained in the lung, bone marrow, liver or gonads. It is just another example of extreme inattention to the human health harm by the DOE/NNSA from radiation.

Studies Find Higher Retention of Plutonium in the Body and Higher Dose Conversion Factors

More recent studies of plutonium inhalation have found even higher than previously thought retention in the body. The plutonium inhaled and moved to bone is recycled by the body and less is excreted that previously thought. The more recent, circa 2018 studies, have been ignored in the DOE/NNSA draft SPDP EIS.

While this draft SPDP EIS may assume Type M, moderate clearance, in practice following an actual event, DOE/NNSA may choose Type S clearance in order to lower the estimated dose.

Department of Energy plutonium and americium inhalation radiation doses from insoluble Type S material **have increased by a factor of about 2**, according to a 2019 report by the International Commission on Radiological Protection. [18]

Historically, most plutonium inhalation doses were associated with weapons grade plutonium at Department of Energy facilities including the former Rocky Flats weapons plant, the Hanford site in the state of Washington, the Y-12 Oak Ridge plant in Tennessee, the Los Alamos National Laboratory in New Mexico and the Savannah River Site in South Carolina. But not all plutonium and americium inhalation events are not necessarily similar to weapons grade plutonium. The 2011 plutonium inhalation event at the Idaho National Laboratory's Materials and Fuels Complex involving a plutonium mixed oxide plate at the Zero Power Physics Research Reactor (ZPPR). Radiation dose assessment for the 2011 accident assumed the material inhaled was Type S plutonium and americium.

The radiation dose assessment for the INL's 2011 accident at the Materials and Fuels Complex (MFC) assumed that the ZPPR mixed oxide plate was entirely Type S material rather than Type M which was normally assumed for the americium-241 portion of the dose. The dose predicted by Type M solubility is higher than for Type S solubility, as the higher solubility allows more material to be dispersed to bone and to the liver. And Department of Energy contractor Battelle Energy Alliance (BEA) also ignored the ingrowth of americium-241 from plutonium-241 retained in the body.

Highly insoluble weapons grade plutonium has less plutonium-241 to begin with and therefore less americium-241 ingrowth from plutonium-241 decay. But the mixed oxide fuel plate at the ZPPR facility had far more plutonium-241 than weapons grade plutonium.

While non-pit surplus plutonium to be dispositioned in this draft SPDP EIS does not include ZPPR fuel, non-pit surplus plutonium can have higher Pu-240, Pu-241, Am-241 and Pu-238 than typical of weapons grade plutonium.

The 2019 ICRP report for actinides noted that plutonium-239 combined with uranium compounds appear to have different characteristics in the human body than plutonium oxide alone.

In the 2019 International Commission on Radiological Protection report, the inhalation dose coefficients for highly insoluble plutonium isotopes (Type S), prevalent at Department of Energy facilities, have increased by a factor of 1.5 to 2.0 "because of the revision of the biokinetic models, and a better description of the radionuclide retention and distribution in tissues."

This means that a worker's prior dose estimate may be low by a factor of 2. And in addition, the dose would be low due to unaccounted for americium-241 ingrowth from plutonium-241.

[18] International Commission on Radiological Protection, "Occupational Intakes of Radionuclides: Part 4, ICRP Publication 141. Ann. ICRP Volume 48, No. 2/3," 2019. ISSN 0146-6453. (Online report anib_48_2-3ICRPPart4.pdf). This series of reports replaces the ICRP Publication 30 series and Publications 54, 68, and 78 series.

The ZPPR plates had a very high amount of plutonium-241 relative to americium-241, as accounted for in 2011.

Plutonium may be encountered in a variety of chemical and physical forms, including oxides, metals, chlorides or nitrates, or other forms. Plutonium oxides (PuO_2) can be found in nuclear weapons materials or in mixed oxide (MOX) nuclear reactor fuels. The chloride or nitrate forms would typically be found at reprocessing facilities.

When plutonium-239 is created in a nuclear reactor by neutron absorption, plutonium-240 is also created. And the longer the neutron bombardment in a reactor, the more plutonium-240 and plutonium-241 are created, relative to the plutonium-239 created. Plutonium-241 has a relatively short radioactive half-life (14.4 years) and it decays to americium-241. Americium-241 is actually more deadly than plutonium-239 when inhaled, ingested or entering the body due to a wound.

At the former Department of Energy nuclear weapons plant in Colorado, the Rocky Flats Plant, workers were found by autopsy to show very long lung retention of plutonium, corresponding to very highly insoluble (Type S) plutonium materials. Type S plutonium in the lungs means long retention times of plutonium (and americium) in the lungs.

Mixed oxide fuels, however, can contain much higher plutonium-238 as well as americium-241 levels than weapons grade plutonium, and can behave as much more soluble material, according to the 2019 ICRP report on actinides. While typically still characterized at Type S material, the mixed oxide fuels resulted in greater translocation to systemic organs in the body — such as bone tissue and the liver. In fact, transfer to bone and to the liver was found to be greater for mixed oxide fuels than that of simply plutonium oxide.

Plutonium-238 oxide has been found to be more soluble than plutonium-239 oxide in the 2019 ICRP report [19] and this was also indicated by the disproportionately high plutonium-238 excreted in urine from the 2011 plutonium inhalation event at the Idaho National Laboratory.

Perplexingly, it is not just a question of whether a material is Type M or Type S. Both plutonium and americium may have a fraction of the material that behaves as Type S and a fraction of material that behave as Type M. The question is not simply of whether a material is Type S or Type M, and it also depends on the specific details of the material's composition and form.

Material such as mixed oxide fuel contained in an oxygen deprived environment may include oxides as well as hydrides, according to the DOE Investigation report for the November 8, 2011 accident at the INL. [20] However, after the material is stored before evaluation, it may not

[19] International Commission on Radiological Protection, "Occupational Intakes of Radionuclides: Part 4, ICRP Publication 141. Ann. ICRP Volume 48, No. 2/3," 2019. ISSN 0146-6453. (Online report anib_48_2-3ICRPPart4.pdf). This series of reports replaces the ICRP Publication 30 series and Publications 54, 68, and 78 series. (See pages 221, 222.)

[20] U.S. Department of Energy Office of Health, Safety and Security Accident Investigation Report, *Plutonium Contamination in the Zero Power Physics Reactor Facility at the Idaho National Laboratory, November 8, 2011*, January 2012.

represent the chemical form that was predominately inhaled immediately after exposed to an oxygen-rich environment.

And even if a material, after oxidizing in an oxygen-rich environment, is later determined to be americium oxide of mostly Type S solubility characteristics, the ingrowth of americium-241 in the lungs or other tissues or organs in the body from the decay of plutonium-241 may be a more soluble Type M form, that yields a higher radiation dose in the body than that of Type S.

NNSA Continues to Ignore Radiation Protection Standards Protection of Women, Children and the Unborn

The higher risk to females than males is treated as acceptable by using a radiation cancer death (mortality) coefficient not protective of adult females. And the high risk to children, especially to female children and to the unborn, is not reflected in this Draft SPDP EIS.

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. [21] (Read more in the August 2020 Environmental Defense Newsletter at Environmental-Defense-Institute.org)

DOE actively ignores the current scientific evidence of radiation health harm. The Department of Energy's accepted modeling of health risk from radionuclide emissions (routine or from accidents) actively ignores diverse, compelling human epidemiology. I have been told that the reason is "that somebody high up has decided that the benefit of changing the radiation protection standards isn't worth the cost." This basic description comes from university professors and INL lab directors. Basically, the Department of Energy has decided that protecting your health, or your child's health or protecting human beings in the future from its growing inventory of radioactive waste just isn't worth the cost. It would, after all, increase the cost of nuclear waste disposal and it would require reducing airborne emissions from its facilities.

The biological endpoint focus for the Department of Energy is cancer mortality and not the increased harm to reproductive health.

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

[21] 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.

- The cancer risk is not reduced when radiation doses are received in small increments, as the nuclear industry has long assumed. [22]

- 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. [23]

- 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 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.

Radiation worker training programs are typically horribly inadequate. 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. [24]

There is no mention of the oxidative stress caused as ionizing radiation strips electrons off atoms or molecules in the body at energies far exceeding normal biological energy levels. And there is no discussion explaining the harm of inhaling or ingesting radioactive particles of fission products such as cesium-137, strontium-90, or iodine-131; of activation products such as cobalt-60; or transuranics such as plutonium and americium; or of the uranium itself.

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

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[22] 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.

[23] 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.

[24] 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.

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 depleted uranium. 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.

The nuclear industry, including the Department of Energy, is wrong to use the International Commission on Radiological Protection (ICRP) treatment of heritable disease. While the 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. [25] [26]

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. [27] 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. [28]

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

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[25] 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

[26] 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

[27] 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

[28] 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.

"detailed research on internal radiation exposure has hardly ever been reported in the past." [29] **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." [30]

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. [31]

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. [32]

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.)

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[29] 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

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

[31] 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).

[32] 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."

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 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.

Epidemiology that was conducted of INL workers found unexplained elevated levels of certain radiogenic cancers in both radiation and non-radiation workers. The INL-specific study found radiation and nonradiation workers at the Idaho National Laboratory site had higher risk of certain cancers. [33]

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. [34] Epidemiology of thousands of radiation workers found elevated cancer risk occurring at doses far below the allowable 5000 mrem/yr. [35]

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[33] "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/

[34] "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.

[35] 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

Radiation workers are still wrongly told that there is no evidence of damage to DNA or genetic effects from radiation exposure to humans. DOE's radiation workers are not told of the infertility and increased risk of birth defects from radiation.

Certain surplus plutonium disposition operations may also involve high neutron doses. The harm from neutron dose can be particularly harmful for gonads and may not be adequately monitored, particularly by emergency responders. Neutron dose can be high even if gamma rays are shielded. Neutron dose is difficult to monitor and the biological damage which depends on the neutron energy levels is only guessed at. Neutron shielding in transportation accidents or other configurations may be damaged. Fire or age-related degradation can damage the neutron shielding and so this is primarily an issue for radiation workers and emergency responders. The biological endpoint focus for the Department of Energy is cancer mortality and not the increased harm to reproductive health.

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 nuclear industry has a myopic focus on cancer, although cancer is certainly increased by the inhalation or ingestion of radiative particles and/or from "shine" from penetrating radiation. The actual rates of health harm such as infertility, increased birth defects, heart disease, dementia, shortened life span and other adverse health effects are not adequately represented in nuclear industry radiation protection standards, especially for the chronic radiation exposure of far lower radiation doses. It is known that the developing child in utero, children and the elderly are many times more vulnerable to radiation exposure.

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

Those who accept the flawed 2022 Draft SPDP EIS must explain why 5,000 millirem per year doses to the radiation workers and 100 millirem per year to the public is considered protective regardless of how high certain organ doses are or how detrimental to the unborn child the doses are.

Those who accept flawed 2022 Draft SPDP EIS 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.

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.)

Organ-specific Risks of Radiological Releases, Routine and Accident, Ignored

Death by cancer and cancer incidence are known to be increased by ionizing radiation. However, the organ-specific harm is not reflected in this EIS. The higher incidence of thyroid cancer, for example, from iodine-131 and also from americium-241, caused increased rates of thyroid cancer. Yet, is death by thyroid cancer is deemed less likely to cause mortality, the derivation of the "rem" dose for the radiation is diminished. And these thyroid cancer or disease incidences not only affect adults, that can cause serious health implications in the developing child, from death to reduction in intelligence.

Elevated americium-241 releases, routine at LANL, have likely increased thyroid cancer and illness incidence and must be acknowledged in this draft SPDP EIS. The organ dose to the thyroid, gonads and other organs must not be ignored especially when far above the organ dose from naturally occurring radiation.

Economic Losses Due to Permanent Evacuation of Private Property Not Addressed

There is no discussion of the economic loss due to permanent evacuation of private property in the draft SPDP EIS, nor the lack of insurance coverage for loss of home, property or automobiles. And there is no compensation for members of the public for the loss of life from routine or accident radiological release events. LANL workers who have their lives shortened or have increased cancers or their kids or grandkids have increased levels of birth defects, will not be compensated. However, a few workers, whose DOE radiation records have not been as altered, biased or destroyed, and who have a cancer deemed compensable, may be eligible for compensation under a program for certain DOE or DOE contractor employees, the Energy Employee Occupational Illness Program Compensation Act of 2000, EEOICPA. Still, DOE can and has obscured the radiation records of workers, especially those workers with elevated radiation doses.

Radiation Dose Estimation is Controlled by DOE Contractors Who Caused the Accident

At the Idaho National Laboratory, regarding the 2011 plutonium inhalation event at MFC (operated by Battelle Energy Alliance), the radiological control manager assured a formal citizens advisory board for INL that no curtailment of radiation work would be needed for any of the workers exposed to the 2011 accident at MFC. This would imply a radiation dose below 100 millirem for the intake. Yet, the reality was that bioassay results would prevent more than one worker from returning to radiation work for many months and there was no technical basis for such a claim.

The accident investigation report by DOE headquarters for the 2011 MFC plutonium inhalation event would not include the finding that the fume hood fan in operation had a substantially closed damper and this was only documented in an update of the DOE occurrence

report. [36] The DOE headquarters report also left many inconsistencies regarding nasal swab results and lung count irregularities unexplained.

Lung counts performed by DOE contractors are often the determining factor used to then claim that no inhalation occurred. Yet, in fact, manipulations to lower the lung count results can be made without those manipulations being documented in the lung count report. Also, for the 2011 plutonium inhalation event at MFC, the highest lung count result in the group would have yielded an estimated dose over 5 rem.

Inexplicably, the highest lung count result was not included in the dose estimates made for the lung count results for the group of workers involved. And it was made to appear that all lung count results had been assessed. The DOE has stated that no skin contamination occurred nor was there any miscalibration issue.

Radioactive material particle size as well as solubility is often not accurately known and can influence the estimated dose by a factor of 10 or more. Dose conversion factors for actinides such as plutonium have changed over years and have increased (around 2018).

Inadequate Environmental Monitoring of Routine and Accident Radiological Releases from PF-4

What is at stake if PF-4 has a large release of airborne radionuclides? The meaning of even a 25-rem dose to the offsite public may sound benign to some people. The 25-rem guideline was the level at which, when exceeded, safety class mitigations would be expected to be implemented. With a plutonium-239 or plutonium-238 inhalation dose of 25 rem or higher to the offsite public, the amount of release is enormous. And the contamination, practically speaking, will never be remediated.

The radioactive half-life of Pu-238 is far less than Pu-239. However, both of these radionuclides decay through many additional decay progeny before eventually becoming non-radioactive lead. In the case of Pu-238, once it decays to uranium-234, the tendency is for DOE to ignore it and assume it is from naturally occurring uranium-238 decay. Environmental monitoring programs may monitor Pu-238 but DOE or state programs typically do not monitor airborne radium or radon or thallium or lead levels. Yet, these radioactive particles are still harmful.

The ability for DOE to plan ahead to obscure the true level of its environmental releases should not be ignored. In Idaho, the state monitoring programs in Idaho National Laboratory releases are coordinated with the Department of Energy to minimize the association of the elevated contamination levels with the INL, and I say this after studying decades of environmental monitoring data associated with the INL.

[36] Department of Energy Occurrence Report, NE-ID—BEA-ZPPR-2011-0001, "ZPPR Workroom Pu Contamination Event in MFC-775," Update September 25, 2012.

DOE and state monitoring programs have gaps in monitoring data that often coincide with elevated releases. The Environmental Protection Agency radiological air monitoring in Idaho and the northwest also has blackouts in air monitoring that may coincide with operations, accidents and elevated releases. To reduce the growing contamination levels by a factor of ten, they know that they only need to switch to a different analytical laboratory to send the environmental samples to.

Draft SPDP EIS Actively Ignores Local Epidemiology and Environmental Monitorin

The rates of cancer for children continue to be elevated, especially in counties surrounding the Idaho National Laboratory. The incidence of thyroid cancer is double in the counties surrounding the INL and double that of all other counties in Idaho and double the rates for the country from the SEER database. This is a consistent result over a decade. As thyroid cancer incidence was climbing everywhere, is has been consistently double in the counties surrounding the INL.

I suspect there may be similar problems around LANL.

The Department of Energy, while accepting lower tabulated radiation doses and focusing on whole-body doses exclusively, has remained silent on the increased thyroid cancer incidence rates from various alpha emitters, and especially americium-241 around the INL. Due to the low tissue weighting value, whole body dose estimates are not affected much by the elevated thyroid doses.

A 2013 Pacific Northwest National Laboratory (PNNL) report incorporating Federal Guidance Report 13 tabulated whole body and organ specific dose conversion factors for an average half-male and half-female at various ages. [37] The 2013 PNNL report is to be used for calculating radiation dose but not the risk of higher radiation risks recognized in the EPA's 1999 Federal Guidance Report 13. Buried near the end of the PNNL report is a chart of how wildly increased the thyroid cancer incidence was for various radionuclides, by a factor of 10, of 100, of 1000, of 10,000 and of 100,000! See Figure 1 below.

[37] T.R. Hay and J.P. Rishel, Pacific Northwest National Laboratory, Department of Energy, *Revision of the APGEMS Dose Conversion Factor File Using Revised Factor from Federal Guidance Report 12 and 13*, PNNL-22827, September 2013. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22827.pdf

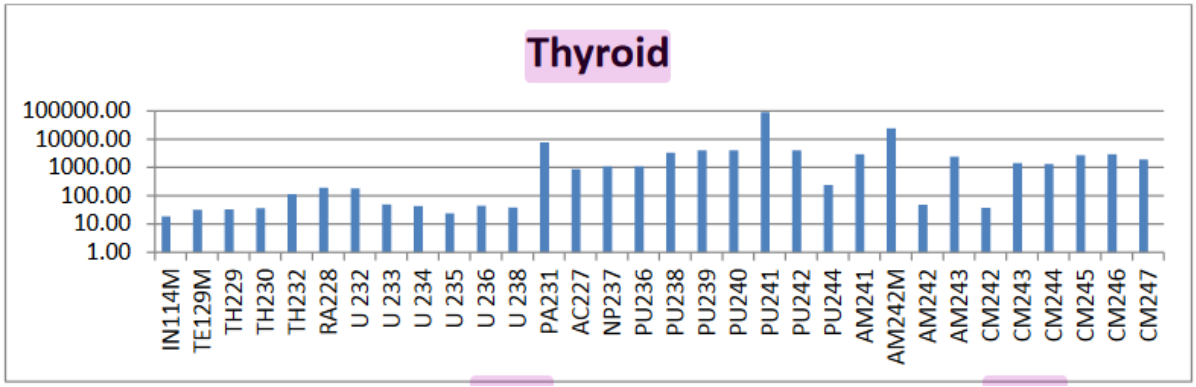

Figure 1. Ratio of the revised Federal Guidance Report (FGR) 13 thyroid dose conversion factors (DCFs) to the original Department of Energy (HUDUFACT.dat) thyroid DCF for radionuclides having the largest increases. (PNNL-22827)

The radionuclides in Figure 1 include thorium, uranium and uranium decay progeny, plutonium, curium and americium. The thyroid cancer incidence rate increases for plutonium-238, plutonium-239, plutonium-240, plutonium-241 and americium-241 is over 1000.

It is important to understand that for many years, releases of these various americium, curium and plutonium radionuclides were not stated or were understated by the Department of Energy in its environmental monitoring reports.

The extensive airborne concentrations of americium-241 at the INL may be important to the underestimation of thyroid doses and risks of thyroid cancer incidence. A 1993 study estimated that the dose to the thyroid from americium-241 to be about 1.42 times that delivered to bone. They concluded that the thyroid dose is much higher from americium-241 than has been reported in people. [38]

On the potential health harm of americium-241, the Agency for Toxic Substances and Disease Registry has stated that: “The radiation from americium is the primary cause of adverse health effects from absorbed americium. Upon entering the body by any route of exposure, americium moves relatively rapidly through the body and is deposited on the surfaces of the bones where it remains for a long time. As americium undergoes radioactive decay in the bone, alpha particles collide with nearby cell matter and give all of their energy to this cell matter. The gamma rays released by decaying americium can travel much farther before hitting cellular material, and many of these gamma rays leave the body without hitting or damaging any cell matter. The dose from this alpha and gamma radiation can cause changes in the genetic material of these cells that could result in health effects such as bone cancers. Exposure to extremely high

[38] G. N. Taylor et al., Health Physics, “241Am-induced Thyroid Lesions in the Beagle,” June 1993. https://pubmed.ncbi.nlm.nih.gov/8491622/

levels of americium, as has been reported in some animal studies, has resulted in damage to organs.

The Department of Energy has largely thwarted efforts to have epidemiology conducted near the INL and other DOE labs. Epidemiology that was conducted of INL workers found unexplained elevated levels of certain radiogenic cancers in both radiation and non-radiation workers.

Public water supplies are intermittently monitored for radionuclides, and may reveal gyrating levels of high levels of gross alpha emitters which usually cannot be shown to be from natural uranium and thorium levels or from past weapons testing fallout. Monitoring programs routinely seek to avoid reporting elevated levels of radionuclides in water, air and soil. These programs, including state and DOE's contractor for environmental reporting, may actively use poor sampling protocols, data deletion, biased blanks for count comparison, and false narratives to explain elevated results. The Draft SPDP EIS must include an evaluation of cancer incidence, including thyroid cancer and must include environmental monitoring program results and adequacy of the environmental programs is typically not assured, even with state involvement. Independent assessment of environmental monitoring programs and results is needed because the DOE/NNSA routinely make efforts to coverup ongoing radiological contamination.

Conclusion

To continue to conduct work unsafely at LANL while falsely claiming otherwise, and to add to the work load at LANL, that is already straining under the pressure of the difficulty in retaining workers for this life-shortening, child-birth-defects-increasing, and high hazard work – is not an ethical or a beneficial endeavor.

The 2022 SPDP EIS is extremely defective and disingenuous and must be redone in entirety. The current difficulty in hiring and in retaining qualified workers, the high cost of living near LANL, and the push toward 24/7 operations all increase the likelihood of calculational mistakes and operator errors that put workers and the public at even greater increased risk.

These comments are from Tami Thatcher, a mechanical engineer, who was a qualified nuclear safety analyst for a Department of Energy nuclear reactor facility at the Idaho National Laboratory. Her specialty was in nuclear risk assessment for DOE and Nuclear Regulatory Commission (NRC) nuclear reactor facilities. Her work included nuclear reactor probabilistic risk assessment and included seismic event nuclear accident risk assessment. Risk assessment is not required of non-reactor DOE nuclear facilities, but the insights from performing a systems analysis of the failure causes are relevant to non-reactor DOE nuclear facilities, despite it not being a requirement of the Department of Energy or the National Nuclear Security Agency (NNSA). Many of her reports and articles are at www.environmental-defense-institute.org.