IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
AIKEN DIVISION

SAVANNAH RIVER SITE WATCH, TOM CLEMENTS, THE GULLAH/GEECHEE SEA ISLAND COALITION, NUCLEAR WATCH NEW MEXICO, and TRI-VALLEY COMMUNITIES AGAINST A RADIOACTIVE ENVIRONMENT,	)	CA: 1:21-cv-01942-MGL
Plaintiffs,	)	
v.	)	
UNITED STATES DEPARTMENT OF ENERGY, JENNIFER GRANHOLM, in her official capacity as the Secretary, THE NATIONAL NUCLEAR SECURITY ADMINISTRATION and JILL HRUBY, in her official capacity as the Administrator,	)	
Defendants.	)	

SETTLEMENT AGREEMENT

This Settlement Agreement ("Agreement" or "Settlement Agreement") is entered into by and between Plaintiffs Savannah River Site Watch, Tom Clements, The Gullah/Geechee Sea Island Coalition, Nuclear Watch New Mexico, and Tri-Valley Communities Against a Radioactive Environment, and Defendants United States Department of Energy ("DOE"), Jennifer Granholm, in her official capacity as the Secretary of Energy, the National Nuclear Security Administration ("NNSA"), and Jill Hruby, in her official capacity as the Administrator of the NNSA (collectively, the "Parties") for the purpose of resolving this lawsuit without further judicial proceedings. The Parties, by and through their undersigned counsel, state as follows:

WHEREAS, DOE and NNSA are charged with maintaining and enhancing the safety, reliability, and performance of the U.S. nuclear stockpile, including the ability to design, produce, and test, in order to meet national security requirements. 50 U.S.C. § 2401(b)(2). This includes bearing the responsibility to produce plutonium pits. 50 U.S.C. § 2538a.

WHEREAS, a plutonium pit (which principally contains plutonium and/or enriched uranium) is one of the critical components of every nuclear weapon in the United States and serves as the explosive core or primary that initiates thermonuclear fusion upon detonation.

WHEREAS, DOE/NNSA authored the 2008 Final Complex Transformation Supplemental Programmatic Environmental Impact Statement ("2008 CT SPEIS") to study the program-wide environmental effects of producing up to 200 pits per year at five different facilities, two of which were Los Alamos National Laboratory ("Los Alamos or LANL") and Savannah River Site ("SRS" or "Savannah River"). The 2008 CT SPEIS, 73 Fed. Reg. 77644 (Dec. 19, 2008), like prior National Environmental Policy Act ("NEPA") analyses between 1999 and 2008, authorized production of up to 20 pits per year at Los Alamos.

WHEREAS, the 2018 Nuclear Posture Review, which was drafted by the U.S. Department of Defense, concluded there was a need to increase pit production to maintain the existing nuclear arsenal and stated that NNSA should begin producing at least 80 plutonium pits per year beginning in 2030.

WHEREAS, the Under Secretary of Defense for Acquisition and Sustainment and the NNSA Administrator issued a Joint Statement on May 10, 2018, describing NNSA's recommended alternative to pursue a two-site approach to manufacturing plutonium pits—(1) to produce a minimum of 50 pits per year at SRS and (2) to produce a minimum of 30 pits per year at Los Alamos. Beginning in October 2018, Plaintiffs wrote to NNSA five times asserting that the agency

was required under NEPA to conduct a new programmatic environmental impact statement for expanded plutonium pit production.

WHEREAS, in early 2019, Congress passed the John S. McCain National Defense Authorization Act for Fiscal Year of 2019, which required Los Alamos to produce a minimum of 30 pits per year and to implement surge efforts to exceed 30 pits per year. Pub. L. No. 115-232. Later in 2019, Congress passed the National Defense Authorization Act for Fiscal Year 2020, in the interest of national defense, which modified § 4219 of the Atomic Energy Defense Act by requiring DOE/NNSA to produce not less than 80 war reserve plutonium pits per year beginning in 2030. Pub. L. No. 116–92, 133 Stat. 1952 (2019). Neither the John S. McCain National Defense Authorization Act for Fiscal Year of 2019 nor the National Defense Authorization Act for Fiscal Year 2020 mandated production of plutonium pits at Savannah River.

WHEREAS, in 2019, DOE/NNSA prepared the Supplement Analysis of the Complex Transformation Supplemental Programmatic Environmental Impact Statement ("2019 SPEIS SA") to evaluate, at a programmatic level, the sufficiency of prior environmental analyses that had previously examined the environmental effects of producing pits at Los Alamos or Savannah River. The purpose of the 2019 SPEIS SA was to determine whether the environmental impacts of producing a minimum of 30 pits per year at Los Alamos and a minimum of 50 pits per year at Savannah River, to meet the legally required rate of no fewer than 80 pits per year, would be less than the impacts of producing 125 to 200 pits per year at a single location as had been previously evaluated in the 2008 CT SPEIS.

WHEREAS, Plaintiffs SRS Watch, Nuclear Watch New Mexico and Tri-Valley CAREs submitted comments on the draft 2019 SPEIS SA, asserting that NNSA was required under NEPA

to complete a new and full programmatic environmental impact statement for simultaneous plutonium pit production at two sites.

WHEREAS, on September 2nd, 2020, DOE/NNSA concurrently issued two records of decision:

- An Amended Record of Decision ("AROD") for the 2008 CT SPEIS ("SPEIS AROD 1"), *see Amended Record of Decision for the Complex Transformation Supplemental Programmatic Environmental Impact Statement*, 85 Fed. Reg. 54550 (Sept. 2, 2020); and,
- An AROD for the 2008 LANL SWEIS. *See Amended Record of Decision for the Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, NM*, ("LANL AROD") 85 Fed. Reg. 54544 (Sept. 2, 2020).

Both the SPEIS AROD 1 and the LANL AROD authorized the production of 30 pits per year (with additional surge capacity) at Los Alamos.

WHEREAS, in September 2020, NNSA issued the 2020 Final Environmental Impact Statement for Plutonium Pit Production at the Savannah River in South Carolina ("2020 Savannah River EIS"), which studied the impacts of producing 50 pits per year (with additional surge capacity) at Savannah River.

WHEREAS, Plaintiffs SRS Watch, Nuclear Watch New Mexico and Tri-Valley CAREs submitted comments on the draft 2020 Savannah River EIS, asserting again that NNSA was required under NEPA to complete a new and full programmatic environmental impact statement for simultaneous plutonium pit production at two sites

WHEREAS, on November 5th, 2020, DOE/NNSA concurrently issued two more records of decisions— a second Amended Record of Decision for the Complex Transformation Supplemental Programmatic Environmental Impact Statement, 85 Fed. Reg. 70598 (Nov. 5, 2020), and the Record of Decision for Final Environmental Impact Statement (EIS) for Plutonium Pit Production at Savannah River in South Carolina, 85 Fed. Reg. 70601 (Nov. 5, 2020), both of which authorized the production of 50 pits per year (with additional surge capacity) at Savannah River.

WHEREAS, Plaintiffs filed a Complaint on June 29, 2021, and filed an Amended Complaint on July 11, 2022. Plaintiffs challenge, among other things, the DOE's and NNSA's decision not to prepare a new or supplemental PEIS pursuant to NEPA, 42 U.S.C. §§ 4321-4370, before deciding to produce plutonium pits at a second location—namely, Savannah River.

WHEREAS, Defendants deny any violations of law.

WHEREAS, the Court, in its Memorandum Opinion, ECF No. 208, found in favor of Plaintiffs as to Count One. Specifically, the Court found that the DOE and NNSA violated NEPA by failing to sufficiently evaluate the programmatic (as opposed to site-specific) environmental impacts of producing pits at a second location and by failing to consider reasonable alternatives for pit production locations. The Court dismissed Plaintiffs' claims in Counts Two through Five without prejudice and ordered the Parties to negotiate a compromise remedy to resolve the aforementioned NEPA violations.

WHEREAS, in light of the Court's order directing the Parties to negotiate a compromise remedy, the Parties, through their authorized representatives, and without any admission or further adjudication of the issues of fact or law, have reached an agreement to resolve this litigation in accordance with the terms set forth in this Settlement Agreement.

WHEREAS, the terms of this Settlement Agreement address Plaintiffs' concern that no nuclear pits should be produced at Savannah River until a new PEIS and Record of Decision ("ROD") is completed, while also addressing Defendants' concern, as evidenced by the Declarations of General Anthony Cotton, Administrator Jill Hruby, and Deputy Administrator Marvin Adams (attached, respectively, as Exhibits 1, 2, and 3 to this Agreement), that halting the pit production mission would likely pose grave risks to national security. Plaintiffs disagree with Defendants' national security concerns, as evidenced by the Declarations of Dylan K. Spaulding, Ph.D. and James J. Coghlan, attached hereto as Exhibits 4 and 5 to this Agreement. The Parties have agreed to attach these declarations for the sole purpose of memorializing their respective positions.

NOW, THEREFORE, the Parties hereby agree as follows:

1. The DOE and the NNSA will conduct a new PEIS to address all of the deficiencies identified by the Court.

2. DOE and NNSA agree to complete the PEIS and issue a new ROD within 2.5 years of the Court's entry of a final order or the Parties' executing a settlement agreement, whichever comes first.

3. DOE and NNSA agree to make reference materials that are publicly available and cited in the draft PEIS available via hyperlink references but will only do so once in a reference index included in the draft PEIS. DOE and NNSA do not agree to provide hyperlinks to documents that are cited within a referenced document.

4. DOE and NNSA agree to publish scoping information for the PEIS and hold public scoping meeting(s).

5. DOE and NNSA agree to allow forty-five (45) days for a public comment period that will commence after the final public scoping meeting.

6. DOE and NNSA agree to extend the public comment period on the draft PEIS from 45 days to 90 days.

7. DOE and NNSA agree to hold multiple public meetings on the draft PEIS at Aiken, SC; Kansas City, MO; Livermore, CA; Santa Fe (or Los Alamos), NM; Washington DC; and any other location deemed relevant to the PEIS by DOE and NNSA.

8. DOE and NNSA agree not to introduce or process any nuclear material in the Main Processing Building at the Savannah River Plutonium Processing Facility ("SRPPF") until the new PEIS is finalized and a new ROD is published.

9. DOE and NNSA also agree to the following terms:

   A. Until the PEIS is complete and a ROD is issued, NNSA will not install classified equipment into the Main Process Building.

      a. NNSA may procure and store classified equipment on-site or at an appropriate location.

   B. Until the PEIS is complete and a ROD is issued, NNSA will not start field construction of the Waste Storage RCRA Waste/DOT Inspection Station.

      a. NNSA can proceed with installing a mudmat and running underground utilities up to the area where the facility will be constructed. NNSA can also continue with the design and purchase of material, equipment, and components needed to start field installation, including any fabrication supported by the design documents.

   C. Until the PEIS is complete and a ROD is issued, NNSA will not start constructing the Waste Characterization Lab in the former Waste Solidification Building.

      a. NNSA can complete design and procure all components/materials needed for construction.

   D. If the PEIS is not complete and the new ROD has not issued by June 1, 2028, NNSA will not start construction, or if construction has already started NNSA will cease construction on the Construction Maintenance Building.

   E. If the PEIS is not complete and the new ROD has not issued by June 1, 2028, NNSA will not construct or will cease construction on the Vehicle Entry Control Facility.

      a. NNSA can still run above ground and underground utilities and install the mudmat for the Vehicle Entry Control Facility.

10. The Parties agree that any compromise is based on the law as it exists on the date of execution and that this Agreement may be superseded by future Acts of Congress.

11. The Parties agree that they shall participate in annual meetings at a location to be determined by the NNSA site counsel at the Savannah River facility until a new ROD is issued.

(a) Plaintiffs may bring up to two representatives and an additional two consultants (for a total of four people) to the annual meetings.

i. Any consultant must:

a. only be present to advise Plaintiffs;

b. be a U.S. citizen; and

c. be subject to the ultimate approval of DOE or NNSA after Plaintiffs present the requisite background information for said consultant necessary for site access.

12. The Parties further agree that at each annual meeting, upon Plaintiffs' request, Plaintiffs will receive a tour of the building currently known as the Mixed Oxide Fuel Fabrication Facility ("MOX")—that will become the Main Processing Building. The Parties' agreement about annual tours is subject to this limitation:

a. Once the MOX/Main Processing Building becomes classified—as determined by the relevant government agencies, including DOE and NNSA—Plaintiffs, who do not have the requisite security clearances to observe a classified space, can no longer enter the MOX/Main Processing Building.

i. If the MOX/Main Processing Building becomes classified, site counsel for Savannah River will provide declarations every six months that explain whether DOE/NNSA's activities occurring in the MOX/Main Processing Building are in compliance with this Settlement Agreement in lieu of the annual tour.

13. The Parties agree to file this Agreement as an exhibit to a joint motion to dismiss the Plaintiffs' Amended Complaint, pursuant to Fed. R. Civ. P. 41(a)(2), with prejudice.

14. That joint motion to dismiss shall request that the Court retain jurisdiction for the sole purpose of resolving disputes over compliance with the terms of this Agreement. This Agreement is conditioned on the Court entering an order: (a) dismissing Plaintiffs' claims with prejudice; and (b) retaining jurisdiction to resolve disputes over compliance with the terms of this Agreement. The Parties, however, will not request that the Court approve the Agreement or that the Court enter this Agreement as a stipulated order or judgment.

15. The sole remedy available to the Parties in the event of a finding of non-compliance is an order compelling compliance.

16. Before moving to enforce this Settlement Agreement, the moving party shall provide thirty (30) days' notice of any asserted non-compliance in writing and shall engage in good faith negotiations to resolve the dispute.

17. This Settlement Agreement shall not be enforceable through a proceeding for contempt of Court.

18. This Agreement constitutes the Parties' complete and final resolution of all legal, equitable, and administrative claims arising out of the following Records of Decision—85 Fed. Reg. 54550 (Sept. 2, 2020); 85 Fed. Reg. 54544 (Sept. 2, 2020); 85 Fed. Reg. 70598 (Nov. 5, 2020); and 85 Fed. Reg. 70601 (Nov. 5, 2020). Plaintiffs and their respective members, successors, and assigns hereby unconditionally and irrevocably release, waive, covenant not to sue, and forever discharge Defendants (including its past, present, and future officers, agents, and affiliates) from claims, causes of action, demands, suits, judgments, liabilities, fees, interests, or obligation, whether known or unknown, foreseen or unforeseen, disclosed or undisclosed, or presently asserted or otherwise, with the exception of any claims for attorneys' fees and costs arising out of this lawsuit, which will be separately resolved by the parties or by the Court.

19. The Parties acknowledge that nothing in this Agreement limits Plaintiffs' rights to challenge subsequent agency actions, including new NEPA analyses and/or decision(s), in a separate administrative or judicial action including, but not limited to, the judicial review provisions of the Administrative Procedure Act, 5 U.S.C. §§ 701-706, and that nothing in this Agreement limits DOE's or NNSA's rights to assert any applicable defenses.

20. This Settlement Agreement contains all of the agreements between Plaintiffs and Defendants and is intended to be and is the final and sole agreement between the Parties concerning the complete and final resolution of Plaintiffs' claims in the above-captioned case. Plaintiffs and Defendants agree that any prior or contemporaneous representations or understanding not explicitly contained in this Settlement Agreement, whether written or oral, are of no further legal or equitable force or effect. Any subsequent modifications to this Settlement Agreement must be in writing and must be signed and executed by all Parties to this Settlement Agreement.

21. This Settlement Agreement represents the entirety of the undersigned Parties' commitments regarding settlement. Except as expressly provided herein, none of the Parties waive or relinquish any legal rights, claims, or defenses they may have.

22. Nothing in this Settlement Agreement shall be interpreted as, or shall constitute, a

requirement that Defendants are obligated to pay any funds exceeding those available or take any action in contravention of the Anti-Deficiency Act, 31 U.S.C. § 1341, or any other applicable law.

23. Nothing in this Settlement Agreement shall be construed to waive any obligation to exhaust administrative remedies, to constitute an independent waiver of the United States' sovereign immunity, to change the standard of judicial review of federal agency action under the Administrative Procedure Act, or to otherwise extend or grant this Court jurisdiction to hear any matter, except as expressly provided in this Settlement Agreement.

24. It is hereby expressly understood and agreed that this Settlement Agreement was jointly drafted by Plaintiffs and Defendants. Accordingly, the Parties hereby agree that any and all rules of construction, to the effect that ambiguity is construed against the drafting Party, shall be inapplicable in any dispute concerning the terms, meaning, or interpretation of the Settlement Agreement.

25. The undersigned representatives of the Plaintiffs and Defendants certify that they are fully authorized by the respective Parties whom they represent to enter into the terms and conditions of this Settlement Agreement and to legally bind such Parties to it. This Settlement Agreement is binding on Plaintiffs and Defendants once signed by the Parties.

Dated: January 16, 2025

Executed By:

TODD KIM
ASSISTANT ATTORNEY GENERAL

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By: _____

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EXHIBIT 1

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
AIKEN DIVISION

SAVANNAH RIVER SITE WATCH, TOM CLEMENTS, THE GULLAH/GEECHEE SEA ISLAND COALITION, NUCLEAR WATCH NEW MEXICO, and TRI-VALLEY COMMUNITIES AGAINST A RADIOACTIVE ENVIRONMENT, Plaintiffs, v. UNITED STATES DEPARTMENT OF ENERGY, JENNIFER GRANHOLM, in her official capacity as the Secretary, The NATIONAL NUCLEAR SECURITY ADMINISTRATION and JILL HRUBY, Administrator, Defendants.	No. 1:21-cv-01942-MGL **DECLARATION OF GENERAL ANTHONY J. COTTON, COMMANDER, UNITED STATES STRATEGIC COMMAND, IN SUPPORT OF DEFENDANTS' POSITION ON REMEDIES**

I, ANTHONY J. COTTON, declare the following:

1. I have spent my entire career in furtherance of the defense of the United States. I have held a variety of leadership positions with increasing responsibilities and have commanded at the squadron-, group-, wing-, and major-command levels. These positions have primarily involved intercontinental ballistic missiles, space surveillance, and the military's readiness to deter, respond to, and counter nuclear threats to the United States.

2. I was promoted to four-star general on August 27, 2021, with assignment as Commander, Air Force Global Strike Command, where I was responsible for the organization, training, and equipping of two of the three legs of our nuclear triad. On June 8, 2022, I was nominated by President Biden for reappointment to the grade of four-star general, with assignment

as Commander, U.S. Strategic Command (USSTRATCOM), and I was confirmed by the United States Senate on September 29, 2022. I have been the Commander of USSTRATCOM at Offutt Air Force Base, Nebraska, since December 2022.

3. USSTRATCOM is one of eleven unified Combatant Commands under the Department of Defense (DoD). As the single Command responsible for all strategic nuclear forces, it provides the President and Secretary of Defense a range of options to deter adversaries and assure allies. Strategic deterrence, which is a military strategy aimed at preventing an adversary from launching an attack by convincing them the consequences would be unacceptable, is one of the most important aspects of our national defense.

4. USSTRATCOM is responsible for strategic deterrence; nuclear operations; nuclear command, control, and communications enterprise operations; joint electromagnetic spectrum operations; global strike; and missile-threat assessment.

5. As Commander of USSTRATCOM, I am also a member of the Nuclear Weapons Council (NWC). Title 10 U.S.C. § 179 gives the NWC specific responsibilities, including evaluating, maintaining, and ensuring the safety, security, and control of the nuclear weapons stockpile, as well as developing nuclear weapons stockpile options. The NWC is the focal point for interagency activities to sustain and modernize the U.S. nuclear deterrent.

6. In these capacities, I am privy to the most sensitive national security matters, including the national defense needs and requirements of the United States.

7. The purpose of this Declaration is to provide the Court with important information on the impact of delay with respect to the expanded pit production mission at Los Alamos National Laboratory in New Mexico and at the Savannah River Site in South Carolina. The statements and professional judgments made herein are based on my military experience and personal knowledge

of strategic nuclear operations and information made available to me as Commander, USSTRATCOM, and as a member of the NWC.

8. The international security environment has continued to destabilize due to geopolitical events and the actions of the United States' strategic competitors, including heavy investment in new nuclear capabilities. Today, the United States, its allies, and partners are confronted by two major nuclear powers as strategic competitors and potential adversaries: the Russian Federation and the People's Republic of China (China). I am personally familiar with the data and intelligence that supports the conclusion that powers throughout the world, including potential adversaries, are rapidly expanding their nuclear capabilities. This conclusion is further supported by a recent report by the Defense Intelligence Agency entitled: Nuclear Challenges – The Growing Capabilities of Strategic Competitors and Regional Rivals, which is attached as Exhibit 1 to this Declaration.

9. China, for example, has rapidly accelerated its nuclear program. In 2020, the DoD estimated China's operational nuclear warhead stockpile was in the low 200s and was expected to double by 2030. *See also*, *id.* at 1. Defying those expectations, China currently has more than 500 operational nuclear warheads and will likely field more than 1,000 operational nuclear warheads by 2030. *See also*, *id.*

10. I am also aware in recent years, several powers have engaged in aggressive, norm-breaking military activities. Russia, for example, has increasingly displayed nuclear norm-breaking behavior by invading Ukraine, a non-nuclear weapon state, without provocation, and then taking control of a Ukrainian nuclear power plant. This aggression, and reports that Russia intends to move nuclear weapons into Belarus, are especially concerning, as are reports that Russia has considered using nuclear weapons as part of its war efforts.

11. The United States, its allies, and partners also face a growing nuclear threat from the Democratic People's Republic of Korea (North Korea) and the Islamic Republic of Iran (Iran).

12. North Korea's missile testing continues at a significant pace, posing a threat to the United States and its allies. *See also*, *id.* at 19–24.

13. Likewise, Iran continues to expand its nuclear program by enriching uranium to a higher level and faster than ever before. *See also*, *id.* at 25–26. Iran is stockpiling enriched uranium while continuing to test missiles that hold much of the Middle East region at risk, posing a threat to the United States and its allies. *See also*, *id.*

14. Based on my experience and professional judgment, the level of concern about the current threat environment is as high as it has been since the end of the Cold War. Our Nation's potential adversaries are increasingly coordinating and cooperating with one another, raising the possibility of near-simultaneous conflicts with multiple nuclear-armed, opportunistic adversaries. These destabilizing behaviors, which have only increased since the Plaintiffs' lawsuit was filed in 2021, create an increasingly complex geopolitical environment which is evolving and uncertain. Nuclear weapons will continue to provide a unique deterrent, promoting international security in ways no other element of U.S. power can achieve for the foreseeable future.

15. The United States addresses these adversarial challenges by ensuring the President has options to deter all potential adversaries. Ensuring the United States' nuclear arsenal, which is our primary strategic deterrent, remains safe, secure, effective, and credible requires a significant and coordinated effort. Responsibility for this mission is shared by the DoD and the Department of Energy's National Nuclear Security Administration (DOE/NNSA). Only by aligning the priorities and programs of these two Departments can U.S. nuclear forces meet their mission to deter threats and assure security.

16. A plutonium pit is one of the core components of a nuclear weapon. Pit production—as mandated by 50 U.S.C. § 2538a, which requires NNSA to produce at least 80 pits per year by 2030—is paramount to ensuring the stockpile, and hence the nuclear deterrent, remains effective and credible. Thus, pit production is of utmost importance to the U.S. military, and any delay or suspension to production will pose an imminent and serious threat to national security.

17. To meet the requirements of 50 U.S.C. § 2538a, the DOE/NNSA is expanding its pit-production capability at Los Alamos and repurposing the former Mixed Oxide Fuel Fabrication Facility at Savannah River.

18. While the Nation's nuclear weapons stockpile is currently safe, secure, effective, and credible, the stockpile cannot remain static. Our two nuclear peer strategic competitors, Russia and China, are significantly and rapidly modernizing and expanding their existing capabilities, as well as pursuing new ones. We must address our aging nuclear weapons stockpile and its supply chain as our nuclear competitors accelerate fielding of advanced capabilities. While we can and do meet the objectives today, USSTRATCOM will have less flexibility in providing deterrence options as the stockpile ages beyond its planned service life and it becomes increasingly uncertain how its performance might be affected. Therefore, delays in pit production would introduce risk to national security and strategic deterrence, and the lengthier the delay, the more significant the risk.

19. Modernizing a new or significantly updated weapon in today's enterprise takes time. Congress recognized this reality and mandated pit production, as noted above. The first wave of pit modernization is the current Program of Record which includes components to support weapon systems from all three parts (air, land, sea) of the Nation's nuclear triad. New or modernized warheads all need *new* plutonium pits over time. The NNSA can provide this

capability only by expanding pit production at Los Alamos and Savannah River. Delays in receiving the congressionally mandated number of new plutonium pits from the NNSA will have a significant, adverse impact on our ability to add new warheads to our stockpile or modernize existing warheads. Delaying pit production in any manner (i.e., through delaying the construction and operation of the Savannah River Plutonium Processing Facility and/or by otherwise limiting the number of pits produced at Los Alamos) will have a direct, month-for-month negative impact on the ability to modernize the stockpile.

20. It is my opinion that lengthy delays pose significant risks to national security. Every effort should be made to minimize delays in pit production, as producing pits is vital to our national security and strategic deterrence.

21. A sweeping injunction, like the one requested by the plaintiffs, poses unacceptable risks to national security. An injunction, if one is absolutely necessary, should be limited to the specific projects identified by NNSA in order to avoid incalculable harm to readiness and strategic deterrence.

I declare under penalty of perjury, pursuant to 28 U.S.C. 1746, the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 13th day of November 2024.

Anthony J. Cotton, General, USAF
Commander, United States Strategic Command

EXHIBIT 2

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
AIKEN DIVISION

SAVANNAH RIVER SITE WATCH, TOM CLEMENTS, THE GULLAH/GEECHEE SEA ISLAND COALITION, NUCLEAR WATCH NEW MEXICO, and TRI-VALLEY COMMUNITIES AGAINST A RADIOACTIVE ENVIRONMENT, Plaintiffs, v. UNITED STATES DEPARTMENT OF ENERGY, JENNIFER GRANHOLM, in her official capacity as the Secretary, The NATIONAL NUCLEAR SECURITY ADMINISTRATION and JILL HRUBY, Administrator, Defendants.	No. 1:21-cv-01942-MGL **SECOND DECLARATION OF NNSA ADMINISTRATOR, JILL HRUBY, IN SUPPORT OF DEFENDANTS' POSITION ON REMEDIES**

I, JILL HRUBY, declare the following:

1. I previously executed a declaration in this case and my qualifications are set forth therein. *See* ECF No. 190-1. In short, I am the Under Secretary for Nuclear Security for the United States Department of Energy, the Administrator for Nuclear Security and lead the National Nuclear Security Administration (NNSA), and a member of the Nuclear Weapons Council (NWC).

2. The purpose of this Declaration is to provide the Court with important information on the impact of delay with respect to the expanded pit production mission at Los Alamos National Laboratory (LANL) in New Mexico and at the Savannah River Site (SRS) in South Carolina. The statements and professional judgments made herein are based on my experience and personal knowledge of information (both unclassified and classified) made

available to me as NNSA Administrator and as a member of the NWC. I provided only non-classified information in this declaration, but my personal knowledge and opinions are based on both unclassified and classified information.

3. I have reviewed General Cotton's Declaration, dated November 13, 2024, and agree that enjoining any critical path work, which will result in lengthy delays to the expanded pit production mission at LANL and SRS, will pose an unacceptable risk to national security.

4. While any delay poses risk to NNSA's ability to deliver war-reserve plutonium pits to the military in a timely manner, I took seriously the Court's order directing the parties to reach compromise on a remedy in the above-styled case. I directed my staff, through NNSA's General Counsel, to search for areas of compromise to offer to the Plaintiffs.

5. I am familiar with the five (5) scopes of work the subject matter experts on my staff identified, which they believe can be enjoined without posing intolerable risks to national security and wreaking significant economic harm. I initially only authorized my staff to compromise on two of these scopes of work, given very real concerns about whether enjoining more scopes of work would delay the production of pits; however, after several rounds of negotiations with Plaintiffs, I ultimately authorized my staff to offer all five of these scopes of work to: (1) ensure NNSA was negotiating in good faith, and (2) to comply with the Court's order.

6. The five scopes of work are as follows:

a. Until the PEIS is complete and a ROD is issued, NNSA will not begin the following 3 projects:

i. **Classified Equipment Installations in the Main Process Building** – the project will not install classified equipment into the Main Process Building. (The project will procure, and store classified equipment on-site or appropriate location).

ii. **Waste Storage RCRA Waste/DOT Inspection Station** – the project will not start field construction of this facility. It will install a mud mat and run underground utilities up to the area where the facility will be constructed. (The project will continue with the design and purchase of material, equipment, and components needed to start field installation, including any fabrication supported by the design documents).

iii. **Waste Characterization Lab in the former Waste Solidification Building** – the project will not start constructing the Waste Characterization Lab in the former Waste Solidification Building (but will complete design and procurement of all components/materials needed for construction).

b. If the PEIS is not complete and a ROD is not issued by June 1, 2028, NNSA will not start construction, or if started NNSA will cease construction on the **Construction Maintenance Building**; and

c. If the PEIS is not complete and a ROD is not issued by June 1, 2028, NNSA will not construct or will cease construction on the **Vehicle Entry Control Facility** (excluding underground utilities, mud mat, utilities ran to build of lines).

7. Enjoining the first two scopes of work in that list will be less disruptive to NNSA's national security mission than enjoining the last three. As you progress down the list, each scope of work gains more importance. However, if absolutely necessary but nevertheless more impactful to the pit production mission, the Court could enjoin all five.

8. In my professional judgment, though, enjoining anything beyond these five activities would pose an unacceptable risk to national security. I cannot authorize my staff to offer any points of compromise that would pose unacceptable risks to national security. Moreover, project management is by no means an exact science, it would be preferable (and best for the pit production mission) if NNSA could retain the ability to propose the exchange of the activities identified herein if the exigencies of construction, the project or program dictate a change.

9. With respect to the National Environmental Policy Act (NEPA), let me be clear that the National Nuclear Security Administration and the Department of Energy place great emphasis on environmental stewardship, and understand and appreciate the importance of the NEPA. Thus, I fully support any further NEPA analysis as an appropriate remedy in this case. Enjoining any of the five aforementioned scopes of work until a new programmatic EIS is completed will ensure that NNSA cannot produce any plutonium pits at Savannah River until it considers the nationwide effects of a two-site pit production strategy and considers a full-range of alternatives for production sites.

I declare under penalty of perjury, pursuant to 28 U.S.C. 1746, that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 5 day of December 2024.

Jill Hruby
Under Secretary for Nuclear Security of the United States Department of Energy and Administrator of the National Nuclear Security Administration

EXHIBIT 3

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
AIKEN DIVISION

SAVANNAH RIVER SITE WATCH, TOM CLEMENTS, THE GULLAH/GEECHEE SEA ISLAND COALITION, NUCLEAR WATCH NEW MEXICO, and TRI-VALLEY COMMUNITIES AGAINST A RADIOACTIVE ENVIRONMENT, Plaintiffs, v. UNITED STATES DEPARTMENT OF ENERGY, JENNIFER GRANHOLM, in her official capacity as the Secretary, The NATIONAL NUCLEAR SECURITY ADMINISTRATION and JILL HRUBY, Administrator, Defendants.	No. 1:21-cv-01942-MGL **DECLARATION OF NNSA DEPUTY ADMINISTRATOR, MARVIN ADAMS, IN SUPPORT OF DEFENDANTS' POSITION ON REMEDIES**

I, MARVIN ADAMS, declare the following:

1. I serve as the Deputy Administrator for Defense Programs at the National Nuclear Security Administration (NNSA). In this role, I am responsible for the design, manufacture, certification, transportation, and maintenance of the Nation's nuclear weapons stockpile, and for its safety, security, and reliability.

2. I first served DOE as a physicist at the Lawrence Livermore National Laboratory (LLNL) in 1986, and I remained engaged with the U.S. national security enterprise even after leaving LLNL in 1992 to become a professor of nuclear engineering at Texas A&M University. I was a tenured full professor for many years, until the U.S. Senate confirmed my appointment to my current role in April of 2022. In the past three decades I have served on the President's Council of Advisors on Science and Technology, the Stockpile Assessment Team of the Strategic Advisory Group for U.S. Strategic Command, the JASON defense advisory group, and many other review and advisory bodies related to national security.

3. The purpose of this Declaration is to provide the Court with important information on the national-security impact that would be caused by any delay in our pit production mission at Los Alamos National Laboratory (LANL) in New Mexico or at the Savannah River

Site (SRS) in South Carolina. The statements and professional judgments made herein are based on my professional experience and personal knowledge of information made available to me as NNSA Deputy Administrator for Defense Programs. I provide only non-classified information in this declaration, but my personal knowledge and opinions are based on both unclassified and classified information.

4. I have reviewed General Cotton's and Administrator Hruby's declarations, and I agree that enjoining any critical-path work, which would delay pit production at LANL and/or SRS, would pose an unacceptable risk to national security. General Cotton's Declaration, for example, spoke at length about the deterioration in today's international security environment and the geopolitical drivers that increase the importance of executing the ongoing modernization of the United States' nuclear weapons programs as quickly as can be achieved.

5. A key component of a nuclear warhead is the plutonium pit. When a pit is compressed by explosives inside a warhead or bomb, it reaches a configuration that can sustain a rapidly growing supercritical fission chain reaction, which is the first step of the nuclear explosion.

6. General Cotton's Declaration correctly notes that all warheads in the U.S. stockpile will eventually contain new plutonium pits, which we plan to manufacture at Los Alamos and Savannah River. As of the end of Fiscal Year 2023, there were 3,748 warheads in the U.S. nuclear stockpile.

7. NNSA is required to meet a challenging warhead delivery schedule, with two warhead types in production in Fiscal Year 2025 and five more scheduled to enter production at various points in the next 12 years. A similarly challenging schedule continues for decades. The requirements these warheads must meet differ from those met by existing warheads. In some cases, existing pits that might seem be available for reuse are not well suited to the new requirements or are not available in the needed quantities. This is one reason pit manufacturing is needed without further delay.

8. A second reason pit manufacturing is needed without further delay is that we must replace old pits before they age to the point that we can no longer certify their ability to perform as required. Pit performance degrades over time. The damage caused by radioactive decay of the plutonium changes the properties of the material, which in turn degrades the performance of the weapon. There is no concern about reliability today, but concerns will develop as existing pits continue to age.

9. If we were unable to replace pits before aging phenomena called their performance into question, the effectiveness of our nation's nuclear deterrent would suffer, with substantial negative impact on U.S. national security.

10. Because it will take several decades to replace all existing war reserve plutonium pits, it is important to start producing new pits without further delay. We are racing against aging phenomena that are in progress every minute of every day.

11. We have already experienced setbacks and schedule delays on the SRS project, arising from a variety of factors, including supply and workforce problems associated with the pandemic. Nuclear construction and operations are complicated processes and were not made easier by the pandemic. The delays already incurred have eliminated any schedule margin we had. Further delays would pose serious risk to the nation's nuclear deterrent.

12. If the Court believes an injunction is necessary, the injunction that appears to be most effective and, simultaneously, least harmful to national security is precluding NNSA from introducing or producing nuclear material at the Main Processing Building at SRPPF.

13. If the Court believes some construction must be enjoined, I understand that NNSA experts have identified up to five projects that they believe could be the subject of a narrowly tailored injunction. It is my professional opinion that outside of the five specific projects identified, all other activities ongoing today at SRPFF must continue uninterrupted or we will face further delays in re-establishing critical manufacturing capability. Achieving the required SRPPF pit production capacity without further delay is essential for sustaining the effectiveness of our Nation's nuclear deterrent and ensuring that our nuclear weapons will remain safe, reliable, and effective ten, twenty, thirty, forty, and fifty years from now.

14. In sum, time is of the essence in establishing pit production capacity because of warhead requirements, plutonium aging, and the evolving geopolitical landscape. Delaying the restoration of this capability would introduce significant risks to national security and would ultimately lead to significant cost increases, which would be born by American taxpayers. DOE, NNSA and the Department of Defense agree that there is an urgent need to move forward with alacrity to maintain the effectiveness of the nation's nuclear deterrent.

I declare under penalty of perjury, pursuant to 28 U.S.C. 1746, that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 12th day of December 2024.

Dr. Marvin L. Adams
Deputy Administrator of the National Nuclear Security Administration

EXHIBIT 4

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
AIKEN DIVISION

SAVANNAH RIVER SITE WATCH, TOM CLEMENTS, THE GULLAH/GEECHEE SEA ISLAND COALITION, NUCLEAR WATCH NEW MEXICO, and TRI-VALLEY COMMUNITIES AGAINST A RADIOACTIVE ENVIRONMENT, Plaintiffs, v. UNITED STATES DEPARTMENT OF ENERGY, JENNIFER GRANHOLM, in her official capacity as the Secretary, THE NATIONAL NUCLEAR SECURITY ADMINISTRATION, and JILL HRUBY, Administrator, Defendants.	)	No. 1:21-cv-01942-MGL **DECLARATION OF JAMES J. COGHLAN**

I, James J. Coghlan, make the following Declaration pursuant to the provisions of 28 U.S.C. § 1746 which is based upon my personal knowledge:

1. I am the authorized representative and Executive Director for the nonprofit organization Nuclear Watch New Mexico, one of the co-plaintiffs in this litigation. Nuclear Watch's mission statement and my extensive experience in National Environmental Policy Act (NEPA) issues involving the Department of Energy (DOE) and its semi-autonomous nuclear weapons agency, the National Nuclear Security Administration (NNSA), were previously discussed in my April 26, 2024 declaration.

2. I am professionally familiar with DOE's long history of chronic noncompliance with NEPA for programs that involve critical public safety and environmental protection issues and huge taxpayer costs. In October 1990, the Natural Resources Defense Council, a public

interest nonprofit organization, secured a court order which required DOE to complete programmatic environmental impact statements on 1) its proposed reconfiguration of its nuclear weapons complex; and 2) related waste management and environmental restoration. Exhibit 1, *NRDC v. James D. Watkins, Secretary, USDOE*, Civil Action No. 89-1835 SS. In defiance of that court order, DOE never completed a PEIS on its proposed reconfiguration of its nuclear weapons complex until pre-litigation negotiations in 1995 that I was involved in compelled it to do so. See ¶5, infra.

3. Similarly, DOE never completed a PEIS on waste management and environmental restoration. Instead, in a December 1998 Court Stipulation and Order, DOE agreed to a public "Central Internet Database" that would track its nation-wide shipments of radioactive wastes. Exhibit 2, Joint Stipulation and (Proposed) Order, *NRDC v. Bill Richardson, Secretary, USDOE*, Civ. No. 97-936 SS. However, contrary to that court order, DOE never completed the Central Internet Database. Nor did DOE ever complete a PEIS on nation-wide environmental restoration of Cold War legacy wastes, the largest cleanup program in human history.[1] In sum, DOE has a long and serious history of illegal, chronic noncompliance with the National Environmental Policy Act.

4. The very first NEPA lawsuit[2] that I was a party to is relevant to the remedies under consideration here. It included a request for injunctive relief because of DOE's failure to prepare an environmental impact statement for the Dual-Axis Radiographic Hydrodynamic Testing Facility (DARHT) at the Los Alamos National Laboratory (LANL). DARHT uses two powerful x-rays to radiograph explosive "full-scale mockups of the events that trigger

[1] According to the Government Accountability Office, DOE has spent over $215 billion since 1989, with future estimated costs of $675 billion or more. *Nuclear Waste Cleanup: Closer Alignment with Leading Practices Needed to Improve Department of Energy Program Management*, GAO, June 2024, https://www.gao.gov/products/gao-24-105975

[2] *LASG, et al vs. DOE*, District of New Mexico, Civil Action No. 94-1306 M

the nuclear detonation."[3] Despite the fact that DARHT would explosively test hazardous materials in the open air, DOE had given it a Categorical Exemption circumventing the public's legal right under NEPA for review and comment.

5. At the time I was working for Concerned Citizens for Nuclear Safety (CCNS) based in Santa Fe, NM, which was a co-plaintiff in the DARHT lawsuit. I was personally involved in pre-litigation negotiations in which DOE agreed to complete a Stockpile Stewardship and Management (SSM) Programmatic Environmental Impact Statement (PEIS). Significantly, it is the original PEIS that remains relevant to this case today.

6. DOE also agreed in pre-litigation negotiations to prepare an environmental impact statement (EIS) for DARHT. However, DOE refused to halt construction while completing the EIS, making the illogical if not illegal claim that continuing construction would not prejudice its Record of Decision to finish and operate the facility. Accordingly, as a co-plaintiff, Concerned Citizens for Nuclear Safety filed suit on November 16, 1994.

7. In resisting the injunction. DOE claimed national security concerns should allow construction to continue:

> Given the current environment, including most importantly both the absence of underground testing and the ongoing negotiations for a Comprehensive Test Ban Treaty (CTBT), the development of nonnuclear capabilities for ensuring reliability of the current weapons stockpile is absolutely essential... DARHT would provide the hydrodynamic testing capabilities needed for accurately assessing reliability, safety and performance of the Nation's nuclear weapons stockpile.[4]

8. Judge Edwin Mecham rejected this argument and granted injunctive relief reasoning as follows:

> I find that the delay associated with completing an EIS will not endanger national security to a degree that would prevent the dispensing of injunctive relief... Ample

[3] *DARHT Delivers*, LANL, April 2007, https://cdn.lanl.gov/files/april2007_76c25.pdf

[4] Defendants' Opposition to Plaintiffs' Motion for Preliminary Injunction, LASG et al vs. DOE, District of New Mexico, 94-1306 M, November 30, 1994. The U.S. signed the CTBT but the Senate did not ratify it.

> evidence points to the fact that the existing nuclear stockpile is, at this time, safe and reliable... DOE has not presented to the court with [sic] enough evidence amounting to a reason to fear that the delay has threatened or will threaten national security... Because compliance with NEPA is an obligation an agency is assumed to be aware of, delay associated with preparing an EIS cannot be considered an unforeseen setback... The fact that construction of the housing facility [for DARHT] is almost one-quarter complete and the procurement stage well on its way to being half done, is not enough of a reason in itself to support a denial of an injunction... I find that the balance of harms favors the plaintiffs. A comparatively short delay for the purpose of ensuring that environmental consequences have been properly assessed does not create a state of urgency constituting a threat to national security... Public interest "of the highest order" is served by "having government officials act in accordance with the law." *Public Service*, 825 F. Supp. at 1509... Therefore, issuance of an injunction would not be adverse to the public interest.

Exhibit 3, Memorandum Opinion and Order, U.S. District Court of New Mexico, Civil Action No. 94-1306-M, January 26, 1995.

9. The "comparatively short delay" transpired as follows: DOE published a Notice of Intent in the Federal Register for the SSM PEIS on June 14, 1995. The scope of the SSM PEIS was very broad, analyzing proposed experimental facilities, the multi-billion dollar National Ignition Facility, high explosives fabrication, the production of highly enriched uranium secondaries, nuclear weapons assembly/disassembly, nonnuclear components fabrication, and pit production. On December 26, 1996, DOE issued a Record of Decision for the SSM PEIS, including "reestablish[ing] the pit fabrication capability, at a small capacity, at LANL," thereby transferring the mission from the Rocky Flats Plant which ceased operations after a 1989 FBI raid investigating environmental crimes.[5] A subsequent

[5] Ultimately the Rockwell Corporation, DOE's Rocky Flats Plant management contractor, pled guilty to ten environmental crimes and paid an 18.5 million dollar fine to the government, at the time a record penalty. However, this followed the sealing of the grand jury report by the Department of Justice, which was then leaked to a local newspaper. According to subsequent publications, the Rocky Flats special grand jury had indicted three DOE officials and five Rockwell employees with environmental crimes. The grand jury also wrote a public report pillorying the DOE and Rocky Flats contractors for "engaging in a continuing campaign of distraction, deception and dishonesty." http://archive.boulderweekly.com/010605/coverstory.html

September 20, 1999 Record of Decision for a new LANL Site-Wide Environmental Impact Statement (SWEIS) explicitly limited pit production to 20 pits per year.[6]

10. Concerning Defendants' potential resistance to injunctive relief by claiming that such relief would be contrary to national security, it should be noted that NNSA's contemplated future pit production is not to maintain the safety and reliability of the existing, extensively tested nuclear weapons stockpile. Instead, it is for new-design nuclear weapons (specifically NNSA's proposed W87-1 and W93 warheads) that can't be tested because of the international testing moratorium, or conversely could prompt the U.S. to resume testing, which would likely have severely negative global proliferation consequences.[7] Any narrow injunctive relief while NNSA completes a new supplemental PEIS on pit production is highly unlikely to degrade national security because the existing nuclear weapons stockpile will not be affected.

11. As Executive Director of Nuclear Watch New Mexico I routinely review and am familiar with annual Congressional Budget Requests for DOE projects, particularly at the Los Alamos National Laboratory.

12. The "30 Reliable Equipment Installation (30R) Subproject (21-D-512-03)" was included in DOE's Congressional Budget Request for the federal fiscal year 2025 (which began this October 1, 2024). The purpose of this Subproject is expressly intended to "expand[] the capability and capacity to provide 30 war reserve pits per year to the stockpile at a 90% confidence using a single shift." Exhibit 4, Excerpt DOE Budget Request Fiscal

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[6] https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/EIS-0238-ROD-1999.pdf

[7] A former national security advisor to newly elected President Trump has previously declared "Washington must test new nuclear weapons for reliability and safety in the real world for the first time since 1992—not just by using computer models." See *The Return of Peace Through Strength*, Robert O'Brian, Foreign Affairs, June 18, 2024, https://www.foreignaffairs.com/united-states/return-peace-strength-trump-obrien

Year 2025 at p. 236. I believe that narrowly tailored enjoinment of just the 30R Subproject for the LANL portion of NNSA's two-site strategy would comport with the Court's finding that NNSA has violated NEPA by not undertaking a proper alternatives analysis given the change in need and purpose and changed circumstances since the 2008 CT SPEIS. ECF No. 208 at pp. 7-12.

13. In my experience, NEPA reviews and the public participation they mandate aren't just paper exercises for federal agencies to just check off. Instead, they result in tangible, real benefits for both the public and the government. For example, after completing its environmental impact statement, DOE's October 16, 1995 DARHT Record of Decision required the phase-in of steel containment vessels for most explosive tests in order to prevent environmental contamination and better protect human health.

14. Another pertinent example of tangible benefits from NEPA processes is the 1999 LANL Site-Wide Environmental Impact Statement (SWEIS). I submitted formal comment on the draft SWEIS pointing out that DOE had not analyzed the very real risk of wildfire. To DOE's credit, the final LANL SWEIS included a detailed hypothetical wildfire that became all too real a half year later during the catastrophic 2000 Cerro Grande Fire. That hypothetical scenario helped to convince Lab leadership to order mandatory evacuation of all but essential personnel. Mitigation provisions in the SWEIS Record of Decision included wildfire measures that helped to prevent the Cerro Grande Fire from reaching plutonium-contaminated transuranic wastes stored above-ground at the Lab's Area G. It could have been catastrophic had the radioactive wastes drums ruptured due to high heat.

15. Even LANL recognized that public comment helped to avert potential catastrophe, writing:

> Environmental Impact Statements, in particular, seem to some people to be a costly paper exercise: Before you - the great public "jury" - decide what you think, listen to the story of the 1999 Site-Wide Environmental Impact Statement (SWEIS)... It is a story of an EIS process, of helpful public comments, of a timely response ...

> then a great fire, called Cerro Grande, that proves the value of outsiders' ideas… When the Cerro Grande Fire swept down from the mountains this spring, these extra defensive steps, taken in response to the public comments, paid for themselves many times over. The savings were in the form of the harm to facilities that was reduced or avoided and reduced risk to the public that might have resulted. [8] [9]

16. While Plaintiffs filed this suit in June 2021 seeking to compel a new supplemental PEIS, our efforts actually began nearly three years before that. Beginning on October 30, 2018, we sent a total of five formal letters to NNSA notifying it that it had a legal obligation under NEPA to complete a new supplemental PEIS.[10] Thus, this legal issue, and any delay injunctive relief may necessitate, could have been resolved long ago without litigation had NNSA heeded our comments.

I declare under penalty of perjury, pursuant to 28 U.S.C. § 1746, that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 11th day of December, 2024.

James J. Coghlan

James J. Coghlan

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[8] https://hwbdocuments.env.nm.gov/Los%20Alamos%20National%20Labs/General/13435.pdf

[9] As yet another example of NNSA's chronic noncompliance with NEPA, the agency published a Notice of Intent in the Federal Register to complete a new LANL SWEIS on August 16, 2022. NNSA still has not released a draft SWEIS despite the NEPA requirement that an EIS be completed within two years of the published Notice of Intent. See 40 C.F.R 1501.10 *Deadlines and schedule for the NEPA process.*

[10] Exact dates of our five formal letters are October 30, 2018; May 17, 2019; September 17, 2019; June 4, 2020; and October 23, 2020. We subsequently filed suit on June 29, 2021.

Dec. J. Coghlan Exhibit 1

ATTACHMENT F

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

NATURAL RESOURCES DEFENSE COUNCIL, INC., et al.,
Plaintiffs,
v.
JAMES D. WATKINS, SECRETARY, U.S. DEPARTMENT OF ENERGY et al.,
Defendants.

Civil Action No. 89-1835 SS

FILED
OCT 22 1990
CLERK, U.S. DISTRICT COURT
DISTRICT OF COLUMBIA

STIPULATION AND ORDER OF DISMISSAL

WHEREAS, on June 27, 1989, Plaintiffs commenced this action, alleging Defendants' failure to comply with the requirements of the National Environmental Policy Act, 42 U.S.C. §§ 4321-4370a, (NEPA) and the regulations of the Council on Environmental Quality, 40 C.F.R. Parts 1500 to 1508 ("the CEQ regulations"), as adopted by the United States Department of Energy ("the Department"), 10 C.F.R. Part 1021, in connection with the Department's proposals for the cleanup and modernization of the nuclear weapons production complex;

WHEREAS, Plaintiffs' complaint sought a declaratory judgment that Defendants are in violation of Section 102(2)(C) of NEPA and the CEQ regulations by failing to prepare, circulate for comment, and consider in their decision-making process a Programmatic Environmental Impact Statement concerning the Department's proposals for the cleanup and modernization of the nuclear weapons production complex and further sought a mandatory injunction requiring that Defendants prepare such a Programmatic Environmental Impact Statement;

(N)

WHEREAS, on January 12, 1990, Defendant James D. Watkins issued two memorandum decisions, one stating that the Department intends to prepare a Programmatic Environmental Impact Statement on the Five-Year Environmental Restoration and Waste Management Plan and the other stating that the Department intends to prepare a Programmatic Environmental Impact Statement on the modernization of the nuclear weapons production complex;

WHEREAS, the Department will, in a timely fashion, prepare, circulate for comment, make available to the public and consider in its decision-making process, in accordance with NEPA and the CEQ regulations, two Programmatic Environmental Impact Statements, one concerning the Five-Year Environmental Restoration and Waste Management Plan and the other concerning the reconfiguration (referred to previously and above as "modernization") of the nuclear weapons production complex, and will publish Records of Decision in the Federal Register;

WHEREAS, the preparation, circulation for comment, publication and consideration by the Department of the two Programmatic Environmental Impact Statements, as described in this stipulation, will substantially satisfy Plaintiffs' claims in this action;

WHEREAS, entry into this stipulation is made in good faith in an effort to avoid further expensive and protracted litigation, and without any admission by the Department concerning whether it has an obligation under NEPA or the CEQ regulations to prepare either Programmatic Environmental Impact Statement;

WHEREAS, each undersigned representative of the parties certifies that he or she is fully authorized to enter into and execute this stipulation on behalf of each respective party and to legally bind such party to this stipulation;

NOW THEREFORE, the undersigned attorneys for the respective parties to this action hereby stipulate and agree as follows:

1. The Department will file in the Federal Register a Notice of Intent to Prepare the Programmatic Environmental Impact Statement on the Five-Year Environmental Restoration and Waste Management Plan on or before November 1, 1990, which Notice of Intent was approved for publication by Acting Assistant Secretary for Environment, Safety and Health Peter N. Brush on October 15, 1990; and will file in the Federal Register a Notice of Intent to Prepare the Programmatic Environmental Impact Statement on the reconfiguration of the nuclear weapons production complex on or before March 31, 1991; except that those deadlines of November 1, 1990 and March 31, 1991 may be extended by the Court upon application of counsel for the Department, in accordance with the Court's statement at the August 22, 1990 status call in the above-captioned action.

2. Without conceding that any liability exists under the Equal Access to Justice Act, 28 U.S.C. § 2412, the Department shall reimburse the Plaintiffs' attorneys fees and costs in the total amount of $18,000.00.

3. This action shall be dismissed without prejudice. However, the Court shall retain jurisdiction over this matter to enforce this stipulation. This matter may be reopened on the merits by any party upon ten days' notice to all other parties. Under no other circumstances will this stipulation be admissible as evidence in any other proceeding.

Respectfully submitted,

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Counsel for Defendants

ORDER

So ordered.

By: STANLEY SPORKIN
UNITED STATES DISTRICT JUDGE

DATED: ~~September~~ October 22, 1990.

Dec. J. Coghlan Exhibit 2

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

NATURAL RESOURCES DEFENSE COUNCIL, et al.,

Plaintiffs,

v.

BILL RICHARDSON, Secretary of Energy, et al.,

Defendants.

Civ. No. 97-936 (SS) (AK)

NATURAL RESOURCES DEFENSE COUNCIL, et al.,

Plaintiffs,

v.

JAMES D. WATKINS, Secretary of Energy, et al.,

Defendants.

Civ. No. 89-1835 (SS) (AK)

JOINT STIPULATION AND [PROPOSED] ORDER

I. INTRODUCTION

In Count I[1] of Natural Resources Defense Council v. Richardson, Civ. No. 97-936 (SS), plaintiffs allege that defendants have violated and continue to violate a settlement agreement entered as an Order by this Court on October 22, 1990 in Natural Resources Defense Council v. Watkins, Civ. No. 89-1835 (SS) (1990 Stipulation and Order), by failing to prepare an

[1] Count I is the only remaining count in this case. Count II was dismissed without prejudice on August 18, 1998.

Environmental Restoration (ER) and Waste Management (WM) Programmatic Environmental Impact Statement (ER/WM PEIS). Plaintiffs allege that, because of the violation, the Secretary of Energy, the Acting Assistant Secretary for Environmental Management, the Assistant Secretary for Environment, Safety, and Health, and the United States Department of Energy (DOE) are in civil and criminal contempt of this Court.

Defendants allege that they are not in violation of the 1990 Stipulation and Order. They further allege that the Secretary, the Assistant Secretaries, and DOE are not in civil or criminal contempt of this Court.

By and through undersigned counsel, the parties agree and stipulate that they are making this Joint Stipulation in good faith in an effort to avoid further litigation of Count I of Natural Resources Defense Council v. Richardson, Civ. No. 97-936 (SS), or Natural Resources Defense Council v. Watkins, Civ. No. 89-1835 (SS); without any admission by defendants that they have violated and are continuing to violate the 1990 Stipulation and Order or that they are in civil or criminal contempt; and without any concurrence by plaintiffs regarding defendants' positions. In addition, by and through undersigned counsel, the parties agree and stipulate to the following:

II. CENTRAL INTERNET DATABASE

A. Categories

DOE will establish a central database (Database), available to the public through the Internet, that will contain information in the following categories:

1. Contaminated environmental media, contaminated facilities, and waste controlled by the DOE Environmental Management (EM) Program. DOE will categorize waste and contaminated media by waste type (i.e., high-level waste, transuranic waste (including buried

transuranic waste), low-level waste, and mixed low-level waste). As to contaminated facilities, DOE will identify the facilities, and describe their use and status (operating or standby) and size (approximate square footage).

2. Contaminated facilities and waste generated by programs managed by the DOE Offices of Defense Programs (DP), Science (SC), and Nuclear Energy (NE). DOE will categorize waste and contaminated media by waste type (i.e., high-level waste, transuranic waste, low-level waste, and mixed low-level waste). As to contaminated facilities, DOE will identify the facilities, and describe their use and status (operating or standby) and size (approximate square footage).

3. DOE-managed, domestic, and foreign research reactor spent nuclear fuel, excluding spent fuel from commercial reactors.

4. Sites governed by Section 151(b) of the Nuclear Waste Policy Act (NWPA), upon the transfer of those sites to DOE ownership. As to these sites, DOE will provide the name and the location of the sites, describe the sites, and include available information provided to DOE at the time of transfer or acquired by DOE after the transfer, regarding residual contamination.

5. Sites managed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), if they have been returned to DOE for management. As to these sites, DOE will provide the name and the location of the sites, describe the sites, and include available information provided to DOE at the time of transfer or acquired by DOE after the transfer, regarding residual contamination.

B. **Types of Information**

For each of the categories listed above, DOE will provide the following types of information in the Database:

1. Location of site/radioactive material. DOE will provide the name of the DOE site (e.g., the Savannah River Site (SRS), the Pantex Plant (Pantex), the Idaho National Engineering and Environmental Laboratory (INEEL)) where the radioactive material is generated, stored, treated, or disposed.

2. Volume or mass of radioactive material. (a) As to waste, which DOE will categorize by waste type (i.e., high-level waste, transuranic waste, low-level waste, and mixed low-level waste), DOE will provide information about the annual volumes (beginning with 1998), and the future projected volumes, of waste in storage, newly generated, treated, and disposed; (b) as to contaminated environmental media, DOE will provide the estimated volume of the media; (c) as to spent nuclear fuel, DOE will provide the mass of spent nuclear fuel in storage and the annual new receipts of spent nuclear fuel; (d) as to contaminated facilities, DOE will provide the approximate square footage of the facility, and identify whether the contamination is radioactive, chemical, or both.

3. Chemical constituents. As to waste and contaminated environmental media, DOE will identify the major chemical constituents of concern from a regulatory or programmatic perspective.

4. Radioactivity of materials. As to waste, contaminated environmental media, and spent nuclear fuel, DOE will identify the major radionuclides of concern from a regulatory or programmatic perspective, and it will provide the total estimated curie content.

5. Generator of waste or contaminated materials. DOE will provide information about the generator of waste, contaminated media, or spent nuclear fuel, by the DOE site (e.g., SRS, Pantex, INEEL) and the major program (i.e., the DOE EM, DP, SC, and NE Offices) that is

responsible for its generation, to the extent such information is collected by DOE.

6. Waste disposition plans and waste transfers. As to each waste type, DOE will provide information about the waste disposition path in terms of storage, treatment, and disposal, including site locations, to the extent that such information is collected by DOE. As to waste transfers between DOE sites or to commercial facilities, DOE will identify the shipping and receiving sites, and the annual volume of transferred waste (by waste type).

C. Database Availability and Reporting Capability

DOE will make the Database available to the public on the Internet, through a Web-based reporting tool which will provide the capability to generate standard reports and perform searches and queries. DOE will develop the definition of user requirements for the reporting tool in consultation with stakeholders. DOE will provide reports, in hard copy, that are derived from the Database to organizations that work on issues relating to DOE's environmental management activities, that do not have computer access to the Database, and that make reasonable written requests to the DOE point-of-contact (see Section II.G.1 of this Joint Stipulation) for specific information from the Database.

D. General Provisions Regarding the Database

DOE will premise the development, operation and maintenance of the Database on the following:

1. DOE will include in the Database only data (a) that is presently available and collected by DOE on a national level, or (b) that is presently planned to be collected in the future by DOE on a national level.

2. The level and degree of detail of the data that DOE will provide in the Database for

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United States Department of Energy
Office of the General Counsel
Washington, D.C. 20585

Attorneys for Defendants

[PROPOSED] ORDER

SO ORDERED.

Date: _____

_____
HON. STANLEY SPORKIN
United States District Judge

The following counsel should be notified of the entry of this Order:

David E. Adelman
Natural Resources Defense Council
1200 New York Avenue, N.W., Suite 400
Washington, D.C. 20005

Howard M. Crystal
Eric R. Glitzenstein
Meyer & Glitzenstein
1601 Connecticut Ave., N.W., #700
Washington, D.C. 20009-1035

SIGNED ~ 11:30 am
MONDAY
DECEMBER 14, 1998

DOE NEWS

NEWS MEDIA CONTACT:
Anne Elliott (202) 586-5806

FOR IMMEDIATE RELEASE
December 14, 1998

ENERGY DEPARTMENT SETTLES LAWSUIT WITH ENVIRONMENTAL GROUPS

Settlement Creates New Tools For Public Participation In Cleanup Process

The U.S. Department of Energy (DOE) and the Natural Resources Defense Council, Inc. (NRDC) today announced a settlement of a lawsuit that would avoid further litigation and result in the creation of several new tools to enhance public understanding of the multi-billion dollar cleanup of the former nuclear weapons complex. The settlement was submitted Saturday to United States District Court Judge Stanley Sporkin in Washington for approval. Judge Sporkin signed the settlement in open court this morning.

"We are proud of this settlement and believe that the settlement represents a victory for the public and for the environment. Instead of litigating, the Department of Energy, NRDC and the other environmental groups who were participants in the lawsuit have agreed to work together to improve the availability of information about DOE's environmental management program through the Internet, and to support independent scientific and technical analysis for stakeholders," said Mary Anne Sullivan, Department of Energy General Counsel. "The settlement reflects this Administration's commitment to find creative approaches to settling lawsuits in ways that can serve a broad public good."

In 1997, NRDC, acting on behalf of itself and 38 non-governmental groups, filed suit against the Department of Energy and several DOE officials, alleging that the DOE violated a 1990 consent order by failing to prepare a Programmatic Environmental Impact Statement for the department's environmental restoration program, and that this constituted contempt of court. Under the terms of today's agreement, the organizations would drop their claims concerning the 1990 consent order, as well as the contempt allegations.

- MORE -

R-98-188

The settlement has three major features:

- DOE will establish a central information database, available to the public through the Internet, containing information on radioactive and non-radioactive waste and contaminated facilities at DOE sites. The information to be included in the database will come from the department's Offices of Environmental Management, Defense Programs, Science, and Nuclear Energy. Through a series of public forums DOE will work with NRDC and others to enhance the usefulness of the database and to explore the establishment of Internet links to other DOE databases.

- DOE will establish a $6.25 million fund to assist citizens' groups and tribes in conducting technical and scientific reviews of environmental management activities at DOE sites. The resulting technical reports will be made available to any interested member of the public.

- DOE will prepare and invite public comment on a study on long-term stewardship, that is, the surveillance and maintenance activities that will occur at DOE sites following cleanup.

"Our hope is that the database will be an effective tool for the department and the public as we work together to clean up environmental contamination at our sites. I am particularly pleased that four of DOE's major programs will be working together to make this database a success, and I look forward to working with NRDC and others to improve the database's usefulness,"added Jim Owendoff, Acting Assistant Secretary for Environmental Management.

-DOE -

R-98-188

Dec. J. Coghlan Exhibit 3

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEW MEXICO

LOS ALAMOS STUDY GROUP and CONCERNED CITIZENS FOR NUCLEAR SAFETY,

Plaintiffs,

v.

HAZEL O'LEARY, Secretary of Energy, and DEPARTMENT OF ENERGY,

Defendants.

No. 94-1306-M Civil

MEMORANDUM OPINION AND ORDER

This matter comes on for consideration on Plaintiffs' Motion for Declaratory Relief and Preliminary Injunction. Having considered the motion and responses and being otherwise fully advised in the premises, I find that plaintiffs's motion for preliminary injunction is well taken and is hereby granted, and that consideration of plaintiffs' motion for declaratory judgment will be deferred until a trial on the merits.

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NEPA requires an agency to make decisions which are "fully informed and well-considered." Vermont Yankee Nuclear Power Corp. v. Nat'l Re. Defense Council, Inc., 435 U.S. 519, 558 (1978), cited in Sierra Club v. U.S. forest Service, 843 F.2d 1990, 1192 (9th Cir. 1988). Plaintiffs have shown that the insufficiently detailed discussion of DARHT's environmental impacts leaves remaining deficiencies in DOE's analyses and increases the risk of environmental harm. This risk is the very harm NEPA tries to avert, and establishes that irreparable harm is sufficiently likely.

C. Balance of Hardships

Defendants assert that any harm plaintiffs may suffer does not outweigh the harm an injunction would cause in terms of national security and financial cost.

Harm to national security

DOE emphasizes the role of DARHT in the "stockpile stewardship program," in the development of alternative capabilities for ensuring that existing nuclear weapons remain safe, secure and reliable. Id. Although there is no national defense exception to NEPA compliance, it is a factor the court may weigh when considering equitable relief. State of Wisconsin v. Weinberger, 745 F.2d 412, 425 (7th Cir. 1984).

I find that the delay associated with completing an EIS will not endanger national security to a degree that would prevent the dispensing of injunctive relief. The cases relied on by defendants to discourage judicial appraisals of situations where national security is concerned are not helpful to an analysis of the present situation. These cases involved imminent danger to national security, NEPA violations that were minor and more formalistic, or the administration of military affairs. Comm. for Nuclear

Responsibility, Inc. v. Seaborg, 463 F.2d 796 (D.C. Cir. 1971) (delay in detonation of nuclear device posed risk of mechanical or technical failure); Concerned about Trident v. Rumsfeld, 555 F.2d 817 (D.C. Cir. 1977) (where Navy had completed several EAs and an EIS, but failed to adequately assess one of the chosen sites as alternative); Chappel v. Wallace, 462 U.S. 296 (1983) (enlisted personnel seeking damages from superior officer for constitutional violation).

Ample evidence points to the fact that the existing nuclear stockpile is, at this time, safe and reliable. See, Hearings on the House Subcomm. for Energy and Water Development Appropriations, 103rd Cong., 2nd Sess. 736 (1994) (statement of Dr. Harold Smith, Ass't to the Sec'y of Defense for Atomic Energy). Suspending DARHT construction will have no effect on the PHERMEX system which is an operating hydrotest facility currently supplying diagnostic information for the stockpile stewardship program. Although completing an EIS will delay moving the program into full operation, DOE has not presented the court with enough evidence amounting to a reason to fear that the delay has threatened or will threaten national security by endangering plans for the Comprehensive Test Ban Treaty. There is also no reason to believe that a delay resulting from a NEPA review will result in a loss of intellectual resources, as defendants allege. As plaintiffs point out, scientists considering retirement in the interim during which DOE is completing the EIS can either opt to delay retirement or work after retirement as consultants.

Because compliance with NEPA is an obligation an agency is assumed to be aware of, delay associated with preparing an EIS cannot be considered an unforeseen

setback. Protect Key West, 795 F.Supp. at 1563 (delays for environmental assessment "should [be] built into the project schedule originally"). In fact, in October 1994, DOE figured in a six-month delay in construction for NEPA review purposes to take place from November 1994 to May 1995. Pltfs.' Mem. Brief, Ex. 11. Other delays have been part of DARHT history, for example, the four-year delay between the first two stages (the radiographic support lab and the groundbreaking for the hydrotest firing site). See Tr. of Proceedings at 45. DOE is in the best position to expedite the completion of the EIS, having done some preliminary environmental analyses.

Effect of delay on economic harm

Considerable cost is involved whether construction proceeds but an alternative other than full operation is selected, or is suspended until DOE finished the EIS. Approximately $19 million would be spent over the next year if construction continues while the EIS is being done.

Defendants claim an approximate $12 million cost in a year's delay which includes elements of design, management, construction and restarting costs. Burns Decl., ¶ 9; Programmatic Cost Impact Due to Project Delay for EIS, Pltfs.' Reply, Ex. 22 & Defts.' Ex. A. This figure, however, may be inflated for several reasons. See Weida Aff., Pltfs.' Reply, Ex. 23. First, defendants' estimates reflect some costs which are were committed as a project expense, unrelated to the delay itself, for example, machine upgrades and maintenance. Id., ¶ 6(f). Second, some items should not have been included at all. The projected $1.5 million cost of an EIS preparation

for DARHT is a legal obligation of the agency and cannot be assessed as a cost of delay. Id., ¶ 6(e). DOE included an escalated cost of the DARHT second axis, when Congress has not yet authorized or funded this item. Id., ¶ 6(h). Also, defendants' estimate does not include any offsets intrinsic to a delay, and at the same time, incorporates a generous 15% contingency fee. Id., ¶ 6(d)(g).

The fact that construction of the housing facility is almost one-quarter complete and the procurement stage well on its way to being half done, is not enough of a reason in itself to support a denial of an injunction. See Foundation on Economic Trends v. Weinberger, 610 F.Supp. 829, 943 (D.C.D.C. 1985) (courts have enjoined ongoing projects to preserve full opportunity to choose among alternatives); Richland Park Homeowners Ass'n, Inc., 671 F.2d 935, 942 (project which has proceeded to advanced stage of completion may be enjoined if NEPA violations are blatant and public interest not irreparably harmed).

I find that the balance of harms favors the plaintiffs. A comparatively short delay for the purpose of ensuring that environmental consequences have been properly assessed does not create a state of urgency constituting a threat to national security. The exigency in getting a dual-axis machine in place does justify a shortcut around the NEPA mandate, particularly when DARHT operations are not scheduled to begin until the year 2000. Any economic harm is not such that it outweighs the environmental harm which is likely to ensue without adequate NEPA-based evaluation. My findings do not in any way diminish the importance of the DARHT project, but rather underscore the critical nature of the NEPA objective.

D. Public Interest

Consideration of public interest weighs against the defendants. DOE's pledge to enlist public participation during forthcoming EIS preparations is especially meaningful considering the lack of public disclosure associated with the DARHT proposal. Public interest "of the highest order" is served by "having government officials act in accordance with the law." Public Service, 825 F.Supp. at 1509. In this situation, failure of officials to carry out the NEPA directive could have repercussions damaging to the health and safety of the public. Therefore, issuance of an injunction would not be adverse to the public interest.

IV. Attorney's Fees

Plaintiffs request a reimbursement for costs, expenses, expert witness fees, and attorney's fees pursuant to the Equal Access to Justice Act, 28 U.S.C. § 2412(d)(1)(A). I defer decision on this matter to the time when the merits of the case are tried.

CONCLUSION

I find that this court has equitable jurisdiction based on a showing of irreparable injury by plaintiffs as well as a lack of adequate legal remedy. Plaintiffs would likely succeed at trial in their claim that DOE's actions concerning the DARHT facility violated the National Environmental Policy Act, 42 U.S.C. § 4321 - § 4361. Plaintiffs' risk of environmental harms flowing from such violation outweighs any harm to defendants in terms of a project delay pending DOE's completion of an EIS. Lastly, a

consideration of the public interest supports my finding that the imposition of an injunction favoring plaintiffs is appropriate.

Fed.R.Civ.P. 65(c) requires a giving of security by the plaintiffs, in an amount the district court may deem proper. See also State of Kansas ex. rel. Stephan, v. Adams, **705 F.2d 1267, 1269 (10th Cir. 1983).** Posting a substantial bond on non-profit environmental groups might chill the private mechanisms of enforcement NEPA has traditionally encouraged. See Natural Resource Defense Council v. Morton, **337 F.Supp. 167, 169 (D.C.D.C. 1971);** Wilderness Soc'y v. Tyrrel, **701 F.Supp. 1473, 1492 (E.D. Cal. 1988),** rev'd on other grounds, **918 F.2d 813 (9th Cir. 1990).** I therefore require that the plaintiffs post a nominal bond for security in the amount of $100.00.

A Decree of Injunction will be issued contemporaneously with this Memorandum Opinion and Order.

IT IS SO ORDERED.

SENIOR UNITED STATES DISTRICT JUDGE

Dec. J. Coghlan Exhibit 4

DOE/CF-0202
Volume 1

Department of Energy
FY 2025 Congressional Justification

National Nuclear Security Administration

Federal Salaries and Expenses
Weapons Activities
Defense Nuclear Nonproliferation
Naval Reactors

30 Base Equipment Installation (30B) Subproject (21-D-512-02)
Pit production enclosures and programmatic equipment procurement and installation to support pit production capacity of a base of 30 ppy at 50 percent confidence. The scope encompasses designing, procuring, installing, testing, transitioning to operations (TTO), and hot startup of new gloveboxes and associated equipment in PF-4. To support reduced project and program risk, long-lead procurement and fabrication of enclosures and process equipment was approved on January 3, 2022, with a cost of $72M, and is expected to be complete in June 2024. Additional long lead procurement and site preparation was approved on August 5, 2022, with a cost of $43M, and is expected to be complete in June 2024. Advanced procurement of the long-lead equipment integrates with the approval of CD-2/3 on January 19, 2023, enabling installation to proceed immediately after the approval of the performance baseline. Installation of the long-lead procurement will proceed as the remainder of the 30B enclosures and equipment are fabricated. This tailored approach minimizes impacts to program operations and increases construction efficiencies. Additionally, temporary 80,000 sq ft of warehouse space will be provided for the pre-staging of equipment for setup, testing, and assembly, prior to final installation.

30 Reliable Equipment Installation (30R) Subproject (21-D-512-03)
Pit production enclosures and programmatic equipment procurement and installation to support pit production capacity of 30 ppy reliably. The scope encompasses designing, procuring, installing, testing, transitioning to operations (TTO), and hot startup of new gloveboxes and associated equipment in PF-4 and the Sigma facility. The 30R subproject expands the capability and capacity to provide 30 war reserve pits per year to the stockpile at a 90% confidence using a single shift. To support reduced project and program risk, long-lead procurement and fabrication of enclosures and process equipment was approved on March 29, 2023, with a cost of $99M, and is expected to be complete in FY 2025. Advanced procurement of the long-lead equipment integrates with the anticipated approval of CD-2/3 in December of 2024, enabling installation to proceed immediately after the approval of the performance baseline. Installation of the long-lead procurement will proceed as the remainder of the 30R enclosures and equipment are fabricated. This tailored approach minimizes impacts to program operations and increases construction efficiencies.

Training and Development Center (TDC) Subproject (21-D-512-04)
The Training capability will ensure that production personnel can effectively receive approximately 700,000 required annual staff training hours for initial and annual training, including certification to fully satisfy skill and qualification requirements. The Development capability will support the enduring pit production mission by providing facilities and space for process improvement and development in a non-nuclear environment. The two nonnuclear capabilities require 75,000 net square feet and are briefly summarized below. Design activities are underway and CD-2/3 approval followed by final design completion is anticipated in Q4 FY2026.

- Nuclear worker training laboratories for glovebox operator and fissile material handler fundamentals training and process worker requalification training. The requalification training laboratories will have a dual purpose to also support production process and technology development activities.
- Unclassified Training areas including classrooms, computer-based training rooms, a training records management center and training staff office space.
- Classified Training areas including classrooms, conference rooms, auditorium/lecture hall, classified records management and storage, facility control system simulation area, cold machine shop, a glovebox equipment pre-installation testing area, and a classified parts vault-type room.

West Entry Control Facility (WECF) Subproject (21-D-512-05)
The TA-55 WECF is required to accommodate the additional 800 workers per day entering the property protection area at TA-55 projected to implement the 30 ppy mission. This projected increase effectively doubles the workforce entrance control processing demand. The new WECF, like the existing East ECF, must be a DOE-compliant personnel screening facility which maintains integrity of the protected area at TA-55 to enable safe and secure environment for manufacturing operations and support the required 24/7 schedule. To support reduced project and program risk, long-lead procurement was approved on December 15, 2023, with a cost of $28M. Design activities are underway and final design completion is anticipated in Q3 FY2024. CD-2/3 approval is anticipated in Q4 FY2024.

Justification
The NNSA's ability to produce pits in the required quantities established by the Nuclear Weapons Council (NWC) is an essential component of the nuclear deterrent. An Analysis of Alternatives (AoA) was conducted after CD-0, in accordance with the requirements of Office of Management and Budget (OMB) Circular A-11. The NNSA Administrator selected a

EXHIBIT 5

UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF SOUTH CAROLINA

AIKEN DIVISION

SAVANNAH RIVER SITE WATCH, TOM CLEMENTS, THE GULLAH/GEECHEE SEA ISLAND COALITION, NUCLEAR WATCH NEW MEXICO, and TRI-VALLEY COMMUNITIES AGAINST A RADIOACTIVE ENVIRONMENT, Plaintiffs, v. UNITED STATES DEPARTMENT OF ENERGY, JENNIFER GRANHOLM, *in her official capacity as the Secretary*, NATIONAL NUCLEAR SECURITY ADMINISTRATION, and JILL HRUBY, *in her official capacity as Administrator*, Defendants.	No. 1:21-cv-01942-MGL **DECLARATION OF DYLAN K. SPAULDING, Ph.D. IN SUPPORT OF PLAINTIFFS' POSITION REGARDING REMEDIES**

I, Dylan K. Spaulding, Ph.D., make the following Declaration pursuant to the provisions of 28 U.S.C. § 1746 which is based upon my personal knowledge:

1. I am a Senior Scientist in the Global Security Program at the Union of Concerned Scientists and have been studying the issue of plutonium pit production in preparation for a technical report on the subject that will appear in early 2025. My technical background is in high-pressure/high-temperature materials science and shock physics relevant to nuclear stockpile stewardship and nuclear testing. I have experience as a graduate student, visiting researcher, and postdoctoral fellow at Sandia, Los Alamos, and Lawrence Livermore National Labs as well as the French Commissariat à l'Énergie Atomique. I hold a bachelor's degree in physics from Brown University and a PhD in Earth and Planetary Science with an emphasis on high energy density physics from UC Berkeley. At the Union of Concerned Scientists, my work focuses on technical issues related to US nuclear modernization, nuclear testing, and exploring measures to reduce the threat posed by nuclear weapons worldwide.

2. On the basis of my research into NNSA's efforts to expand pit production capabilities, a programmatic environmental impact review is necessary to assess the overall effects of plutonium pit production. The program that is being undertaken involves work that is "connected, cumulative, or similar" across many Department of Energy sites, meeting the requirement for a programmatic assessment rather than individual, site-specific analyses under NEPA (Hart and Tsang 2020; American Bird v. Fed. Communications 2008).

3. In addition to Los Alamos National Laboratory (LANL) and the Savannah River Site (SRS) where production may occur, other sites including the Pantex Plant (near Amarillo, TX), the Kansas City National Security Campus (Kansas City, MO), the Waste Isolation Pilot Plant (WIPP, Carlsbad, NM), and Lawrence Livermore National Laboratory (Livermore, CA) all play some role in pit production, necessitating transportation of material; potential addition of infrastructure; and management, transportation, and disposition of radioactive waste from multiple locations across the country.

4. Currently, LANL relies primarily on revisions to a 2008 Supplemental PEIS (the "Complex Transformation SPEIS") that did not explicitly consider the two-site approach that was being pursued. Moreover, LANL still relies upon a 2008 Site-Wide Environmental Impact Statement (SWEIS) "tiered" off the Complex Transformation SPEIS.[1] Since 2008, the track record of safety at the relevant site at Los Alamos has proven to be poor and severe accidents have led to multi-year shutdowns at both LANL and WIPP in 2013 and 2014, respectively.

5. Although the PF-4 facility at LANL where pit production is taking place has undergone extensive renovation, it remains a challenging facility in which to accommodate the type of industrial and nuclear safety that would likely be included in a new facility built for the same purpose. The independent Defense Nuclear Facilities Safety Board has challenged LANL's engineered safety systems that would serve to minimize release of radioactive material in the event of a significant accident (Connery 2022), as well as how LANL calculates the amount of radioactive material that could escape the facility (Randby et al. 2019; Connery 2022). Such measures are fundamental for protecting the public and yet pit production has already begun with what appear to be exceptions to best practices for nuclear facility operation. In some cases, LANL has invoked "exigent circumstances" at the plutonium facility to allow operations for which there is apparently no means of mitigating harmful offsite exposure within normal DOE guidelines in the event of a

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[1] Note that NNSA published a Notice of Intent to complete a new LANL SWEIS in August, 2022 at which time the Union of Concerned Scientists submitted a public comment. The NNSA has apparently not released a new draft since then, despite NEPA requirements which normally stipulate completion within 2 years. (*§1501.10 Deadlines and Schedule for the NEPA Process*, https://www.ecfr.gov/current/title-40/chapter-V/subchapter-A/part-1501/section-1501.10)

severe accident (Boussouf, Gutowski, and Plaue 2022). In a public hearing, NNSA did not commit to avoiding the use of "exigent circumstances" in the future in the context of pit production, suggesting that regulatory limits for potential exposure of the public may be bypassed for the sake of expediency ("Defense Nuclear Facilities Safety Board Public Hearing on Los Alamos National Laboratory National Security Missions and Nuclear Safety Posture" 2022).

6. Current practices for plutonium pit production do not compare to the extremely harmful practices carried out at the Rocky Flats Plant near Denver, Colorado, which was forced to abruptly shut down due to egregious violations of environmental law. Communities surrounding Los Alamos and the Savannah River Site are keenly aware of the ongoing legacy of environmental contamination from activities that took place decades ago, including plutonium in soil and water. Much of this contamination remains unremediated and there is significant public concern over the relative emphasis between environmental remediation and new activities related to weapons programs, including pit production. This disparity is reflected in the respective budgets. The federal budget requests in FY 2025 for environmental management were 15.3% and 10.6% *below* FY 2023 levels at Los Alamos and Savannah River, respectively, while the NNSA saw a 16% *increase* in its weapons activities budget over the same period. Legacy waste cleanup at Los Alamos represents roughly 5% of the laboratory's FY 2025 funding while pit production will consume roughly 40% of a record $5B annual budget ("DOE Budget in Brief - FY 2025 Congressional Justification" 2024).

7. Properly executed environmental impact statements provide one of the only means of public accountability for the national laboratories. A comprehensive programmatic environmental impact statement is the best step that NNSA can take to demonstrate that it takes public protection and participation seriously, that cumulative effects of pit production are appropriately considered, that hazards are appropriately mitigated across all sites involved, that multiple alternatives are conceived of and assessed, and that the agency fully complies with the long-established National Environmental Policy Act.

8. Respondents may contend that any delays in plutonium pit production that result from an injunction could be deleterious for national security concerns because of potential disruption to the needs of the stockpile. It is critical to state, however, that new plutonium pit production *does not support the current stockpile* and is not required for the near-term maintenance of any of the ~3,700 US warheads that are deployed or in strategic reserve.

9. Instead, the resumption of plutonium pit production is to support the production of two future nuclear warheads: the W87-1 intercontinental ballistic missile (ICBM) warhead and the W93 submarine-launched warhead. These will be the first newly designed and newly produced warheads to enter the US stockpile since the Cold War. In contrast, warheads that are currently deployed (all of which were developed prior to 1990) have been subject to periodic maintenance and "life-extension" programs informed by a

science-based initiative referred to as the Stockpile Stewardship Program (SSP). The existing stockpile can continue to be maintained into the next decade or beyond using the same approach with any delays in pit production affecting only the two new designs, neither of which will be deployed until the mid-2030's under the most optimistic scenarios. Most designs in the stockpile have undergone such refurbishment relatively recently (with one exception, the W78) and further life-extension of existing weapons should be feasible without manufacture of new plutonium pits based on their current age and anticipated period of deployment for some time to come during which a PEIS may be prepared and completed.

10. Finally, a slower and more careful approach is also the safest path forward. The NNSA is currently responsible for meeting a congressional mandate to produce 80 pits/year by 2030 – a goal that will not be met by its own admission. Instead, NNSA is seeking to meet the mandate "as close to 2030 as possible," resulting in round-the-clock work at Los Alamos to produce the first pits while construction and installation of equipment is still underway. (Department of Energy FY 2025 Congressional Justification: National Nuclear Security Administration, 2024) This artificial mandate is not conducive to worker safety, accident avoidance, nor cost savings.

11. Radiation-induced damage in plutonium is often discussed in the context of renewed pit production because changes occur in the material at the atomic level and accumulate with time due to natural radioactive decay. Accurate determination of the mechanisms and rate of deterioration in plutonium is therefore critical for determining the urgency of re-establishing pit production capabilities should this degradation affect the existing stockpile.

12. A notable independent assessment of plutonium aging was carried out by the government advisory group, the JASONs in 2006 (Hemley 2006) and revisited in 2019 (Adams 2019). The 2006 study concluded that the probable lifespan of plutonium within the primary stage of nuclear weapons was ~85-100 years. The more recent study cited a lack of emphasis on plutonium aging at the national laboratories over the intervening years but recommended re-establishing pit production "as expeditiously as possible". My own assessment, conducted on behalf of the Union of Concerned Scientists and based on unclassified literature, agrees with the 2006 assessment in that there is no apparent evidence of any sort of run-away degradation, including evidence from samples that have been artificially aged at accelerated rates to simulate longer timeframes. In fact, some studies provide evidence that plutonium is self-healing to some degree and even unexpectedly stable over long periods of time. Plutonium pits in the current stockpile were produced between 1978 and 1989, meaning they range in age from ~35-46 years old as of 2024.

13. There is an important distinction between plutonium aging and other possible aging issues that could result in shorter lifespans for certain designs in the nuclear stockpile.

However, it appears unlikely that plutonium is the life-limiting component within nuclear weapons. Chemical incompatibility (e.g., corrosion) or other forms of deterioration may occur elsewhere in the nuclear part of the weapon in a manner that results in a lifespan of less than 85-100 years for the primary stage but there are likely alternate ways of remediating such effects for designs in which the plutonium can be separated from surrounding components. This does not require purification and casting of new pits, which is central to NNSA's current plans.

14. To the best of my knowledge and based upon my experience and research, plutonium aging is *not* an urgent driver for pit production and will not affect the current stockpile in the immediate future during which a programmatic environmental impact statement could be prepared and completed.

15. Furthermore, as stated above, newly produced pits are not for the existing stockpile and therefore any delay incurred because of a programmatic environmental impact statement does not affect the United States' ability to deploy its existing weapons nor does it preclude increasing the number of deployed weapons from the strategic reserve.

16. The re-use of thousands of existing plutonium pits from disassembled weapons should be analyzed as a possible alternative to NNSA's current plans as part of any future programmatic environmental impact survey.

17. During the Cold War, the United States produced tens of thousands of weapons, although we currently maintain only 3,748 (Kristensen 2024). Pits from disassembled weapons are stored at the Pantex Plant near Amarillo, TX. Pantex is authorized to store up to 20,000 plutonium pits and is believed to have ~15,000 in storage today, 4,000-5,000 of which are held in strategic reserve. These pits can and should be considered for use in place of new pit production as, in most cases, their age is not yet a reason to exclude them. The condition of the reserve pits is unknown and has been called into question due to the possibility of negligent storage conditions and packaging (Connery 2021) which is further reason for a thorough assessment of U.S. strategic assets given the enormity of the cost (both economic and environmental) and effort required to remanufacture them.

18. To my knowledge, NNSA did not completely analyze options and viability for pit re-use as an alternative to the 80 pit/year production schedule it is currently striving to meet. Nor does it appear that it has conducted a thorough inventory of the number and condition of reserve pits which would have a significant bearing on the required production rate, and hence environmental impact, at both Los Alamos and the Savannah River Site, as well as other sites which would necessarily be relied upon in the pit production enterprise.

19. NNSA administrator Jill Hruby has testified that some number (potentially up to half) of W93 warheads would employ reused pits (Hruby 2024a), suggesting not only the

feasibility but also the compatibility of reserve pits with Defense Department demands for the W93 warhead. Furthermore, NNSA has suggested that responsibility for pit production for the W93 would lie solely with Savannah River (Hruby 2024b). This division of labor was not originally specified when the two-site plan was proposed, nor am I aware of any discussion of reusing existing pits to alleviate pressure on pit production in the main process building at SRS. This also calls into question NNSA's consideration of the timing, scope, and basic necessity for pit production at the Savannah River Site which should be thoroughly vetted in any PEIS analysis, including whether a single site can meet the actual demand. Production of up to 450 pits/year was previously considered feasible at Los Alamos alone, but these earlier proposals were abandoned.

20. It is possible that some options for pit re-use, whether direct or following 'invasive' refurbishment, could be completed within the infrastructure that Los Alamos has already upgraded and developed and therefore the possibility of a single pit production site may still be viable to meet national security requirements, which would drastically change the impacts of the program in the context of a PEIS.

21. As such, I recommend that an analysis of alternatives as part of a programmatic environmental impact statement include thorough consideration of options for reuse, including quantifying the existing pit inventory at the Pantex Plant along with the physical condition of that inventory in order to justify the scope of NNSA's current plans.

22. I have attached as Exhibit "A" a manuscript titled "Human and Environmental Impacts of Pit Production," authored by myself and soon to be published by the Union of Concerned Scientists. Exhibit A provides a thorough analysis of both past and present environmental considerations relevant to renewed pit production at Los Alamos and Savannah River. This includes further details about NNSA's reliance on site-specific environmental impact surveys as well as issues that should be considered in the context of future re-evaluation to ensure worker and public safety. It is incorporated herein by reference.

23. I have attached as Exhibit "B" a list of sources upon which I have relied in offering the statements contained herein and it is incorporated herein by reference.

I declare under penalty of perjury, pursuant to 28 U.S.C. § 1746, that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 11TH day of November, 2024.

DYLAN K. SPAULDING

Dylan K. Spaulding, Ph.D.

Dec. D. Spaulding Exhibit A

References:

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Dec. D. Spaulding Exhibit B

Human and Environmental Impacts of Pit Production

Dylan Spaulding
Senior scientist, Global Security Program, Union of Concerned Scientists

"We're still cleaning up the legacy mess that we made by working the way we did." – Robert Webster, Los Alamos Deputy Director for Weapons in Time Magazine, July, 2023

"If there is no "after" to nuclear contamination, and no place on Earth beyond its reach, what does it mean to remediate this space?" – Shannon Cram, from Becoming Jane: The making and unmaking of Hanford's nuclear body, 2015

Introduction

The impacts of renewed plutonium pit production as well as manufacture of new warheads have implications far beyond the fences of the national labs and production sites where the work will take place. Undertakings of such magnitude reverberate throughout local areas in myriad ways, often as invisible costs borne by workers and communities in the form of environmental, economic, and health impacts that may outlast the program with which they are associated.

While practices for handling plutonium have changed with time, the harmful aftermath of past plutonium work still haunts nearly every site that was previously involved in such work while the present-day risks remain poorly understood or overlooked outside of the national laboratories. Today, the national laboratories apply improved practices to minimize human risk but humans ultimately remain fallible and where there are severe hazards there are also severe risks.

This work calls attention to the human context surrounding renewed pit production in hopes of highlighting the critical role of protective measures, adequate and inclusive environmental analyses, and sound engineering and work practices for protecting people. The historical context of the production sites at Los Alamos and Savannah River carries relevance that should not be overlooked as frontline communities have historically suffered from the inadequacy of such measures in the past, leading to a legacy of contamination and health effects still felt today.

To understand the potential risks, we must understand the populations who face the highest danger, the health effects and mobility of plutonium, methods of mitigation, as well as the broader social and economic impacts that surrounding communities can expect from the proposed activity.

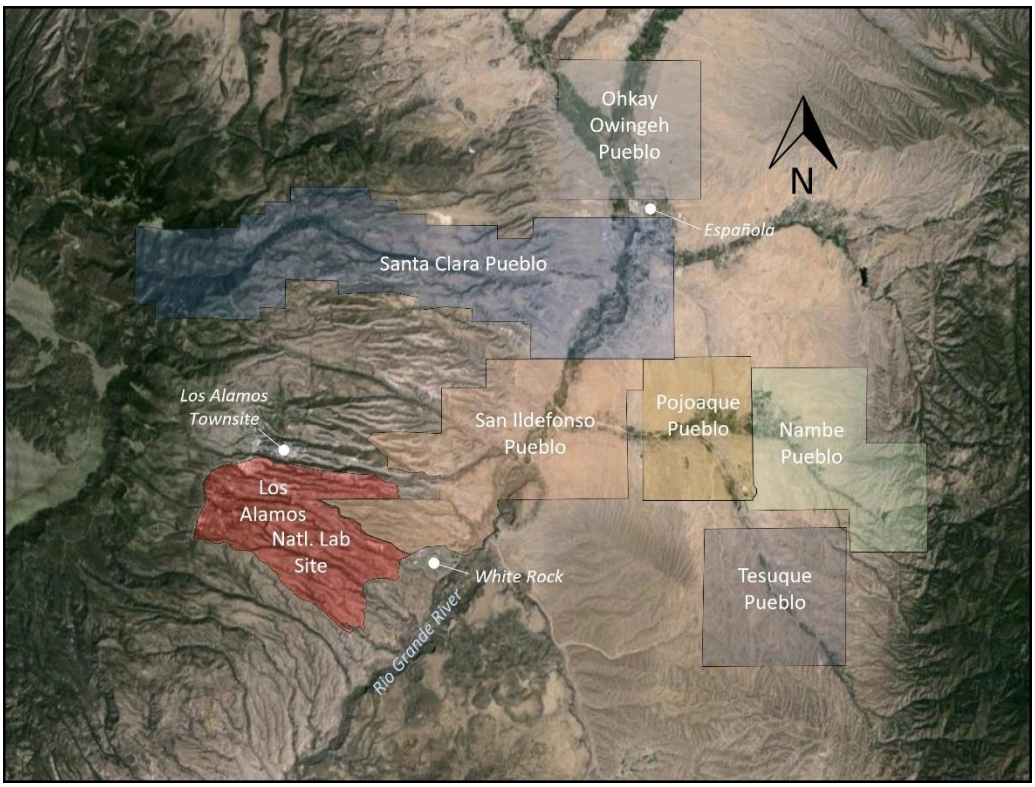
The Legacy of Cold War Plutonium: Environmental and Human Costs

The two proposed sites for resumed pit production are vastly different from one another, geographically, culturally, and demographically. As a result, the impacts on neighboring communities, infrastructure, and workforce are site-specific and wide-ranging.

LOS ALAMOS, NM

Los Alamos National Lab (LANL) is located in north-central New Mexico, approximately 25 miles to the north-west of Sante Fe and consists of numerous 'technical areas' that span roughly 40 square miles and include 900 individual facilities (LANL 2024). The lab is perched on the side of the Jemez caldera and built atop the volcanic Pajarito plateau, cut by deep canyons containing seasonal streams that drain to the Rio Grande River.

Figure 1 Geographic Context for Los Alamos National Laboratory



Los Alamos (highlighted in red) is surrounded by the federally-recognized Pueblos of Po-Woh-Geh-Owingeh (San Ildefonso) and Kah'p'oo Owingeh (Santa Clara). The community of White Rock (pop. 5,800) houses many lab employees, as does Espanola (pop. 10,500), to the north. Source: Google Earth.
SOURCE(S): Modified from Google Earth, 2024 (Spaulding/UCS)

The laboratory and town of Los Alamos comprise their own county (incorporated in 1949) consisting predominantly of federally-owned land. Perched on mesa-tops, the unique geography limits municipal expansion and, today, only about 35% of the lab's workforce lives in Los Alamos County. Some 990,000 people live within 60 miles of the lab and approximately 65%

of the workforce commutes from surrounding communities in Rio Arriba, Sante Fe, and Sandoval counties (Connery, Roscetti, and Summers 2023).

Demographically and culturally, Los Alamos county is exceptional compared to its surroundings. It is the most affluent county in the state of NM with a median income more than twice that of its neighbors (C. Clark 2023; Lerner 2017)). This is in stark contrast to neighboring Rio Arriba county which remains one of the poorest, with a poverty level twice the national average (US Census Bureau 2022). The median household incomes in Los Alamos and neighboring Rio Arriba counties are $135,801 and $52,031, respectively ("U.S. Census Bureau" 2024). Unlike most of the communities in and around the northern Rio Grande Valley, the population of Los Alamos is comprised mainly of non-Hispanic whites while Hispanic and Native American populations otherwise represent a cumulative majority statewide (US Census Bureau 2021).

Ostensibly chosen during World War II for its remote nature, Los Alamos is in fact built upon land continuously inhabited by the Tewa tribes, Po-Woh-Geh-Owingeh (San Ildefonso) and Kah′p′oo Owingeh (Santa Clara) for more than one thousand years prior to Spanish colonization of New Mexico. These Pueblo communities are amongst the longest continuously inhabited communities in the United States. Today, Los Alamos shares it's eastern boundary with the Pueblo of Po-Woh-Geh-Owingeh and the community of White Rock, while the remaining perimeter abuts national forest or national monument land.

THE ENVIRONMENTAL LEGACY OF HISTORICAL ACTIVITY AT LOS ALAMOS

Research activities at LANL have historically left a heavy environmental and health burden on the region. The initial rush to complete the Manhattan Project (1942-1945), coupled with a relative ignorance of some of the health and safety risks associated with newly-produced fissile materials resulted in work practices that would be considered exceedingly reckless by today's standards. In the post-war years and into the 1950's, technology to monitor human and environmental exposure was relatively undeveloped and was used sporadically when it was available. Even as risks of radioactivity and associated health effects became better understood, work practices lead to many laboratory staff being exposed to radionuclides and other noxious chemicals, either through direct handling or accidental overexposure.

Direct releases of hazardous materials to the environment were also common practice prior to the enactment of environmental regulations such as the Clean Air Act (1963) and the Clean Water Act (1972). Throughout the 1940's and 1950's, radioactive waste was often disposed of in canyons surrounding the research sites and airborne and waterborne releases were largely uncontrolled, resulting in direct environmental contamination and spread of contaminants to neighboring communities.

The degree to which hazardous substances, including radioactive materials, were released from LANL is not fully known either because of the lack of monitoring or absence of early record-keeping, particularly during the Manhattan Project and post-war years. An extensive study was conducted on behalf of the Centers for Disease Control (CDC) to gather historical records from LANL and document or reconstruct past releases of radionuclides and chemicals from the lab's inception through the 1990's. The project was referred to as the "Los Alamos Historical Document Retrieval and Assessment" project, or "LAHDRA" report and it provided revised estimates of laboratory effluents (Widner 2010).

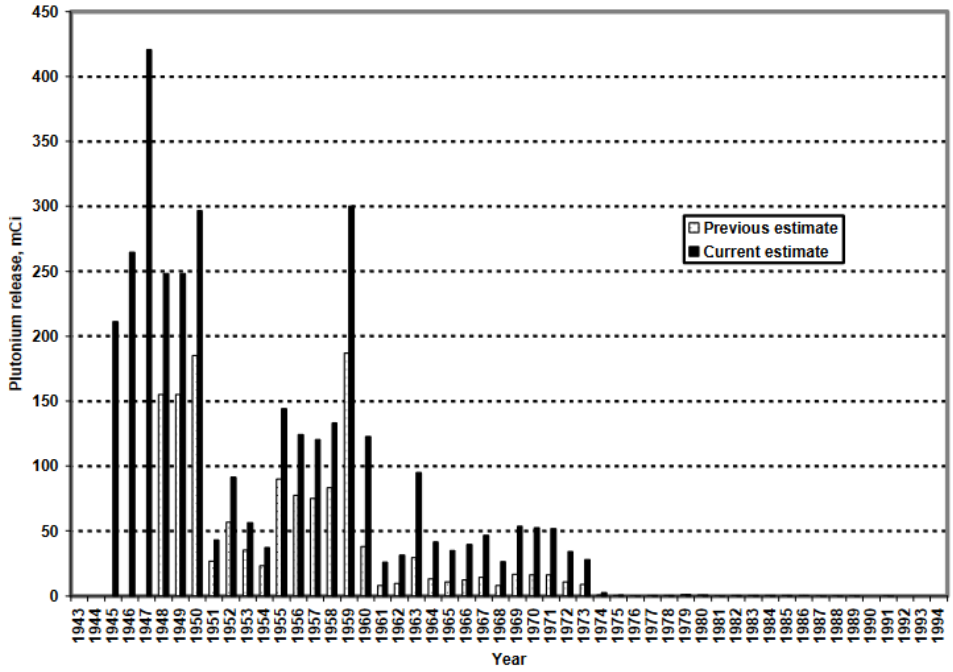
Figure 2 Past practices included waste discharge directly into the environment

Left: Discharges of liquid radioactive waste in Acid Canyon, ca. Late 1940s; Right: Discharge of liquid waste to DP Canyon, ca. 1973. SOURCE(S): Los Alamos National Laboratory, printed in (Widner 2010)

The LAHDRA study concluded that releases of plutonium were of greater concern over most of the lab's history than other materials such as uranium or tritium. The authors concluded that airborne releases of plutonium were significantly higher than officially reported prior to 1970 and that soil samples surrounding LANL may contain as much as 100 times more plutonium than previously estimated (Widner 2010). An earlier study estimated the airborne release of plutonium to be ~3.4 Curie (Ci), or about 30 times above the background expected from worldwide nuclear testing fallout (Franke et al. 2003).

Buildings in which the first plutonium work was done (the D-building at TA-1) vented directly to the air and even maintained positive pressure internally, which would serve to expel radioactive contamination rather than contain it. From 1945 until 1978, plutonium work occurred at "DP site" (approximately 1.5 miles to the east of the original site at TA-1) and although filtering was employed, it is estimated that airborn releases from 1948-1955 alone were over 10-times the total reported by LANL for operations before 1973 (Widner 2010). The DP site was largely decommissioned by 1981, however there remain buried tanks containing aqueous plutonium residues, contaminated soil and waste disposal wells. (Dept of Energy 2020) within 0.25 miles of residential and commercial property in Los Alamos. The western-most edge of the site has recently been developed for residential housing.

Figure 3 Airborne releases of plutonium from LANL, 1945-1994



Airborne releases of plutonium (in mCi/yr) were extraordinarily high throughout the early history of the laboratory. Laboratory estimates were shown to be systematically lower than those reconstructed from historical data. SOURCE: (Franke et al. 2003)

Research and development work on plutonium was of the highest priority at LANL, not just in the leadup to the use of the first plutonium implosion device over Nagasaki, but also in the post-war years as the US forged ahead with the ambition to develop a nuclear arsenal. As a result of the varied activity, plutonium was present in numerous facilities across the lab (contrary to today's practice of strictly isolating plutonium work to dedicated facilities). This resulted in measurable contamination, particularly in the portions of LANL that were developed first and which are now part of the townsite outside the boundaries of the present-day laboratory (see figure 6 – plutonium in and around Los Alamos).

Other sources of significant radioactive contamination include outdoor explosive tests that employed radioactive lanthanum, referred to as "RaLa" experiments. LANL conducted 254 such tests in Bayo Canyon to study implosion designs for weapons. These tests involved large quantities of high-explosives, spreading fallout regionally up to several miles (Dummer, Taschner, and Courtright 1996; Widner 2010). Today, there is residential development less than 0.5 miles from the former test site, which is also directly adjacent to San Ildefonso Pueblo Trust land. While the Department of Energy considers the site remediated and suitable for recreational use, they note that Strontium-90 (^{90}Sr) will remain elevated through the year 2142 (Dept of Energy 2018) and the site includes markers to indicate the presence of buried radioactive waste and discouraging excavation, though it is open for public recreational use.

HUMAN IMPACTS FROM HISTORICAL ACTIVITY AT LOS ALAMOS

The degree to which these past activities have harmed workers and the public is only partially documented owing to incomplete records and monitoring. Significantly, there has been little attention to neighboring communities and Pueblos outside of Los Alamos county. Population studies are difficult because of the relatively small statistical sample compared to average incidence rates for various health outcomes, population mobility, and the fact that Los Alamos county is demographically unprepresentative of racial, ethnic and economic diversity present elsewhere in NM.

Even within the laboratory, accurate analysis of historical occupational health is challenged by the fact that LANL was long divided between technical staff (predominantly white, anglo, and male) who were employees of the University of California (which ran LANL independently until 2006) and contract workers (called "Zia" workers) who provided maintenance, construction, and support services. Zia workers included a larger number of Hispanic and Native Americans. An analysis of one occupational health study at LANL by Wing and Richardson (Wing and Richardson 2003) found that records were available for 97% of UC employees but only 20% of the Zia workers.

It is now established that past release of plutonium from LANL has had impacts on the general population, both in Los Alamos county and beyond. Autopsy results collected as part of the "Los Alamos Human Tissue Program" (McInroy 1995; Widner 2010; Gaffney et al. 2013) surveyed plutonium distribution in the bodies of more than 1000 employees known to have had occupational exposure as well as some members of the public. The latter were intended as both a control group and to assess expected biological background levels from atmospheric fallout as a result of nuclear testing. Controversy surrounds whether sampling for the study was performed with consent (McInroy 1995; Guzmán 2023a; Hughes et al. 1996).

Significantly, the study documented the presence of plutonium in non-lab workers at elevated levels, particularly those living near the lab prior to 1955 (Gaffney et al. 2013). In at least one case, a woman living over 30 miles from LANL but whose husband worked as a janitor was discovered to have 60 times the average level of plutonium in her body compared to the statewide reference (Widner 2010; Guzmán 2023a).

There is strong evidence that the cumulative exposure to materials present at LANL often manifest in elevated cancer rates. This has been established through monitoring of employees and Los Alamos county residents (US Dept of Energy 2003; Richards 2003). Table 5.X shows the levels of incidence and mortality reported for several types of cancer in county residents compared to the state reference population.

It is evident that cancers of the breast, ovaries, prostate, testis and thyroid as well as melanoma and non-Hodgkin's lymphoma have high incidence rates and often higher mortality compared to statewide levels. Some contributions to these rates, such as thyroid cancer incidence, remain poorly explained (US Dept of Energy 2003; Athas 1996). That cancer incidence and mortality remain elevated above statewide levels well after the peak of historical material release from LANL (when environmental regulations, improved work practices, and more thorough monitoring were in place) attests to the lasting risk from legacy activities as well as the potentially undocumented risk from present activities, however compounding factors are often hard to resolve in such studies.

Table 1: Cancer Incidence and Mortality Rates in Los Alamos County

Type of Cancer	Elevation in Incidence Rate* (1970-1996)	Elevation in Mortality Rate* (1970-1996)
Female Breast	50%	41%
Melanoma	125%	63%
Non-Hodgkin's Lymphoma	48%	26%
Ovarian	45%	27%
Prostate	49%	< state population
Testicular	82%	< state population
Thyroid	106%	< state population
**Rates of incidence and mortality are for Los Alamos County residents compared to the New Mexico state reference population. Data is from Catherine M. Richards, "Cancer Incidence and Mortality in Los Alamos County and New Mexico, 1970-1996" (Richards 2003)*		

Because of these documented past impacts, there remains a great deal of public concern over the potential for additional health impacts from the resumption of large-scale plutonium activities at LANL, despite the lab's assurances of improved procedures and safety culture.

CUMULATIVE REGIONAL IMPACTS OF RENEWED PIT PRODUCTION

While historical impacts linger in Los Alamos and surrounding communities, the current pit production effort is already making itself felt in the region in ways that go beyond human health. Pit production is one of the largest efforts undertaken in the history of the national lab and is already creating palpable ripples for the region's economy, infrastructure and transportation.

Pit production has created a record demand for new staff, with 2500 new workers hired in 2023 (Wyland 2024a). Most new employees are under the age of 35 and are encountering a saturated housing market (that is largely unable to expand due to Los Alamos's geography) with many homes priced at more than twice the state average. ("Laboratory Employee Demographics and Housing Demand Information for the Construction Industry" 2023; Nakhleh 2023). The result is a high number of commuting employees, some who come from more than 50 miles away, who are having a noticeable impact on rental markets and traffic on the few roads that lead to the lab. While LANL offers salaries well above the state average, the result for non-employees who do not receive such salaries is detrimental and perceived as a sort of 'technical gentrification' that actually exacerbates pre-existing economic inequality.

Los Alamos contributes a substantial amount to the state's economy as a result of employee expenditures, by creating demand in the regional service industry, and from use of in-state vendors. This creates indirect support for more than 20,000 jobs outside the laboratory and contributes roughly $3B annually into the state economy. The University of New Mexico's Bureau of Business and Economic Research has pointed out, however, that these numbers don't tell the complete story. In the seven-county region surrounding Los Alamos, more money is spent on basic services to support LANL employees who reside there than the counties collect from taxes paid by those employees, resulting in a net loss for bedroom communities where many LANL workers live (Associated Press 2020; Montgomery 2020; Mitchell, Betak,

and Baca 2019). These basic services include things such as roads, parks, police and fire fighting.

This mixed economic picture must also be considered in the context of socio-economic challenges that have long plagued New Mexico. According to the Annie E. Casey Foundation, New Mexico has ranked 49th or 50th for child well-being every year since 2012. In 2024, the state remains in last place for child well-being and is ranked 48th in economic well-being, 50th in education, 44th in health, and 49th in family and community ("2024 Kids Count Data Book: State Trends in Child Well-Being" 2024). These trends have persisted despite decades of defense spending contribution to the state's economy.

Other impacts include required changes in infrastructure to support activities at the lab. LANL expects to reach capacity on existing power lines leading to the site as soon as 2026 and proposes installation of a 14 mile, 115 kV power line across protected wilderness outside of Sante Fe, known as the Caja del Rio (*ExchangeMonitor* 2024). Residents and members of nearby Pueblos are questioning whether the cultural and environmental impacts have been carefully studied and properly addressed (Dix 2024). Previous proposals for a road and bridge through the region (intended to alleviate regional traffic) were also met with vehement local opposition ("Caja Del Rio Campaign – New Mexico Wilderness Alliance," n.d.; "Protect Caja Del Rio," n.d.).

SAVANNAH RIVER SITE, SC

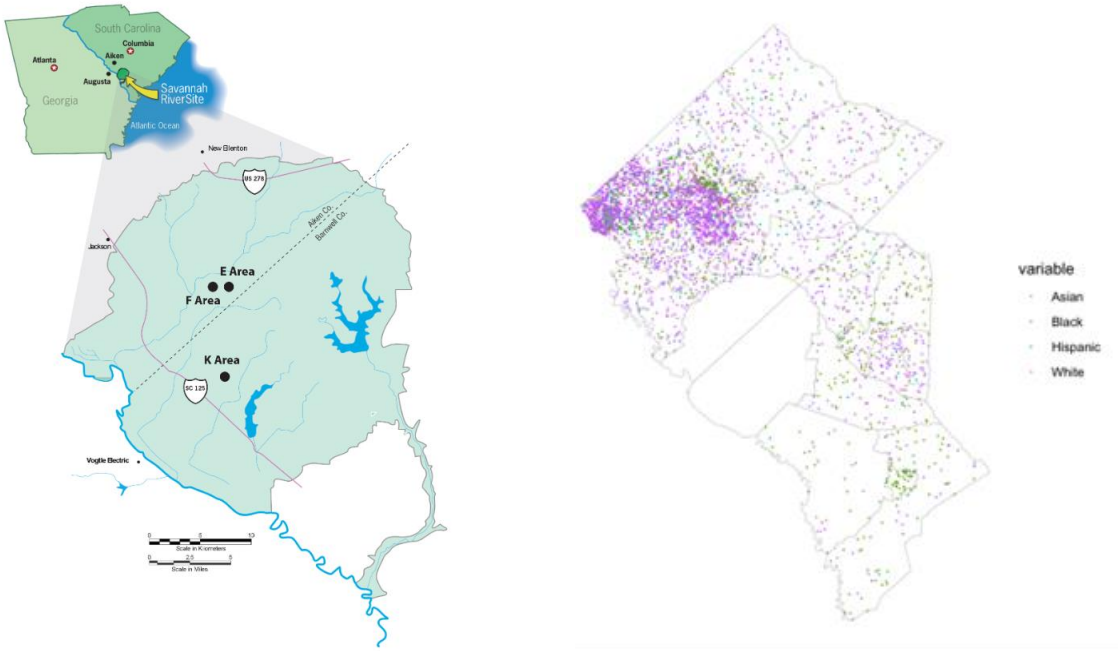
The Savannah River Site (SRS) is the second proposed site for plutonium pit production. The site is located along the Georgia-South Carolina border, approximately 20 miles southeast of Augusta, GA and covers more than 300 square miles ("SRS - Where We Are," n.d.). The nearest residential area to the proposed site is Jackson, SC, 6.5 miles to the west-northwest. 690,000 people live within 50 miles of the site (Connery, Roscetti, and Summers 2023). The demographics of Aiken and Barnwell counties, which SRS spans, are predominantly white and African American with median household incomes of $63,212 and $42,470 respectively (in 2022 dollars)(US Census Bureau 2024).

Activity at the site post-dates the Manhattan Project. Construction began in 1951 and the site was charged with producing plutonium for the growing nuclear arsenal (in parallel with the Hanford plant) from 1953 until 1988. Five reactors were operational at the site throughout the Cold War period, producing plutonium for pits manufactured at Rocky Flats as well as tritium (an isotope of hydrogen that is used to 'boost' the yield of nuclear weapons). The shutdown of Rocky Flats in 1989 along with the end of the Cold War, lead to the cessation of plutonium production at SRS by 1992. Tritium processing continues at SRS today at extraction facilities that treat irradiated fuel rods from the Tennesee Valley Authority's Watts Barr Nuclear Plant. Because tritium has a short half life of only 12.3 years, the nuclear complex must maintain consistent production and handling capability for maintenance of the existing stockpile.

More recently, SRS was to be the site of a Mixed Oxide (MOX) Fuel reprocessing facility. In something of a reversal of the original processes undertaken at Savannah River, the MOX facility would have transformed excess weapons-grade plutonium into reactor fuel for commercial energy production. Construction of the facility began in 2007 but was terminated in 2018 when it's projected construction cost nearly doubled to $8 billion dollars with an estimated $50 billion projected for future operation (Sonne and Mufson 2018; Lyman 2014).

This is the same facility that NNSA is now in the process of retrofitting for plutonium pit production.

Figure 4 Geographic and Demographic Context for the Savannah River Site, SC



Left: Region surrounding Savannah River Site, South Carolina. Right: Demographic distribution around Savannah River Site. SOURCE(S): (US Dept of Energy 2020a), UCS (Dr. Chanese Forté)

THE ENVIRONMENTAL LEGACY OF HISTORICAL ACTIVITY AT SAVANNAH RIVER

SRS was historically involved in isotope separation (heavy water production), fuel and target fabrication (involving HEU, lithium), reactor operations, and chemical separations to produce plutonium and tritium. Plutonium operations primarily occured at two of the site's major facilities, known as F- and H-Canyon. These facilities used remotely-operated chemical processing lines to separate plutonium and uranium from irradiated reactor fuel using a process known as PUREX. SRS and Hanford were the first sites to carry this out at industrial scale.

PUREX (Plutonium Uranium Reduction Extraction) involves the dissolution of the reactor material, separation of fissile materials and subsequent reconstitition into purified metallic form (called 'buttons') that could then be shipped to Rocky Flats for pit production (Reed et al. 2013). This process is inherently 'dirty', producing high-level radioactive waste at several stages of the process. The dissolution involves tri-butyl phosphate (TBP), nitric acid, kerosene, and hydrazine (also a rocket fuel). The combination of tri-butyl phosphate and nitric acid can react explosively at temperatures above 130 deg. C and has resulted in accidents at Savannah River (in 1953 and 1975) (Conway 2003). Similar accidents occured at Hanford (1953) as well

as at an analogous Russian facility, Tomsk-7, in 1993. (International Atomic Energy Agency 1998).

The waste from plutonium separation represents a lasting environmental concern at SRS since it still contains radioactive by-products. Similar to Los Alamos, little thought was given to waste treatment or disposal in the early rush to assemble the US nuclear arsenal. Low-level waste (including TBP by-products from PUREX) was buried directly in the ground in some cases (Condit 1993), while high-level waste (including large volumes of radioative liquid waste) went into sub-terranean steel tanks, awaiting a more permanent solution that never materialized. By the time the last SRS reactor was shutdown in 1988, "tank farms" had proliferated, containing more than 35 million gallons of mixed liquid and solid waste (Reed et al. 2013). Attempts at vitification (conversion to glass) of waste proved relatively ineffective.

Although SRS has approximately half the volume of waste that is present at Hanford, that waste is significantly more radioactive (~ 1.5 times that of Hanford) and is therefore more challenging to remediate (US Dept of Energy 1997). Stewardship of this legacy waste has become a primary part of the SRS mission since the end of the Cold War. The Department of Energy's Office of Environmental Management has had responsibility for the site since 1989 but NNSA will assume management in 2025, largely due to the proposed pit production mission.

HUMAN IMPACTS FROM HISTORICAL ACTIVITY AT SAVANNAH RIVER

Documentation of impacts to communities surrounding the Savannah River Site is sparse compared to that for Los Alamos. Because of the size of the site, there is an appreciable buffer zone of wooded land between the perimeter and the nearest local communities. Contary to Los Alamos, SRS was never a residential site; with a focus on production rather than experimentation, outdoor tests such as those conducted at LANL did not occur at SRS.

Though information on impacts to the public for historical activities at SRS appear to be sparse, impacts on workers are better documented and show a disproportionate burden on Black employees. A survey of occupational health records reveals that Black workers had higher odds of detectable radiation doses than non-Black workers and that from the late 1970's until the mid-1980's, male and female black workers received higher average annual doses than non-Black workers at the site (Angelon-Gaetz, Richardson, and Wing 2010). Positive associations between mortality from leukemia and radiation dose have also been demonstrated for past SRS workers (Richardson and Wing 2007).

Today, SRS is acknowledged to be amongst the most contaminated within the US nuclear complex as a result of the previously mentioned high-level waste that remains onsite. Studies have cited significant concerns for contamination of the regional Tuscaloosa aquifer as well as the Savannah River itself as a result of the local geology and hydrology (Makhijani and Boyd 2004). Tritium contamination is expected to easily infiltrate groundwater as well as become mobile in the atmosphere as it evaporates from contaminated bodies of water onsite, allowing it to subsequently rain out on surrounding regions (Makhijani 2022). Further studies of the impacts of groundwater contamination are needed, particularly for those downstream of the site along the Savannah River who depend on it for drinking water, fishing, and agriculture.

Of course, Los Alamos and Savannah River are not the only two sites that bear the environmental legacy of US weapons development. Plutonium is also present and unremediated (in fact, in much larger quantity) where it was produced and where weapons

were tested. The Hanford site in Washington state is estimated to contain up to 16,700 Curies (Ci) of plutonium. Rocky Flats may still contain up to ~8-10 Ci. Meanwhile, the Nevada Test Site and South Pacific islands and atolls where testing occurred still contain more than 155 Ci and roughly 10,000 Ci, of plutonium, respectively (Hu, Makhijani, and Yih 1992; Makhijani 2024). The Pacific testing sites remain uninhabitable today.

The Mobility of Plutonium in the Environment

The risk to the general public from plutonium operations, past or present, depends on the concentration and mobility in the environment. Despite being a synthetic element that was only first produced in 1940, plutonium is virtually omnipresent in the environment today from global nuclear weapons production and testing. The highest concentrations are found as contamination around sites where nuclear weapons production occurred, but small concentrations are measurable around the world as a result of fallout from more than 500 above-ground (or atmospheric) tests conducted by the US, Russia, the UK, France, and China.

For communities near former production facilities, including Los Alamos and Savannah River, the mobility of localized contamination is still of concern. In the event of potential future accidents at these facilities, environmental mobility also determines who may be at risk and over what timescales and distances. In both cases, understanding how plutonium (as well as other actinides) can move through air, water, and soil is paramount for human health and the security of frontline communities, many of whom still bear the burden of past practices at these sites, which included direct burial of radioactive waste or discharge of contaminated effluents directly into the environment. These practices resulted in long-lived sources of pollution for which complete remediation is nearly impossible.

Finally, because of the long half-lives and toxicity of plutonium and other radionuclides, knowledge of environmental mobility is key to the responsible stewardship of nuclear waste in geologic repositories – a problem that will only grow as the US and other nations continue to develop their nuclear arsenals and one that exceeds human lifespans by orders of magnitude.

IN AIR

Atmospheric transport of plutonium has primarily been due to above-ground tests of nuclear weapons, which cumulatively distributed around 10,000 kg of Pu to the environment (Peterson et al. 2007). Plutonium that is lofted into the atmosphere tends to adsorb (or stick) to particulates and is then deposited by rain-out or dry deposition. Prior to the Partial Nuclear Test Ban of 1963, such particulates were spread globally as nuclear fallout, along with Strontium-90, Cesium-137, Americium-241, and Iodine-131. Recent reconstructions of fallout using historic weather patterns and atmospheric modeling have demonstrated that fallout from the Trinity test in New Mexico and above-ground tests in Nevada reached all of the lower 48 US states (Phillipe et al. 2023) with much higher local concentrations downwind of the test sites where larger radioactive particles are deposited. This local fallout may represent up to 50% of the total, which accounts for elevated cancer incidence and mortality in 'downwinder' populations.

Across the United States, plutonium levels from atmospheric fallout can be measured in soil within a range of approximately 0.01 – 0.1 pCi/g (picoCurie/gram) (Rodriguez 2014). Around Los Alamos, expected plutonium fallout levels have been reported as 0.001 – 0.055 pCi/g, with a mean level of 0.015 pCi/g (Ryti et al. 1998). These levels of plutonium fallout generally

represent a very low risk to the public compared to other environmental exposures and it is important to note that the effects of radionuclides other than plutonium that are present in fallout carry their own health consequences which are beyond the scope of this work.

Box 1 Understanding Quantities: What is a picoCurie?
Levels of plutonium in the environment are often cited in units of Curies (Ci) or picoCuries (pCi) per gram in soil. These units make it difficult to appreciate how much material is actually being discussed. 1 Curie is defined as the amount of material that undergoes 37 billion (3.7×10^{10}) radioactive disintegrations per second. Because different radionuclides decay at different rates, the mass of material corresponding to 1 Curie depends on the isotope and its particular half-life. 37 billion disintegrations per second is *very* big number – so big, in fact, that one trillionth of a Curie (a "picoCurie", pCi, or 0.037 disintegrations per second) is a much more practical and tractable unit for measuring plutonium in the environment where most quantities are vanishingly small. For ^{239}Pu, the principle isotope in weapons-grade material with a half-life of 24,100 years, 1 Curie is equivalent to 15 grams. 1 pCi is therefore 0.000000000015 grams of ^{239}Pu. For ^{238}Pu (used in batteries for spacecraft and which has a half-life of only 88 days), 1 Ci is 54 grams and 1 pCi is 0.000000000054 grams of ^{238}Pu. Average background levels of plutonium from atmospheric fallout in the United States (~0.01 – 0.1 pCi/g), therefore correspond to trillionths of a gram of Pu per 1 gram of soil. In 1990, the total quantity of Pu in soil at Los Alamos was given as 1-2 Ci, 3-5 Ci for Savannah River, 8-10 Ci for Rocky Flats, and 16,700 Ci for the Hanford Site (Burley 1990)

IN WATER AND SOIL

The mobility of plutonium in water and soil once again relies on its unusual and complex chemistry (see Ch 3). Because of plutonium's precarious electronic properties, it can easily be persuaded into different chemical bonding configurations (or "redox states"). In an aqueous solution, plutonium may be present in up to five different redox states simultaneously (a unique trait for any element) according to the local pH, thereby allowing it to 'hitch a ride' on a number of different chemical substrates in the environment (D. Clark 2000). Variations in environmental pH and the degree to which electrons are available from the environment play an important role in determining its chemical state. These various states have varying solubility and reactivity, meaning that they can be mobilized in different ways in nature (Fig. 5).

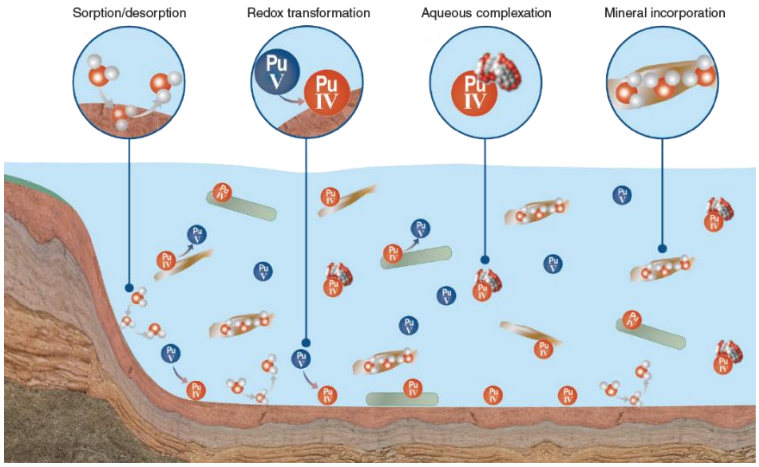
Although water is an important driver for moving plutonium in the environment, plutonium tends to form insoluble compounds and therefore doesn't tend to move in a dissolved form (Runde 2000; Katz, Morss, L.R., and Seaborg 1986). Instead, it has a strong proclivity to adsorb (or chemically 'stick') to surfaces, particularly mineral surfaces like clays. It's mobility in water is therefore defined by what it's attached to. Its deposition may therefore be relatively

heterogeneous according to the hydrological deposition of contaminated sediments when it is present in surface water (Graf 1994).

Insolubility and a tendency to stick to surfaces are both traits that may seem to act as barriers to transport but, once again, plutonium's strange behavior challenges intuition. Colloidal transport in groundwater has been recognized as a rapid way of mobilizing plutonium underground. Colloids are small, naturally-occurring particles that can be mineral, biological, or chemical in nature and that exist as a dispersed phase in another medium (e.g.inorganic precipitates in groundwater). They are typically less than 1/1000 of a millimeter (~0.1 - 1 μm) in size and can therefore be mobile within porous geologic media or within the smallest of fractures.

It was recognized that collloids played a role in transport of radionuclides at the Nevada Test Site as early as 1988 (Buddemeier and Hunt 1988) but it was a 1999 Lawrence Livermore study that highlighted the surprising efficiency of this process (Kersting et al. 1999), identifying plutonium isotopes from a distinct test more than 1.3km away from the test site and suggesting a migration rate of at least 40 meters/year underground via colloidal transport. Laboratory experiments have since supported the idea that colloids enhance Pu transport (Xie et al. 2013) and help explain the unexpectedly rapid dispersion of plutonium from the test site. This rapid mobility is concerning in regions where contamination could intersect groundwater that local populations rely on.

Figure 5 Chemistry Determines Plutonium's Mobility in Water



Plutonium can be mobilized in various ways in water and soil depending on its electronic charge, which determines how it bonds to other substrates and molecules. Roman numerals IV and V refer to the electronic charge states, including the one assumed by plutonium in its common PuO_2 form in the environment. SOURCE: (Chen and Zavarin 2021)

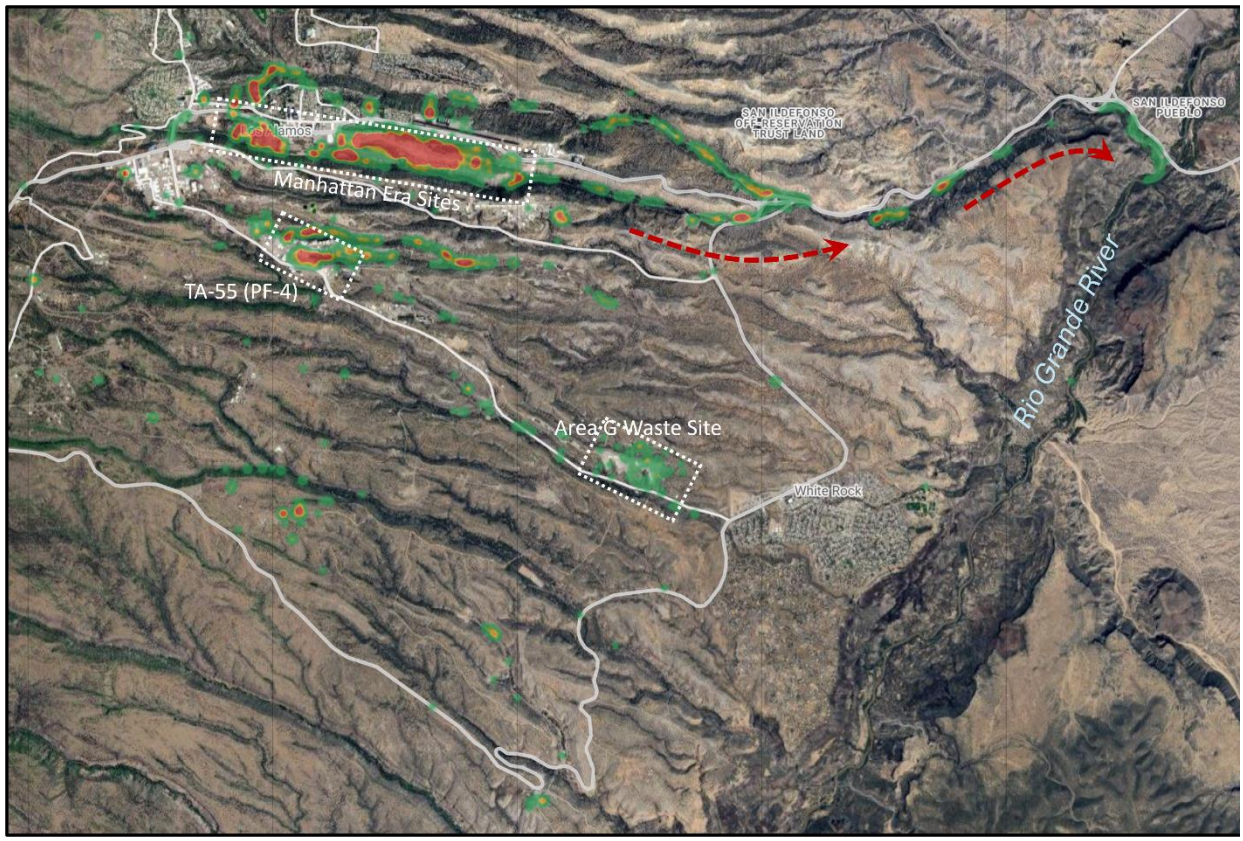
Similar mobility has been noted at Los Alamos where liquid waste was formerly disposed of in canyons and subsequently detected in test wells nearly 3.5 km away from the source (Penrose et al. 1990). Los Alamos acknowledged migration of plutonium in annual environmental surveillance reports e.g. ("Environmental Surveillance at Los Alamos during 2003" 2004; "Environmental Surveillance at Los Alamos During 2004" 2005) and publicly-available data

from the Los Alamos Intellus Environmental Monitoring database ("Intellus New Mexico - Los Alamos Area Environmental Data," n.d.) confirm that plutonium is mobile in the watershed below the laboratory. Indeed, positive detections (above the expected background level from fallout) are found as far away as Cochiti Reservoir, which lies 19 miles downstream on the Rio Grande River.

Figure 6 illustrates the distribution of Pu around Los Alamos where it is present at levels above 0.1 pCi/g (the upper limit of what could be expected from atmospheric fallout). The database lists nearly 5000 regional measurements exceeding 1 pCi/g (at least 10 times fallout), 1600 measurements over 10 pCi/g, 415 meaurements over 100 pCi/g and nearly 100 measurements exceeding 1000 pCi/g (or 10,000 times what could be expected from fallout). A 1980 paper estimated that roughly 2 Ci (~30g equivalent) had been disposed of at Los Alamos in canyon waste disposal sites (Harley 1980). The present-day distribution demonstrates clear patterns emanating from sites known to be associated with past and present plutonium activity, including canyon disposal sites, the former DP site, Technical Area 55, and the waste disposal and staging Area G at Technical Area 54. In addition, migration towards Po-Woh-Geh-Owingeh (San Ildefonso) Pueblo and the Rio Grande river via Los Alamos Canyon are evident.

Migration of plutonium has been observed to accelerate following seasonal runoff, particularly after major wildfires around Los Alamos that decreased the vegetative capacity to retain soil and prevent rapid erosion. Following the 2000 Cerro Grande Fire, $^{239,\,240}$Pu in storm runoff increased to levels 55 times what they were in the 5 years before the fire ("Environmental Surveillance at Los Alamos During 2004" 2005). This may illustrate how future, climate change-induced events such as major wildfires or floods could serve to mobilize existing contamination and accelerate its spread.

Figure 6 Plutonium Contamination and Migration in the Vicinity of Los Alamos



Map indicating measured plutonium concentrations in the environment across the LANL site. Data is filtered to show only measurements ranging from 0.1 – 10 pCi/g (e.g. to exclude levels that could plausibly result from atmospheric fallout, and and showing measurements up to 1000 times that level). Many measurements in the dataset greatly exceed these tresholds. Much of the worst contamination is in or near the current townsite where Manhattan Project work originally took place. SOURCE(S): Map created from Los Alamos Intellus Environmental Monitoring Database, replotted with image courtesy of Google Earth and Intellus data compilation courtesy of Nukewatch NM. ("Intellus New Mexico - Los Alamos Area Environmental Data," n.d.; Coghlan, Stroud, and Kovac 2024)

BIOLOGICAL PATHWAYS

Pathways for mobility that depend on biological uptake of plutonium from the soil are less well understood but are gaining attention. Microbial uptake, either through surface adhesion or actual metabolic processes, may help or hinder mobility of actinides. On the one hand, microbes can act like self-propelled colloids potentially enhancing mobility (Runde 2000). On the other hand, the ability to uptake plutonium could act as a means of remdiation, using specific microbial communities to convert plutonium into less soluble/mobile chemical states and effectively lock them away.

The range of possible biochemical interactions turns out to be difficult to assess. Different bacteria have been observed to handle Pu(IV) in different ways (Kauri et al. 1991) and plutonium uptake can depend on whether bacteria promote reducing conditions (e.g enhance

chemical reactions that can provide electrons to plutonium, changing its charge state) (Mahara and Kudo 2001). Seasonal evolution of microbial communities can also affect uptake as the population cycles, as has been observed in a contaminated pond at Savannah River (Merino et al. 2023).

The uptake of plutonium by plants is also of potential concern to communities in regions affected by contamination since this represents a possible route for potential human ingestion of crops (along with groundwater). The ability of plants to take up plutonium from soil underscores the importance of monitoring how it spreads, particularly where traditional agriculture is practiced, such as the Pueblos that neighbor Los Alamos and where plutonium will continue to migrate underground well into the future in the absence of concerted remediation.

Plants can uptake plutonium from soil through their roots and this may be due to release of compounds like citric acid which act as chelating substances (meaning they can effectively bind the plutonium) at the root surface (Brown 1979). Plants take up iron in a similar manner and it has been suggested that plutonium can mimic iron and follow similar pathways for uptake from the soil in a competitive process in plants, including corn (Hoelbling 2016). Certain isotopes may be more readily taken up by plants than others (Brown and McFarlane 1977) but they can all end up in in leaves and fruiting portions of the plant. To further complicate the issue, different plants appear to have different affinities for plutonium, with differing uptake among species that grow in the same environment (Caldwell et al. 2011).

Given the anticipated heterogeneity in plutonium distribution around contaminated sites and the apparent complexity of its biochemical interactions in the soil and in plants, it is difficult to make conclusive risk assessments for particular locations without focused efforts to measure and monitor its presence locally in a comprehensive manner.

Human Uptake of Plutonium and Radiation Exposure

Epidemiological data on humans is unfortunately sparse due to the relatively small sample size of exposed workers, verified public exposures, and frequent lack of adequate monitoring throughout the period when the volume of plutonium processing was highest. Despite this, we do know that the consequences of exposure are significant. Depending on the specific route of ingestion, plutonium can reside in the body for decades, migrate within the body based on solubility, and lead to various forms of cancer. The size and chemical form can also determine the long-term health effects. Plutonium can enter the body through inhalation (to the lungs), ingestion (via the stomach and gastrointestinal system), or through cuts or wounds (directly into tissue or the bloodstream).

Inhalation of small particles of plutonium is one of the most consequential ways that humans can be exposed because small particles can lodge in lung tissue and remain there for decades (Gaffney et al. 2013). The smaller the particle, the more mobile (and therefore respirable) the material will be. Inhalation could result from exposure to powdered forms of plutonium (which are present at various stages of pit production and plutonium disposition) as well as from plutonium that is airborn in smoke or re-suspended in air from contaminated soil. Inhalation of even a minute amount (as small as tens of micrograms of ^{239}Pu) generated lung cancers in studies on dogs (Bair and Thompson 1974) and an estimated extrapolation to humans predicted certainty of death from lung cancer from inhalation of 80 micrograms of weapons-grade Pu (Fetter and Von Hippel 1990; Hu, Makhijani, and Yih 1992).

Plutonium that is orally ingested typically poses the least risk compared to other routes of intake. It is not easily absorbed by the stomach or gastrointestinal system and the body therefore passes nearly all of the ingested quantity relatively quickly in urine and feces (Bair 1974). This means that intake resulting from contaminated food or water is potentially less harmful than breathing small particulates unless local concentrations are extremely elevated. Communities who grow food near sources of plutonium should have access to reliable measurements of soil contamination to ensure they are below acceptable levels.

In specific cases, workers could have plutonium enter the body directly through cuts, wounds or other abrasions as a result of accidents or tool use in the pit production process. Such accidents have occurred at Los Alamos as a result of glove punctures, pinches, and cuts during operations carried out in glove box enclosures. If this occurs, Pu could directly enter tissue or the bloodstream. Plutonium compounds present in the pit production process have been found in the urine of workers up to 20-30 years after exposure via wounds, again demonstrating its longevity in the body (Keith 2010; Woodhouse and Shaw 1998).

Regardless of the mechanism of intake, once within the body, Pu can and does migrate based on its solubility and chemical form. Once inhaled, plutonium can move from the lungs to the rest of the body. Some may be excreted through transport to the gastrointestinal tract but it can also further mobilize to the lymph nodes and other tissue (Rodriguez 2014; Keith 2010). Insoluble forms (such as ^{239}Pu) mostly concentrate in the lungs and lymph nodes whereas more soluble forms (^{238}Pu) can enter the skeleton, liver and kidney (Keith 2010; Wing and Richardson 2003). In some cases, uncertainties in solubility may not be accurately known, which affects the estimated dose to the individual. Estimation of dose to an affected individual relies on quantitative conversion factors which have been updated as understanding of how Pu moves through the body (referred to as 'biokinetics') has gradually improved (Clement and Hamada 2015; Kaltofen and Plato 2024).

Improved understanding of biokinetics has come from autopsies on exposed workers (McInroy 1995) and animal studies which appear to show similar distribution paths and proportions in the body. Plutonium absorbed following inhalation distributes roughly equally between liver and skeleton (~45% to each) with a much smaller amount distributed to other organs (Widner 2010; Keith 2010). Skeletal accumulation may slowly increase over long periods. Transfer of Pu to the placenta and fetus of a mother who suffered occupational inhalation exposure worker has also been documented (Russell, Sikov, and Kathren 2003).

Plutonium can be difficult to detect in the body. This is because it primarily decays via alpha emission (see Ch. 3), which can only penetrate about 50 microns (0.05 mm) in human tissue. This means that radioactive decay is often not measurable externally (e.g. by *in vivo* counting) except in some cases where gamma emissions from other radionuclides (like Americium) may also be present. Counting of alpha particles can be done on urine, feces, tissue samples or nasal swabs according to the routes of ingestion described above and the time since exposure. Nasal swabs have been a primary means of rapid assay for Los Alamos employees who have known or suspected inhalation risks. Chelation treatment is often used as an emergency medical countermeasure for exposed individuals whose dose exceeds critical levels. Chelation involves injection of zinc or calcium based compounds that help bind and accelerate excretion of plutonium from the body. It is far from 100% effective and is only a means of minimizing the potential damage.

Ultimately, plutonium's residence in the body can lead to various forms of cancer as it undergoes radioactive decay. Because the alpha particles emitted from decay cannot travel far, they deposit their energy over a short distance in a concentrated manner. This causes significant damage to cells in the immediate vicinity. This has an effect on methodologies for calculating dosages to internal organs because of the localized nature of the deposited energy (Kaltofen and Plato 2024).

Increased cancer incidences have been observed in exposed populations that have been studied, particularly for workers at the Mayak facility in Russia (the Russian equivalent of Rocky Flats), where workers were exposed to Pu at levels up to 10 times those estimated for Los Alamos workers over similar periods (Stram et al. 2021; Gilbert et al. 2004). At Los Alamos, plutonium intakes were linked to an increase of bone cancer in workers (Boice 2021) while other cancer rates exhibit increased incidence in both workers and county residents (Table 5.X) (US Dept of Energy 2003; Richards 2003).

SETTING STANDARDS FOR HUMAN RADIATION EXPOSURE

Given the hazards associated with exposure to radiation, we need to understand how much is acceptable and how much is likely for both occupational workers and members of the public. Although the common mantra for radiation exposure is to keep it "as low as reasonably achievable", quantitative regulatory standards exist for occupational workers as well as members of the public. These are set by federal and state agencies, including the Department of Energy (DOE), which manages the national laboratories and sets its own occupational limits. The US Environmental Protection Agency (EPA) sets limits for the public, including maximum allowable amounts in air and water. These limits have been tightened over time as links between radiation exposure and cancer have been better understood and quantified. As a result, the standard for maximum public exposure is 50 times lower today than it was in the 1950s (Makhijani, Smith, and Thorne 2006).

How these limits are set has increasingly come under scrutiny. Typically based on a theoretical, idealized 'reference man', such standards have been criticized for not adequately representing the most vulnerable members of the general population.

Box 2 Understanding Quantities: Radiation Dosage

Just as Curies and picoCuries are used to measure the radioactivity of a substance, *rem* and *Sieverts* measure the amount of energy that a radioactive source deposits in living tissue.

Units for Dose Equivalent
Roentgen Equivalent Man (rem) = unit of 'dose equivalent', which takes into account the absorbed dose (how much radiation is absorbed by an individual) as well as a multiplier (called a 'quality factor') that depends on the type of radiation and its biological impact.

For practical reasons of scale, *millirem* (*mrem*, or 1/1000th of a *rem*) is used more often.

The international scientific unit (SI unit) for dose equivalent is the Se*ivert (Sv)*, which is defined as 100 rem.

Common sources of radiation exposure and the associated dose equivalent:
One coast-to-coast airline flight: ~1 mrem/0.01 mSv
One dental x-ray: ~ 1.5 mrem/0.015 mSv
One head CT scan: ~200 mrem/2 mSv
Cosmic ray exposure from one year living in Denver, Colorado: ~80 mrem/0.8 mSv
One year of average exposure to remnant fallout from nuclear testing: ~ 0.5 mrem/0.005 mSv

Critical dose equivalents:
Onset of radiation sickness: ~100,000 mrem/100 rem/1000 mSv
50% lethality: ~400,000 mrem/400 rem/4000 mSv
100% lethality: ~1,000,000 mrem/1000 rem/10,000 mSv

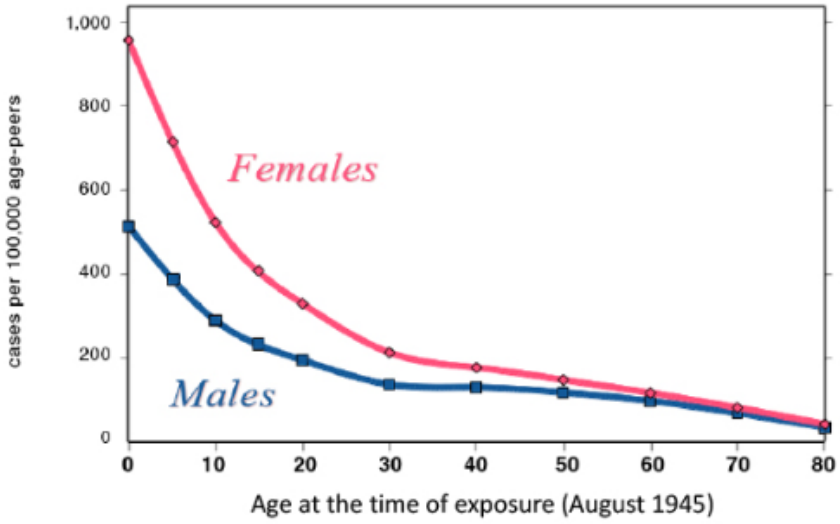
WHO IS REFERENCE MAN?

The earliest guidelines for radiation exposure based on a standardized individual were devised shortly after World War II by American, British, and Canadian doctors with workers in mind (Lochbaum 2021). It is perhaps not surprising then that this fictitious reference was described as follows: "between 20-30 years of age, weighing 70 kg (154 pounds), is 170 cm (5 feet 7 inches) in height, and lives in a climate with an average temperature of from 10° to 20°C. He is a Caucasian and is a Western European or North American in habitat and custom." (Snyder et al. 1975). This model was used for analysis of human exposure to plutonium in the Los Alamos Human Tissue Program (McInroy 1995) which helped define occupational and public exposure more widely (Widner 2010) and has been used internationally in many contexts since. While it may have been a relatively close approximation of the 'average' worker in the late 1940s, it is clearly not representative of the general population and almost undoubtedly results in underestimation of potential harm.

The effects of radiation on the body depend both on whether a given dose is chronic (over a long period) or acute (e.g. a single incidence) but also on gender and age. Children may suffer worse consequences from radiation exposure since rapidly replicating cells are more sensitive to radiation (Keith 2010). Similarly, two influential studies from the EPA and the National Research Council have shown that for a given dose of radiation, women are 52-58% more likely to develop cancer than men (Eckerman et al. 1999; *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* 2006; Makhijani, Smith, and Thorne 2006). This is due, in

part, to the increased radiosensitivity of breast and thyroid tissue in women but the complete mechanism is not totally understood. In addition, women can suffer harm to reproductive health as a result of the finite population of follicles in the ovaries. These disproportionate effects of gender and age on health outcomes appear to be borne out by long term studies on survivors of the atomic bombings in Hiroshima and Nagasaki – a grim case study in acute exposure of an entire population (*Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* 2006; Olson 2019)

Figure 7 Increased cancer risk by age (per 100,000) at exposure to 20 mSv radiation from the use of atomic bombs in Japan



Source: Gender and Radiation Project (Olson 2019), after BEIR VII report (*Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* 2006)

These findings underscore the importance of understanding disparate responses to radiation exposure so that critical radiation protection standards can be developed that assess risks to different populations. As such, more comprehensive alternatives to 'reference man' are required.

ALTERNATIVES TO REFERENCE MAN

New models have gradually been introduced in order to capture different physiological risk as a function of gender and age. The International Commission on Radiological Protection (ICRP) introduced a 'reference person' in 2007, based on an average of a reference female and reference male (Valentin 2007) however such an assumption may not by physiologically representive of either. Newer proposals go further with the goal of considering the most vulnerable members of the population in terms of both human and ecological health. One such example is the *Nava To'I Jiya* (Land Worker Mother) model, proposed by the Tewa Indigenous community neighboring Los Alamos. This model considers cumulative risk to the female body assuming traditional agricultural practices that encompass chronic environmental exposure from land, water, and air. This is similar in spirit to other models

such as 'reference girl' based on the apparently increased risk for younger girls (Fig. 7) (Olson 2019) and a more futuristic construction called "Jane", imagined as a case study in the context of remediation at the Hanford Site in Washington (Box 5.X) (Cram 2015). As of 2024, public limits for exposure are not yet based on models as inclusive as these.

LIMITS FOR THE PUBLIC FOR *ALL* SOURCES OF RADIATION

Regulatory limits place constrainsts on acceptable work practices and release of material to the environment for facilities where radioactive materials like plutonium are handled. DOE regulations require limiting potential public exposure from onsite activities to 100 mrem/yr from all pathways, including air and water ("DOE Order 5400.5 Radiation Protection of the Public and the Environment" 1990). If release of material to the environment is required, it must be demonstrated that it doesn't exceed this limit.

For releases to the air and water, DOE adopts EPA limits which restrict airborne emissions of radionuclides (including, but not limited to plutonium) to 10 mrem/yr for an offsite member of the public ("Subpart H - National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" 2020; Rodriguez 2014) and 4 mrem/yr in water ("40 CFR Part 141 -- National Primary Drinking Water Regulations," n.d.).

To understand these limits and their magnitude, it is helpful to understand the levels of radiation that the population is exposed to via other sources for comparison. Regardless of one's proximity to nuclear facilities, one's profession or location, everyone is exposed to *some* radiation from both natural and anthropogenic sources.

Radon from natural radioactive decay of elements in soil is one common source of ubiquitous exposure (~100-200 mrem/yr), as well as potassium-40 and carbon-14 that we ingest in food (~30 mrem/yr). Cosmic rays also deliver a small amount of radiation which increases with altitude (~30-50 mrem/yr). Artificial sources, including medical x-rays, CT scans and consumer products also represent common sources of public exposure (~60-300 mrem/yr). Cumulatively, these internal and external sources result in an average annual dose of ~300-600 mrem for most people ("UNSCEAR 2008 Report Volume I" 2008). Exposure resulting from residual global fallout from nuclear tests is typically only ~0.5 mrem/yr in most regions ("UNSCEAR 2008 Report Volume I" 2008) (see box 5.X). This means that the national labs are required to limit the dose to members of the public to approximately one third to one sixth of the average annual dose that would be received otherwise.

In addition to setting guidelines for public exposure, regulatory limits inform remediation efforts where contamination is already present beyond laboratory boundaries. Consequently, the labs and the public need to be aware of the evolution of environmental contaminants to ensure strict adherence and public safety. Continued or prolonged de-emphasis on clean-up efforts in favor of scaling up production capabilities risks compounding existing problems, particularly for waste, as discussed below.

LIMITS FOR PLUTONIUM IN THE ENVIRONMENT

Specific limits for allowed quantities of plutonium-239 have been cited as 0.00002 pCi/L in air (recall that a pCi is a measurement of quantity, not dose; see box 5.X) and up to 15 pCi/L in water (including any other alpha emitters that may be present). Note that the limits for air and water differ by a factor of 750,000 because humans take in more air per day than they do water

and because of the increased hazard posed by inhalation compared to ingestion (described above) (Hu, Makhijani, and Yih 1992). More recent analyses have argued that the limit for water should be 100 times lower than it is based on improved understanding of physiology and biokinetics (Makhijani 2005) and indeed, in the state of Colorado where plutonium contamination exists from Rocky Flats, the statewide standard has been set as 0.15 pCi/L (Walker 2016). The admissible limit in New Mexico, set by the state's Water Quality Control Commission, is 10 times higher (1.5 pCi/L) ("Water Quality Standards for Interstate and Intrastate Surface Waters" 2000).

LIMITS FOR WORKERS

Occupational workers are subject to much higher permissible annual doses of radiation than members of the public, which is an additional factor that must be well understood as a condition of employment. Although the principle of maintaining exposure levels "As low as reasonably achievable" still applies, DOE workers are permitted to receive up to 5000 mrem (5 rem)/yr through occupational exposure (50 times the public limit). For workers, limits are published for each organ based on models (Sowby 1979; Widner 2010) and dosimetric measurements are used to monitor individuals at relatively high frequency according to their perceived risk. The International Commission on Radiological Protection recommended that the allowable dose for workers be reduced to 2000 mrem (2 rem)/yr year in 1991 but that recommendation was not adopted by the Department of Energy (Makhijani, Smith, and Thorne 2006).

How the National Laboratories Assess and Report Risk

Putting our knowledge of plutonium mobility, biological hazard, and admissiable limits into the context of plutonium pit production requires requires examining how the national laboratories assess and report risk from their proposed work. Environmental Impact Statements (EIS) issued by the national laboratories offer perhaps the best public-facing analyses of whether proposed actions comply with expected standards for protection of public safety and the environment, including probabilities for specific scenarios and associated risk of expoures. Commentary on new EIS documents is also one of the primary venues for public self-advocacy.

ENVIRONMENTAL IMPACT STATEMENTS

Although many of the processes required for the resumption of plutonium pit production are the same today as they were during the Cold War, the potential impacts and risks are not. Today, improved awareness of potential harms allows better administrative and engineering controls to improve safety. Stronger environmental regulation since the 1970s also contributes to reducing the potential for public exposure and environmental damage. Nonetheless, plutonium remains just as hazardous today and workers remain fallible, despite the best controls. Where there is hazard, there is always finite risk of accidents, leading to harmful human and environmental exposure. Environmental impact statements are the means by which the national laboratories document, predict, and address such hazards.

It is important to understand how the risks inherent in NNSA's current plans compare to the past. Environmental Impact Statements (EIS) are required under the National Environmental Policy Act (NEPA) of 1970 (42 U.S.C. § 4321) and are a primary mechanism for analysing and communicating such impacts to the public. EIS typically include consideration of cumulative

impacts to surrounding regions, including infrastructural, environmental, and economic repercussions as well as analysis of possible accident scenarios and liklihoods.

Los Alamos's PF-4 facility, where pit production will take place, has indeed had numerous recent accidents, even without the level of activity required for pit production. One such incident was severe enough to shut down the facility for three years (Center for Public Integrity and Malone 2017) and many have resulted in worker exposure to plutonium (Defense Nuclear Facilities Safety Board 2022; Guzmán 2023b).

In the past, LANL has considered various levels of pit production, including scenarios in which up to 450 pits per year would be produced at a single facility onsite (US Dept of Energy 2003). Later iterations of this proposal varied the size and scope, including various facility options, none of which ultimately materialized.. Each of these proposals was typically accompanied by supplemental analyses to the laboratory's existing Environmental Impact Statement but, critically, none of them explicitly considered the two-site solution that the NNSA is currently pursuing.

Instead, the most recent scoping for a revised impact statement from LANL ("DOE/EIS-0552: Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, New Mexico" 2022) considers the new pit production mission under what is known as a 'no action alternative', meaning that any and all hazards are considered to be within the scope of existing analyses. NNSA therefore considers no new analysis to be required, instead relying on a complex 'tiered' approach in which addenda and supplements to previous analyses are used to compensate for evolving circumstances and decision-making (in this case, a supplement to the 2008 EIS) (US Dept of Energy 2008; 2020b).

While it is true that NNSA and LANL have previously considered scenarios for pit production that included PF-4, the specific plan being pursued has not been explicitly nor holistically considered in previous documents. EIS analyses can be 'site-specific' if impacts are limited to a specific location or 'programmatic' if proposed actions are "connected", "cumulative", or "similar" across multiple sites or facilities (Hart and Tsang 2020; American Bird v. Fed. Communications 2008).

Given the magnitude of the pit production mission and the fact that it involves numerous DOE sites (including LANL, SRS, Pantex, WIPP, and LLNL) which will be carrying out work that is apparently "connected, cumulative and similar", it seems appropriate in this case that a programmatic EIS be conducted that would holistically consider the national implications. While NNSA's approach may technically be compliant with NEPA requirements, it is arguably an abuse of the tiered decision-making process for site-specific NEPA analyses and simultaneously downplays the magnitude of expanded operations across the complex.

This tactic has been used, even in the wake of accidents severe enough to result in a three-year closure of the Waste Isolation Pilot Plant (WIPP) due to an unanticipated radioactive contamination event (Klaus 2019), when NNSA concluded that an updated environmental analysis for the site was not required (US Dept of Energy 2020b).

PLANNING FOR ALTERNATIVES

A new impact analysis should consider the impacts of simultaneous pit production across multiple sites as well as scenarios in which surge production (beyond currently projected capacity) is required at one or both sites.

NNSA's history of embarking on multi-billion-dollar projects only to have them cancelled when budgets or schedules become untenable (Hunter, Hutton, and et al. 2019) should also encourage exploration of scenarios in which circumstances dictate operation of a single production site. In this case, revisions to infrastructure, transportation and waste management should be explicitly examined along with justification and feasibility for expanded operations at one site or the other. The competing missions within the PF-4 facility will obviously be impacted whether present goals are achieved or not. Extenuating circumstances affecting pit production may therefore have significant ripple effects on additional programs of importance and these should also be considered in terms of their potential cumulative impacts and associated risk management. The Government Accountability Office has raised such concerns regarding competing missions but these remain, to our knowledge, unadressed (Government Accountability Office 2019).

The following sections are intended to provide an independent overview of primary concerns normally addressed in a comprehensive impact analysis, including the risk of radiation exposure for workers and the public and cumulative impacts to surrounding regions, including infrastructural, environmental, and economic repercussions.

PATHS FOR ENVIRONMENTAL RELEASE

Accidental release through fire, failure of building systems such as air handling, or other natural disaster is a worst-case scenario in which relatively large quantities of radioactive material could be released. More likely and potentially frequent occurrences would involve very small amounts of material leaving the facility through contamination of worker's clothing or skin or deposition on surfaces that are removed from the building, particularly through the waste stream. Because pit production involves considerable waste, handling, packaging and transport of that waste likely represents one of the largest ongoing risks for accidental exposure outside of the facilities themselves.

In all cases, administrative controls (e.g. best practices for workflow or standard operating procedures) and engineering controls (use of built systems, safety and monitoring equipment) can assist in greatly reducing potential risks as well as containing accidental release in the event of human error or partial system failure.

ACTIVE VS PASSIVE CONFINEMENT

The most fundamental engineering control to minimize potential release of plutonium is in construction of the facility itself. DOE's preferred standard for nuclear facilities where radiological materials could be released includes what is known as "active confinement ventilation" ("Nonreactor Nuclear Safety Design Guide for Use with DOE O 420.1C, Facility Safety" 2012; Guha 2013). This means facilities are constructed to actively contain potential radiological material using fans, filters, and designed airflow such that the building maintains negative pressure relative to the exterior, thus inhibiting particulates and vapors from escaping even under abnormal conditions such as following an accident. To be qualified as a "safety class" system for the protection of the general public, such systems must be engineered to ensure that releases are moderated to less than 25 rem total effective dose. 25 rem is the approximate does that most Americans receive over their lifetime from background sources (see box 5.X). Under DOE guidelines, this limit is used as a "planning and evaluation tool for accident prevention and mitigation assessment" rather than considered an acceptable or

unacceptable does from an accident ("DOE Standard - Preparation of Nonreactor Nuclear Facility Documented Safety Analysis" 2014).

LANL's PF-4 facility has a version of active confinement ventilation however it is not officially considered a "safety class" system (capable of mitigating release in the event of an accident according to DOE standards) due to potential seismic vulnerability of specific components (Randby et al. 2019). The Defense Nuclear Facilities Safety Board (DNFSB), which monitors public health and safety at DOE facilities, has long suggested improvements to PF-4's ventilation system. NNSA had committed to upgrading it's confinement system to meet "safety class" requirements, including the required seismic criteria, as recently as 2020 however they reversed course in 2022, informing the DNFSB that those modifications would prove too costly (Connery 2022b). NNSA claimed to be undertaking improvements that would result in a "robust", albeit *non*-safety class confiment system as of 2022. The DNFSB notes that LANL's PF-4 facility is unique in the nuclear complex in not pursuing a safety class active confinement strategy (Randby et al. 2019).

Instead, LANL has chosen the alternative, which is considered "passive confinement" in which the building itself is credited with containing radiological release in the event of an accident. This strategy requires justification that the potential offsite dose will fall below the federal regulatory limit for safety class systems of 25 rem through estimation of the fraction of material released that could exit the facility under various scenarios using what is known as a 'Leak Path Factor' (LPF) analysis.

Risk to offsite personnel and members of the public is therefore quantified using specific assumptions to arrive at a "mitigated" dose level, which LANL concludes is 24.2 rem – just below the 25 rem federal guideline.

LEAK PATH FACTOR ANALYSIS

To arrive at an estimated release of 24.2 rem, LANL relies on a leak path factor (LPF) analysis. The leak path factor represents the fraction of radioactive material (in this case, airborne plutonium) that escapes the facility during a bounding accident scenario. Quantifying the leak path factor depends on specific accident conditions (e.g. where and how an accident occurs) as well as weather conditions that would determine how rapidly and how far radiological material could spread if released.

Under NNSA's methodology, the amount of material that could be released is defined as

$$Mobile\ Quantity = MAR\ x\ ARF\ x\ RF\ x\ DR\ x\ LPF$$

Where MAR is the amount of 'material at risk' within the facility (the total amount stored and/or in use), ARF is the fraction that becomes airborne, RF is the respirable fraction (small enough to be inhaled), DR is the 'damage ratio', which is the amount of material damaged in the accident and therefore available for release to the environment, and LPF is the 'Leak Path Factor' which is the fraction of respirable material that is likely to have a physical pathway outside the building structure. (US Dept of Energy 2003)

There are clearly many assumptions required for such a calculation since the only easily predictable factor is the' material at risk', which corresponds to the facility's inventory of plutonium. LANL relies on a number of computer codes to assess the leak path factor, which

include detailed modeling of aerosolized transport within the facility itself. They credit the LPF analysis for the oft-cited worst-case scenario of a post seismic fire with reducing the off-site effective does from 218.6 rem to the value of 24.2 rem, cited above.

The DNFSB has criticized LANL's methodology, citing concerns about both the codes as well as critical assumptions that mathematically reduce the potential for public exposure, stating "the LPF calculations do not provide very high assurance of the confiment of radioactive materials, as required by DOE directives" (Randby et al. 2019; Connery 2022b). Mostly glaringly, arriving at a value below the 25 rem federal guideline requires the exterior doors to the facility to be open for no more than 5 minutes. This includes the time for all personnel to evacuate the facility as well as the time the doors must be open for emergency response. Even before pit production has begun at full capacity, it has been reported that up to 1000 people work at the facility on a given day and this number would be expected to grow significantly as the lab approaches it's 30 pit/year milestone(Hennigan 2023). The DNFSB and others have called into question whether 5 mintes is sufficient for lab workers to place lab systems (such as foundry processes) in a safe configuration, evacuate, and allow emergency response.

Measures that could potentially mitigate the amount of material that could be released in worst-case post-seismic fire therefore include fully upgrading the active confinement system to meet DOE safety class standards (which would serve to reduce the LPF), reducing the amount of plutonium present at a given time (MAR, with implications for facility productivity), or additional modifications to the facility to reduce the fraction of material that could be damaged (DR). The choice to pursue a passive confinement strategy therefore increases the relative importance of other safety systems to keep the mobile quantity (hence public risk) below the regulatory limit.

"EXIGENT CIRCUMSTANCES"

Inadequacies and delays to safety system improvements at PF-4 have recently been highlighted by NNSA's reliance on "exigent circumstances" to justify potential public radiation exposure far beyond the 25 rem federal guideline. Exigent circumstances refer to cases in which specific processes present a risk of exceeding the 25 rem guideline for offsite exposure and in which existing safety systems do not provide viable mitigation of risk. This is, effectively, an exception the rule that may be invoked for atypical operations that NNSA considers mission-critical.

In 2022, NNSA cited exigent circumstances to justify potential offsite exposure levels from 490-3175 rem in the event of a serious accident during handling of ^{238}Pu for a repackaging effort. This is up to 127 times the federal guideline under DOE Standard 3009-2014 and exceeds what is typically a lethal dose (400 rem) *under the most favorable assumptions*. NNSA's invocation of exigent circumstances underscores the inadequacy of PF-4's safety systems for operations deemed necessary under the competing missions that LANL is charged with (including pit production, heat source plutonium and excess plutonium disposition). DNFSB resident inspectors noted that LANL facility managers determined that "no readiness activities, including a management self-assessment or subject matter expert checklist reviews" were required for this exceptional operation (Boussouf, Gutowski, and Plaue 2022), despite the associated and accepted risk.

These judgements on behalf of the laboratory call into question the authority of the standards for public protection, development of adequate safety protocols, and when and how often

exigent circumstances could be used in the future if, for instance, pit production levels beyond 30 pits/year are deemed necessary to meet national security requirements, commensurately increasing the 'material at risk' within the facility. When asked in a 2022 public hearing about whether increased pit production could lead to further invocation of 'exigent cirdumstancs', NNSA administrator James McConnell replied that *"I would like to say, but I can't, that this will be the last time that we use exigent conditions"*. ("DEFENSE NUCLEAR FACILITIES SAFETY BOARD PUBLIC HEARING ON LOS ALAMOS NATIONAL LABORATORY NATIONAL SECURITY MISSIONS AND NUCLEAR SAFETY POSTURE" 2022)

"I would like to say, but I can't, that this will be the last time that we use exigent conditions" - NNSA administrator James McConnell in 2022 public hearing

MONITORING AIRBORNE EFFLUENTS

Los Alamos and its surroundings are equipped with an air monitoring system (AIRNET) intended to detect airborne radionuclides at approximately 40 locations at or near the lab's perimeter. This system is intended to monitor compliance with the lab's statutory requirement to maintain public exposure from airborne sources to less than 10 mrem (from all sources). The system monitors for plutonium, uranium, tritium and other possible radionuclides of interest and stations are located both at potential source locations (such as emission stacks), as well as more distant regional locations expected to be representative of public exposure (Dave Fuehne 2016).

Measurements from the network have typically recorded emissions at levels below 1 mrem. While levels have generally improved since the 1990s, there have been measurements as high as 8 mrem (in 1993), 6 mrem (in 2005, due to a control system malfunction at one facility) and ~3.5 mrem (in 2011, due to specific cleanup activities) (David Fuehne and Allen 2015). Although these fall below the 10 mrem annual limit for public exposure, it has been pointed out that short-term emissions from point-sources could be underreported given the geographic distribution of sensors and that diffuse sources like waste sites may not be adequately captured (Franke et al. 2003).

Unfortunately, past whistleblower testimony as well as critical shutdowns have cast doubt on the utility of AIRNET to provide a measure of public protection when and where it is most needed. In 1996, a former lab safety officer revealed "a pattern and practice of deception" at Los Alamos in which employees would intentionally release airborne effluents, including radioactive tritium and contaminated water, away from stacks and monitoring locations to avoid setting them off, apparently in fear that the facility would be shut down if actual emissions were monitored (Guzmán 2024; Bartlein 1996). Additionally, the system was shut down during the peak of the 2000 Cerro Grande Wildfire which could have mobilized radionuclides in smoke (Alvarez and Arends 2000). LANL published studies following the 2000 fire, as well as the Las Conchas fire in 2011, showing that impacts from both events were minimal and that only naturally-occuring radionuclides were detected in excess of normal background levels (Michelotti et al. 2013; "AIRNET Data Evaluation During the Cerro Grande Fire.Pdf" 2000).

Although the system has been updated recently, it still does not provide real-time public alerts. Monitoring data is available to the public after-the-fact and in annual publications from the laboratory.

Risks to Workers From Pit Production

Compared to the general public, the risks posed to workers within pit production facilities are significantly greater. Workers are in close contact with hazardous materials and will be the first to suffer consequences in accident scenarios. Although safety systems are inherently built into workflows (including both physical and administrative protections), humans are inherently fallible and the PF-4 facility has a troubling history of accidents in which workers have been exposed to plutonium. As the NNSA rushes forward to achieve production capacity, recently hired and newly trained personnel are carrying out new procedures on both new and old equipment. All the while, mission-critical work, demolition and decontamination, and new construction and installation are happening concurrently within the facility on a 24/7 schedule. These circumstances, combined with an ambitious deadline and simultaneous, competing processes within the facility, significantly raise the risk of accidents.

Pit production involves a number of complex processes to recycle existing legacy pits, purify the plutonium, and re-manufacture new pits from that material. Both wet and dry chemical processes are involved that employ acids to dissolve chemicals, nitrate and chloride chemistry to recover specific products, and high-temperature chemistry (pyrochemistry/molten salt chemistry) to strip impurities and decay products from the metal. Molten plutonium is re-cast using processes akin to traditional foundries, but adapted to be carried out within the necessary confines of gloveboxes under controlled atmospheres. The subsequent machining is delicate, must be precisely done, and produces pyrophoric (flammable) shavings and radioactive dust that pose risks of accidental fires – an occurrence that has occured on multiple occasions at Los Alamos and, catastrophically, at Rocky Flats.

Workers are therefore subject to numerous hazards, including chemical, radiological and mechanical risks including handling plutonium in metallic, powdered and molten form, all while working without the usual dexterity that would normally be desirable for such processes.

Elsewhere in the Los Alamos plutonium facility (PF-4), additional processes unrelated to pit production occur. These involve preparation of 'heat source' (^{238}Pu) for thermal batteries used in space missions and a process referred to as ARIES (Advanced Recovery and Integrated Extraction System), which converts excess Pu to a diluted oxide powder form for disposal. These processes use dedicated space within the PF-4 facility but also somewhat complicate administrative and radiological controls since they involve different isotopes and chemical forms of Pu. Because of its higher radioactivity, ^{238}Pu is significantly more hazardous than the weapons grade ^{239}Pu involved in pit production and yet the heat source work cannot be paused while the rest of the facility is retro-fit for the lab's newly-assigned pit production mission since it is the only US facility that carries out such work. This creates a unique combination of hazards in a relatively constrained space that was not originally designed as a production facility nor intended to support competing missions.

WORKER EXPOSURE TO PLUTONIUM

The health risks for workers from plutonium are the same as those described above for the general public with the obvious caveat that workers are much more likely to be exposed to larger quantities and at higher frequency. Exposure to fine particles is one of the most common documented occurrences, presenting the risk of inhalation. Because many processes within

PF-4 either involve or produce small particles and because some equipment is still contaminated from past work, the potential to be exposed to Pu particulates is quite high.

Modern plutonium work is conducted within glovebox enclosures and material is moved between gloveboxes along the production line via trolley system when possible. This keeps workers physically separated from the material. The gloveboxes can often be purged with inert gas such as argon or nitrogen to avoid oxidation of the workpieces and are designed (in most cases) to maintain a slight pressure differential with the room to discourage outflow in the event of a glove rupture or other breach of the enclosure. Glove ruptures are one of the most common accidents and have been documented to occur with surprising regularity. While the consequences are usually quickly controlled and remediated, they have been severe enough for the affected workers to require chelation treatment after confirmed uptakes of plutonium.

Throughout the history of plutonium work at Los Alamos, there have been three worker deaths caused by acute radiation poisoning. All were criticality incidents that would have been prevented with modern work practices. A single plutonium pit (later termed 'the demon core') was responsible for two deaths during very early criticality studies in 1945 and 1946. Another death was caused by plutonium in a tank achieving a critical configuration in 1958, killing the chemist involved within 35 hours (McInroy 1995; Guzmán 2023a). The circumstances that lead to these accidents would not be likely today given present administrative limits and procedures, however disregard for those limits and procedures, either deliberately or by accident, has been a recurring problem at the facility (see 'Accidents', below).

POSSIBLE LONG-TERM OCCUPATIONAL HEALTH EFFECTS FROM PLUTONIUM

To predict the possible long-term health consequences for exposed workers, we unfortunately have limited occupational health studies to inform us. This is because, compared to the general population, the number of plutonium workers with adequate monitoring and longitudinal health tracking is small.

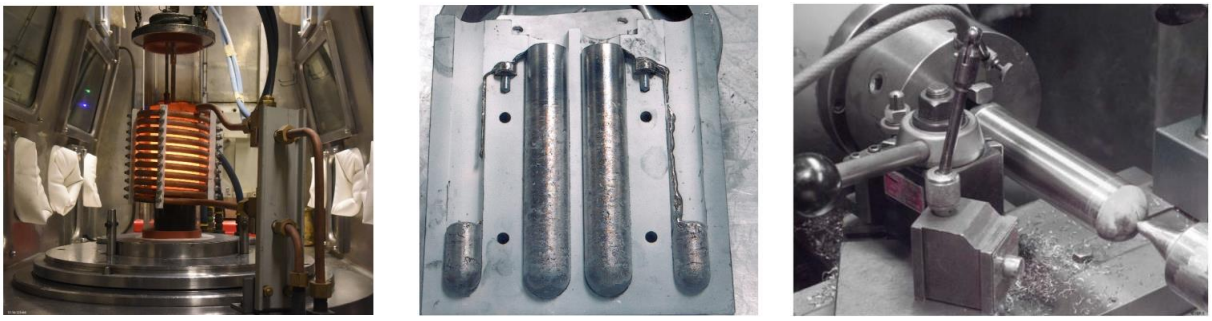
The long-term health consequences for plutonium workers are not always clear, due, in part, to the relatively small sample size relative to the general population, sufficient monitoring of those who may have been occupationally exposed, and a common epidemiological bias known as the 'healthy worker bias'. The healthy worker bias describes the fact that those who suffer the most severe health consequences may leave the workforce and therefore not be sampled as part of the occupational population. Workers may also have access to better healthcare than the general population and, because of occupational monitoring, may be more likely to receive screening and treatment for health risks which can sometimes skew epidemiological surveys when sample sizes are small.

Historically, occupational health studies of LANL workers favored white, male, anglo employees of the University of California and under-represented women and contract workers (called Zia workers prior to 1986) who were more likely to be of Hispanic or Native American descent (Wing and Richardson 2003). A cohort mortality study of these Zia workers found that deaths from all cancers (amongst 1196 individuals who could be tracked) were actually low compared to the US population however leukemia, stomach, liver, pancreas, and bone cancers showed excess deaths, meaning they occurred at higher rates than would be expected for the general population. The authors noted that approximately half of the study population lacked bioassay data (Galke, Johnson, and Tietjen 1992; Wing and Richardson 2003). When compared with other lab workers, an increased risk of lung cancer was noted, however this was based on only 8 deaths.

WORKER EXPOSURE TO BERYLLIUM AND AMERICIUM

In addition to plutonium, beryllium and americium are also involved in pit production and both pose their own hazards for workers. Many pit designs are widely believed to contain beryllium, which would act to reflect neutrons back into the imploding pit during operation of the weapon and produce additional neutrons from alpha decay in the Pu. Beryllium is a highly toxic metal which is also extremely dangerous to inhale and which can lead to Berylliosis- a chronic lung disease that can take years to appear ("Report on Carcinogens, Fourteenth Edition," n.d.). Americium will be present in smaller amounts as a daughter product of ^{241}Pu but poses a greater inhalation risk than plutonium, including to the thyroid.

Figure 8



From left: an induction furnace within a glovebox used to melt plutonium 'buttons' for casting into various shapes; center: plutonium rods, as cast; right: a dry machining process on a lathe to bring castings to final dimension.
Source: Los Alamos National Lab/US Department of Energy

WORKER PROTECTION MEASURES

Workers within facilities that handle nuclear materials such as plutonium are protected through a combination of on-the-job training, administrative controls (prescribed procedures and work flows), engineering controls that provide physical separation from hazards, and personal protective equipment. Where human error is more likely, the other safety elements gain increased significance. This tiered approach to safety is required because any one component of the system is likely to be insufficient on it's own to avoid potential exposure to radiation – a hazard which cannot be seen, smelled, or otherwise felt with human senses.

Alpha monitors are one of the primary engineering controls that are required to be used when workers withdraw their hands from gloveboxes within radiologically controlled areas or radiological buffer areas within the facility. In the event of a glove tear or breach, this is meant to ensure that the contamination is detected immediately, can be contained and remediated. When entering and exiting controlled areas, workers use hand and foot monitors that survey their personal protective equipment for radiation. Full-body monitors are also used at entries and exits of controlled areas to avoid contamination leaving the facility. Larger spaces employ continuous air monitors to detect airborn contamination within work areas by pumping room air through a detector and providing an audio-visual alarm if radiation is detected (Cournoyer

2018). Positive detections typically require evacuation of personel however monitors have been accidentally tripped or ignored during maintenance activities in PF-4 in the past.

A variety of activities are carried out within PF-4 in addition to pit production. These entail different hazardous products and isotopes with varying radioactivity, which can present a challenge for monitoring since not all detectors are universally sensitive. They must therefore be appropriately chosen for specific hazards and used according to protocol to avoid false negative readings which could (and have) allowed workers to leave controlled areas with contamination on their clothing or PPE.

Because worker fallibility is inevitable, particularly as new and unfamiliar procedures are undertaken in new facilities, proper design and certification of engineering controls is critical. In 2023, the Defense Nuclear Facilities Safety Board criticized DOE's assertion that additional safety controls were not required for the design and development of the pit production facility at Savannah River. According to the DNFSB, project personel asserted that *"workers can use their senses to detect accidents such as a glovebox spill or fire and exit the area before receiving significant radiological exposure"*, thereby avoiding designation of certain systems as safety significant controls (Connery 2023). This stance ignores the imperceptible risk of radiation and the well-documented history of accidents and worker exposure at both Los Alamos and Savannah River – a history that clearly demonstrates the ways in which both administrative and engineering controls have failed to protect workers in the past.

ACCIDENTS

Even relatively sophisticated worker protection measures, procedures, and equipment have not prevented a chequered safety history within the plutonium facility at LANL. A number of relatively serious accidents have occurred over the past 15 years involving violations of criticality safety rules, plutonium intake by workers, glovebox fires, floods, and failures of equipment that have lead to contamination outside of glovebox enclosures.

Recent years have seen several instances of what Los Alamos terms 'overmass conditions' (perhaps a deliberate avoidance of the term 'criticality') within PF-4, including one well-publicized incident in 2011 that ultimately triggered a multi-year shutdown of the facility in 2013 (Center for Public Integrity and Malone 2017; Center for Public Integrity, Smith, and Malone 2017). 'Overmass' does not always imply that a criticality accident is imminent. It suggests that workers exceeded what are considered safe administrative limits for material within a given space or geometry, often by accident or fault of accounting for material as it moves through the facility or storage vaults.

The 2011 event was neither accidental nor attributable to faulty accounting. It involved workers staging eight plutonium rods within inches of each other to take a photo of their work (Fig. 9) – an egregious violation of basic criticality safety since close physical proximity of fissile material can lead to a nuclear chain reaction, particularly if a means of slowing or reflecting neutrons back into the material is present. Water can have this effect, but so can a worker's hand, making it potentially dangerous to physically intervene to increase separation. To make matters worse, the response to this event was mishandled, with workers in the room allowed to return to their tasks. The incident lead to the resignation of several criticality safety officers, allegedly out of frustration over lax attention to rules and, two years later, led NNSA management to order a complete facility shutdown while safety measures were re-evaluated.

When work resumed in 2017, the shortage of qualified criticality safety engineers was cited as an ongoing concern (Malone and Smith 2017).

A 2003 risk assessment for an earlier, proposed pit production facility (the Modern Pit Facility) estimated the potential frequency of a criticality accident at ~1/100 per year – higher than other risks including fire and radioactive material spills (US Dept of Energy 2003). While criticality accidents are extremely dangerous and can result in lethal acute doses of radation to anyone in close proximity, they do not result in a nuclear explosion (as occurs in a weapon) because of the material configuration. This means that criticality accidents do not pose a significant risk to the public, but could be lethal for workers and result in signifcant contamination. Criticality incidents have continued to be routinely logged in PF-4, including flooding of a vault containing fissile material in 2021 (Roscetti 2021)and as recently as April of 2024 as work accelerates to produce the first weapon-ready pit (Gutowski 2024a).

Glovebox operations are another frequent source of accidents within PF-4. Gloveboxes are intended to contain radioactive material and protect workers from contact with hazardous materials. Compromised gloves have torn away from the glovebox when workers inserted their hands and small tears or breaches of the gloves themselves occur routinely as a result of chafing, tool use, pinches, or other mechanical or chemical insults. Many glove breaches are relatively benign if detected rapidly because plutonium is primarily an alpha-emitter and personal protective clothing and skin are capable of blocking alpha radiation. If breaches are detected using routine hand scans when workers withdraw from the gloveboxes, any contaminaton can be localized. Despite this, not all glove breaches are benign.

Figure 9

Left: The 2011 photograph showing several kg of cast plutonium rods in close proximity, in violation of criticality safety rules. This incident ultimately led to a multi-year facility shutdown but other 'overmass' incidents have since occurred. Right: a glovebox training facility where workers practice procedures, including an overhead trolley similar to that used in PF-4, used to move material between boxes. Source: Left- Los Alamos National Laboratory/US Department of Energy, Right- Michael Pierce, Los Alamos National Laboratory

Some glovebox accidents have resulted in serious consequences. In 2020, several incidents were attributed to a 'bad batch' of gloves, including one in which a worker was found to have extremely high ^{238}Pu activity on their personal protective clothing (300,000 disintegrations per minute, or roughly 1/10th of the annual occupational exposure limit per minute of exposure)(Roscetti 2020). Just a few months later, 15 workers were simultaneously exposed to ^{238}Pu following another glove breach. Six of them were determined to have had internal uptake and at least one underwent chelation treatment (Connery 2024; Wyland 2020). A 2022 incident resulted in exposure of six workers, three of whom had suspected intake that could exceed 2 or more times the annual occupational limit (Roscetti 2022). One underwent chelation treatment (Connery 2024). These are just the most serious instances out of many cases that required 'bioassay' of affected individuals.

Glove breaches occurred as often as three times in a single week and roughly 2.5 times/month prior to 2021, when 19 instances were noted. A series of 10 incidents in late 2022-2023 spurred further review and criticism of the lab's glovebox safety program as work accelerates at the facility (Connery 2024). The regularity of these events suggests the potential for routine mobility of Pu throughout the facility – a possibility that appears to be borne out from reports of contamination on workers' skin in areas thought to be previously decontaminated (Wyland 2024b) and another recent case in which contamination was detected on a worker who was near but had not used a glovebox that suffered a breach (Dwyer 2024c).

Other glovebox incidents have included fires (3 in 2023, alone, due to the pyrophoric nature of Pu and calcium in material being repackaged), a glovebox tipping over without releasing radioactive material (2016), and a glovebox window being shattered when a worker lost control of a container, causing it to slip. Failed seals, improper valve closure and other engineering deficiencies have also led to dangerous conditions which compromised the integrity of gloveboxes to protect workers and others have been exposed while decontaminating and removing older boxes from the facility.

Triad National Security LLC, the contractor that operates LANL on behalf of the Department of Energy, was reprimanded by the NNSA in 2021 over safety lapses at PF-4. A series of 5 "series II violations" related to 4 separate incidents were noted between February, 2021 and July, 2021. These involved a criticality safety violation, radioactive skin contamination of three employees, the aforementioned flooding of a fissile material vault and separate flooding of gloveboxes containing fissile material through the glovebox ventiliation system. "Series II" violations "represent a significant lack of attention or carelessness towards responsibilities of (Department of Energy) contractors for the protection of public or worker safety" (O'Neill 2023). This cluster of events resulted in a notice of violation from NNSA and $1.4M in penalties (Prokop 2023). This represents only 3% of Triad's annual fee and NNSA's FY2021 performance evaluation of Triad was "excellent" or "very good" in all categories ("FY21 Triad Performance Evaluation Summary" 2021).

The most recent performance evaluation for Triad's management of LANL, issued in December of 2023, states that "Triad increased its production facility construction, maintenance, and program activity levels in pursuit of pit production milestones and identified several processes that needed improvement to provide for the safety of personnel. However, despite identifying needed improvements, Triad did not pursue safety related process improvements". NNSA again issued "very good" or "excellent" scores for all performance categories despite the noted lack of improvements to protect workers ("LANL FY 2023 Performance Evaluation Report" 2023).

The apparent contradiction between administering minor penalties for safety violations while citing ″very good″ and ″excellent″ achievement of performance metrics points to a mission-driven culture with an over-reliance on human infallibilty to ensure the safety of extremely hazardous processes. The 2021 notice of violation cited Triad′s failure ″to identify and correct quality problems in a manner that effectively prevented recurrence″ and an over-emphasis on corrective actions ″that focus on preventing employees from making mistakes rather than on making more effective and longer-lasting changes to engineered controls″ that can serve to avoid the cause in the first place (“Preliminary Notice of Violation, Triad National Security, LLC” 2023).

As with safety-class active ventilation, the cost of effective engineered controls is typically higher than the cost of employee training, but this choice results in less-reliable accident prevention and is contrary to widely-accepted best-practices in occupational health and safety which prioritize engineered controls as a first line of protective defense (CDC 2024). An over-reliance on worker training may be especially perilous during the ramp up to full-scale pit production when a large number of workers are new, temporary trade workers are onsite, and new procedures and work flows are being developed.

This is not a one-off. This is a pattern. This suggests the lab does not have sufficient controls to undertake the extraordinarily hazardous, new operations of pit production. They are having repeated contamination events, which shouldn’t be occurring.” - Dan Hirsch, retired director of environment and nuclear policy programs at the University of California, Santa Cruz, quoted in the Sante Fe New Mexican, Jan 9th, 2024.

ADEQUACY OF WORKER TRAINING

Many accidents that have occurred over the past several years within PF-4 appear to have resulted from incomplete or inadequate preparation of workers to evaluate and manage the complex and interconnected risks that exist within the facility.

Pit production has created a demand for thousands of new employees; 2077 at Los Alamos in FY22 and a similar number anticipated in FY23 (“Laboratory Employee Demographics and Housing Demand Information for the Construction Industry” 2023). Many of these new hires will lack significant experience in a high-security lab setting with a unique combination of hazards. Difficulty recruiting for certain positions has resulted in LANL investing in their own local training pipelines within nearby community colleges and offering full-tuition scholarships for tracks that cater to the lab′s staffing needs. These programs are training would-be staff for positions as radiological control technicians, electrical and mechanical trades, waste management, and numerous other support roles. According to a technical director at LANL, positions at PF-4 come with a $20,000 ″environmental″ bonus in order to recruit people to work in what they termed their ″more challenging facilities″ (Guzmán 2023c).

The cultural and socio-economic differences between Los Alamos and the surrounding region (noted in the opening of this chapter) creates a stark contrast between most regional employment opportunities and those at the national lab. LANL′s specialized training programs result in associates degrees or specialized certificates and come with the allure of above-average salaries but it is not clear that they are adequately preparing future employees to adopt the risks they are likely to encounter on the job.

LANL's 2023 performance evaluation noted that Triad had increased the number of craft workers and radiological control technicians, but blamed schedule slippage and "substantial cost overruns" on inadequate training, lack of "qualified and experienced resources" who were not able to meet demands ("LANL FY 2023 Performance Evaluation Report" 2023). This has resulted in numerous incidents, including electrical accidents that were blamed on employees performing 'out of scope' work or not complying with procedures, unintended radiation exposures, damage to new equipment due to lack of experience with installation, and severe physical injuries.

Recent events continue to call worker training into question. In March of 2024, workers placed heavy equipment on a plate for a pressure-activated decontamination shower, apparently unaware of it's purpose. Water flowed until it seeped through walls and floors, reaching the basement and requiring decontamination of several areas. This was the sixth major flooding event in the facility since 2018. As a result, the Associate Laboratory Directorates for Weapons Production and Plutonium Infrastructure instituted a safety pause at PF-4 during which they "engaged the workforce in discussions about work tempo" and "balancing safety and production" (Dwyer 2024a; 2024b). Just a week later, night-shift employees largely ignored evacuation protocols in response to a glovebox fire alarm, having been told that it was inadvertently actuated.

Of greatest concern is whether all employees within PF-4 are adequately trained for the potential radiological risk. Because of the classified nature of the work within PF-4, many trade workers who perform temporary work and lack security clearances must be escorted at all times by a cleared individual. The Defense Nuclear Facilities Safety Board noted in December of 2023 that "facility specific contamination monitoring training is not being assigned until personnel meet all security requirements for unescorted access to the facility", implying that escorted personnel will not have received training to monitor themselves. While radiological control technicians (RCTs) would normally ensure that protocols are followed, at least one newly-trained RCT from the laboratory's training pipeline performed work for several weeks in 2023, including entry into radiologically controlled areas, without having been assigned a personal radiation dosimeter (Dwyer 2023). Personal dosimeters represent one of the most fundamental components of radiological safety. This event therefore calls into question the adequacy of the RCT's training as well as their preparedness to ensure the safety of those who may depend on them.

AMBITIOUS SCHEDULING INCREASES RISK

NNSA currently has a congressionally mandated deadline to produce 30 pits per year by 2026 at Los Alamos and 80 pits per year by 2030 using both of the chosen production sites ("50 U.S. Code § 2538a - Plutonium Pit Production Capacity," n.d.). It is widely acknowledged, including by NNSA administrators, that this goal is unattainable, particularly at Savannah River, which faces severe delays and complications. Despite the introduction of congressional amendments to remove the 80 pit/year requirement ("Garamendi Fights Against Wasteful, Dangerous Nuclear Weapons Spending in National Defense Authorization Act | Congressman John Garamendi" 2024), it was preserved in the House version of the 2025 National Defense Authorization Act. This deadline was arbitrary to begin with but is increasingly out of sync with the delays facing the warhead and missile programs that it is intended to support. In rushing to meet the 2026 and 2030 production goals, NNSA unnecessarily increases risk to workers, nearby communities, and to their own ambitions should a severe accident occur.

In 2022, round-the-clock operations began at PF-4 in an effort to maximize productivity and allow simultaneous removal and decontamination of old equipment while new equipment was installed and brought online for pit production, all while other work in the facility carried on. Not by coincidence, the number of reported safety incidents in 2022 rose by 33% compared to the previous year. In 2023, NNSA noted that Triad had struggled to gain timely approval for Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR) to meet DOE standards for the plutonium facility, often requiring multiple resubmissions to gain approval, demonstrating that inattention to safety is actually counterproductive rather than expedient ("LANL FY 2023 Performance Evaluation Report" 2023).

In another sign that ambitious deadlines are leading to increased risk tolerance at LANL, in January of 2024 the lab requested permission to increase the types of activities that are allowed under what is called "limited operations mode" – a condition usually induced by the incomplete functioning of safety systems in the facility, whether planned or unplanned (Gutowski 2024b). Limited operations mode is sometimes invoked to allow construction activities, temporary shutdowns of critical systems during equipment changeovers, or in the wake of accidents requiring remediatory action or investigation. The request to increase the allowed scope of work under such conditions suggests that Triad finds the associated safety requirements and/or lost time too cumbersome to meet deadlines and is willing to accept a higher risk threshold in the name of convenience.

Alleviating the mandate for arbitrary production deadlines could have a significant positive impact on worker safety, reduce overall project risk, reduce costs, and allow a more careful approach to what are arguably some of the most hazardous processes undertaken by the weapons complex. Rushing to achieve production with newly trained workers, new equipment, and new procedures while seeking opportunities to shortcut safety puts workers, communities, and the program at risk.

Looking Forward : Handling a Growing Waste Stream

A LONG-TERM SOLUTION OR A SHORT-SIGHTED PLAN?

A future risk that has yet to fully materialize is the issue of waste that results from pit production and how it will be handled in addition to existing waste streams and legacy waste that is still onsite and awaiting remediation and disposal. Because LANL has limited capacity to accumulate nuclear waste onsite (and very little at the technical area where pit production takes place), continuous and efficient waste removal will be required to ensure productivity at projected levels. This risks overburdening an already challenged waste managmenent stream.

Pit production generates both liquid and solid waste. These include acids, radioactive liquid waste, chemicals and salts, contaminated consumables (such as gloves, rags and other single-use items), metals, tools and even entire gloveboxes retired from service. This waste must be transferred to the laboratory's transuranic waste management site, where it is packaged and prepared for shipment to the Waste Isolation Pilot Plant (WIPP), near Carlsbad, NM. LANL estimates that they will generate in excess of 2000 containers of transuranic waste per year once they reach the 30 pit/year production rate (McConnell 2020). If the waste stream is proportional to production levels, Savannah River can be expected to contribute another ~3,300-3,500 containers annually.

WIPP remains the sole repository for nuclear waste in the United States ("U.S. Department of Energy's Waste Isolation Pilot Plant - About Us," n.d.). It began receiving shipments in 1999 and was originally slated to house up to 175,000 cubic meters of nuclear waste in an underground geologic setting that would be secure for 10,000 years (^{239}Pu has a half-life of 24,300 years). As the name suggests, the 'Pilot Plant' was originally expected to close in or around 2024. The lack of any feasible alternative disposal site has led to the inevitable extension of WIPP's operation. In 2023, the state of NM granted a 10 year permit renewal however DOE contends that they may need to rely on the facility into the 2080s (Hedden 2023). Projected capacity at WIPP as well as prioritization of legacy waste vs newly-produced waste remain contentious and illustrates the multifaceted uncertainties in US long-term nuclear waste management strategy.

DOE claimed that WIPP was nearing 43% of it's licenced capacity as of 2024 but nonetheless required additional physical space going forward, resulting in additional excavation (Forinash and Hobbes 2024). A 2020 National Academy of Sciences study concluded that the facility may have insufficient capacity to absorb pit waste in addition to other transuranic waste and surplus plutonium from across the complex under its originally specified quota (Committee on Disposal of Surplus Plutonium at the Waste Isolation Pilot Plant et al. 2020). One condition of the New Mexico Environmental Department's recent permit renewal is that they reserve the right to close the site down if Congress approves increased capacity in the future, ostensibly prohibiting any future expansion. The recent defeat of a separately-proposed interim storage facility for nuclear fuel that would have been situated nearby appears to demonstrate that long-time vocal opposition from NM residents is resonating with state government and licensing agencies who may have a diminishing appetite for hosting nuclear waste ("N.M. Delegation Statement on Nuclear Regulatory Commission Approval of Holtec" 2023).

WIPP's future operation and capacity for pit waste could also be jeapordized by accident. In 2014, two closely spaced accidents resulted in a three year closure of the underground repository after a mining truck caught fire underground and when a barrel of improperly packaged radioactive waste exploded, severely contaminating a portion of the facility and sending plutonium to the surface up to 20 miles away (Klaus 2019). Although NNSA argues the benefits of redundancy in having a two-site pit production capability, another accident such as those in 2014 would likely result in both sites having to cease operations since the capacity for onsite waste accrual at Los Alamos and Savannah River is finite. Reliable and safe long-term storage is therefore an Achilles heel for plutonium pit production as well as the associated expansion of the US nuclear arsenal.

THE PERILS OF YESTERDAY'S WASTE

Even in the absence of new waste from pit production, both Los Alamos and Savannah River still play host to decades-old waste that awaits proper disposal and remediation – a problem that will only be compounded as pit production accelerates. At LANL, most of this work occurs at the labs transuranic waste treatment facility at Technical Area 54, including a site known as Area G where pit production waste would be packaged and staged prior to being shipped to WIPP (Fig. 11). Area G was originally opened in 1957 as a waste dump and contains "32 pits, 194 shafts, and four trenches with depths ranging from 10 to 65 feet below the original ground surface" ("TRU Waste Management Area G - Fact Sheet" 2019). The waste burial sites are believed to be unlined and contain mixed legacy radioactive waste (Abbott 2011). Above ground, the site hosts around 2200 transuranic waste drums, only ~170 of which met criteria for disposal at WIPP as of 2022. More than 1550 are thought to require some type of remediation (Thatcher 2022), repackaging or separation of incompatible waste in order to

Figure 10 Routes and vehicles used for transuranic waste shipments to the Waste Isolation Pilot Plant

Transuranic waste reaches the Waste Isolation Pilot Plant (WIPP) via interstate highway using specially designed trucks laden with 'TRUPACT' waste shipment containers, each of which can hold fourteen 55-gallon drums of waste. The containers are designed to be bullet proof, crash and fire resistant.
SOURCE: Waste Isolation Pilot Plant/US Department of Energy, Los Alamos National Laboratory

avoid a repeat of the drum explosion that occurred at WIPP in 2014. 30-40 shipments of ~ 17 drums each are expected to be made annually, at a cost of around $100,000 per drum (Summerscales 2023).

In addition to the hazards already present at Area G, the site is perhaps one of Los Alamos's most vulnerable. Temporary dome structures are used to house above-ground waste at the site and they lack most of the structural and engineering controls (including advanced fire suppression and HEPA air filtration) that would be present in a more permanent structure to help prevent accidental material release. The domes are classified as Category 2 nuclear facilities, meaning that there is "the potential for significant *onsite* consequences" according to DOE standards ("Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports" 1992) however the site is less than one mile from newly constructed residential housing in White Rock, NM (Fig. 11) and has been threatened by wildfires in recent years, arguably raising the risk of significant off-site consequences as well, particularly from airborne dispersal of contamination, accidental rupture of waste containers or fire, all of which could result in relatively high mitigated offsite doses of radiation (Connery 2022a; Dunlevy et al. 2020).

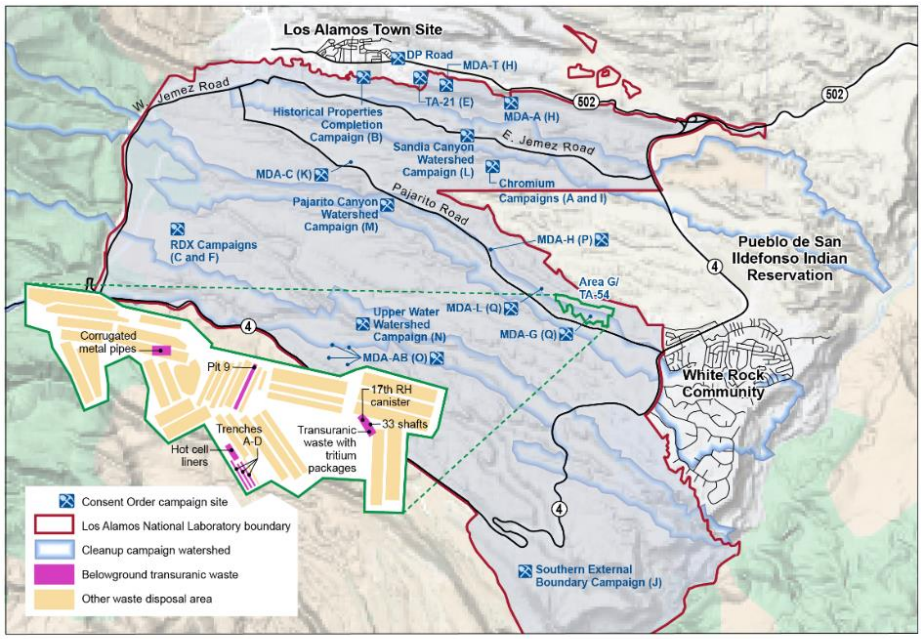
As with PF-4, increasing the demand and pace of work on the site is likely to elevate risk for workers and nearby communities and should be considered as part of the cumulative risk associated with pit production.

Ultimately, the problem of waste management and remediation of past waste is a question of priorities. In introducing his 2024 budget, President Biden quoted his father as saying "show me your budget and I'll tell you what you value". The federal budget requests in FY25 for environmental management were 15.3% and 10.6% *below* FY23 levels at Los Alamos and Savannah River, respectively, while the NNSA saw a 16% *increase* in its weapons activities budget over the same period. Legacy waste cleanup at Los Alamos represents roughly 5% of the lab's FY25 funding while pit production will consume roughly 40% of a record $5B annual budget ("DOE Budget in Brief - FY 2025 Congressional Justification" 2024).

The true environmental cost of nuclear weapons production is virtually insurmountable given the long-lived nature of what is left behind and the near impossibility of achieving complete environmental restoration. As the New York Times noted in an analysis of what may be a $528 billion dollar cleanup effort at Hanford, Washington, *"at site after site, the solution has come down to a choice between an expensive, decades-long cleanup or quicker action that leaves a large amount of waste in place"* (Vartabedian 2023). For the most part, current US plans are prioritizing the latter in favor of efforts that exacerbate the problem going forward as new weapons development is undertaken. As scholar Shannon Cram wrote, *"The challenge of remediation, then, is to measure and manage the conditions of carcinogenic encounter—titrating environmental contamination with human activity to achieve the appropriate balance of permissible dose"* (Cram 2015).

The requirements for pit production outlined in this work recall a similar tension – that between measuring and managing perceived national security requirements and the human and environmental costs that are deemed permissible and borne domestically to deliver that security.

Figure 11 Proximity of LANL's primary transuranic waste site to the general public



Sources: Department of Energy (map); ©2023 Google (terrain). | GAO-23-105665

Top: Map of Los Alamos National Laboratory cleanup locations, with detail of TA-54 (Area G) shown in inset. The area contains numersou trenches and shafts containing buried waste as well as above-ground transuranic waste, some of which is deemed unsuitable or unsafe to be shipped to WIPP. Bottom: Aerial image showing the proximity of the Area G transuranic waste storage area from new housing being built in White Rock, a community adjacent to Los Alamos where many laboratory employees reside. SOURCE: Top - (Anderson 2023); Bottom - Modified from Google Earth, 2024 (Spaulding/UCS)

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