SRS WATCH

Savannah River Site Watch

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**Comments by Tom Clements, Director of Savannah River Site Watch (SRS Watch) in response to Federal Register Notice of December 16, 2020: "Notice of Intent To Prepare an Environmental Impact Statement for the Surplus Plutonium Disposition Program"**
(https://www.govinfo.gov/content/pkg/FR-2020-12-16/pdf/2020-27674.pdf)

**Programmatic Environmental Impact Statement (PEIS) Needed on Plutonium Disposition and All Plutonium Waste Streams Designated for the Waste Isolation Pilot Plant (WIPP) - including from Plutonium Disposition, Proposed SRS Plutonium Bomb Plant (PBP) & Fuel Fabrication for Versatile Test Reactor (VTR)**

These scoping comments are being formally submitted by Savannah River Site Watch (https://srswatch.org/) for the record in response to the Federal Register notice on surplus plutonium disposition. I expect that there will be a response in the draft Environmental Impact Statement to each and every comment below. Thank you in advance for that.

These scoping comments are being submitted based on the knowledge gained from having been involved from the public-interest perspective in DOE's plutonium disposition efforts since 1995, when the first National Academies of Sciences reports on the matter were released. From the start of the plutonium disposition efforts, I supported immobilization of plutonium as waste. It was a colossal and costly mistake on DOE's part to terminate that effort, influenced by self-serving pro-MOX forces inside and outside DOE, underscoring that wisdom on the matter at hand was with public interest groups that supported immobilization and that opposed the MOX boondoggle. (The MOX debacle still merits investigation by Congress and other entities.)

I request that all documents referenced in the draft EIS will be made available on line and easily available for public review.

I also request that all "data call" documents solicited to prepare the draft EIS be made part of the public record and be made available via the internet. Further, I request that all Critical Decision-0 and Critical Decsion-1 documents related to the expanded plutonium disposition facilities in the K-Area at SRS be made part of the public NEPA record.

Additionally, I request that all scoping comments be published in the draft EIS, along with the responses to them.

The on-line scoping webinar on January 25, 2021 posed problems due to a broken link in an email notice sent by NNSA and due to an incorrect link printed in The State newspaper in Columbia, SC. The transcript of that meeting will show that I made an oral comment about this during the meeting. The problem with the links is simply unacceptable given the NNSA financial resources and personnel involved in the scoping process. When the draft EIS is announced, much better performance will be expected.

Please acknowledge receipt of these comments, which are being emailed and, due to poor handling of emailed comments during the plutonium pit NEPA process, are also being mailed.

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Claims have been made that disposal of plutonium is being done for nuclear non-proliferation reasons. While plutonium undergoing disposal might not be readily available for nuclear weapons use, what impact does plutonium disposition have on the maintenance of around 4000 active and reserve weapons and plans for several new weapon designs? Is there any connection or impact?

**Amount of plutonium covered in the NOI needs clarification**

The Notice of Intent states that "in August 2020 NNSA prepared a Supplement Analysis (SA) based on the analysis presented in the 2015 SPD SEIS to evaluate using dilute and dispose for disposition of 7.1 MT of non-pit plutonium that comprises a part of the 34 MT (DOE/EIS–0283–SA–4, August 2020)" and "This same dilute and dispose process is being proposed to disposition the full 34 MT of surplus plutonium that is the responsibility of the Surplus Plutonium Disposition Program."

Thus, will the draft EIS apply to an additional 26.9 MT of surplus plutonium or not? Please clarify the amount of plutonium to be covered by the draft EIS and why the NOI was issued for 34 MT when the actual amount appears to be 26.9 MT.

How does the 6 MT of plutonium designed for dilute & dispose in 2016 relate to the 34 metric tons covered in the NOI? (See Record of Decision, April 5, 2016: https://www.govinfo.gov/content/pkg/FR-2016-04-05/pdf/2016-07738.pdf) Is D&D now proposed for 40 MT (34 MT + 6 MT) of surplus plutonium?

How much plutonium designated for disposition is now managed and will be managed during storage, processing and disposal by DOE's National Nuclear Security Administration and/or DOE's Office of Environmental Management? What is the relationship between the offices of NNSA, EM and WIPP site management in the D&D project?

The National Academies of Sciences indicates in its plutonium disposition report that 48.2 MT of plutonium could go to WIPP. From the report: "Therefore, this report reviews and assesses the viability of DOE's plans to process up to 48.2 MT of surplus plutonium—the amount that is under consideration or slated for disposal—as diluted surplus plutonium transuranic (DSP-TRU) waste in WIPP." Does DOE/NNSA agree that 48.2 MT would eventually be processed for disposal in WIPP? Does that mean that an additional 8.2 MT would eventually go to WIPP (40 MT now apparently designated by DOE to go to WIPP + 8.2 MT not yet designated)?

How much plutonium is currently surplus? In total, how much surplus plutonium will eventually be disposed of? How does plutonium not yet designated for future disposition impact current planned development of facilities? How would the draft EIS and final EIS before us now relate to or impact preparation of future NEPA documents on plutonium disposition?

If more plutonium than mentioned in the NOI were to be formally considered for disposition, which appears to be the plan, what type of NEPA document(s) would be prepared? Why isn't the full amount of surplus plutonium being considered now? If more plutonium is added later and reviewed under NEPA how does that not comprise "segmentation" under NEPA?

**Programmatic Environmental Impact Statements (PEISs) Required**

Concerning plutonium processing and disposition, at least two Programmatic Environmental Impact Statements (PEISs) are needed.

The first PEIS that is needed, as has been communicated several times to NNSA by the lawyer for Savannah River Site Watch, Nuclear Watch New Mexico and Tri-Valley CAREs, concerns system-wide impacts of plutonium pit production. Though a PEIS is legally required, NNSA went immediately to preparation of site-specific NEPA documents for Los Alamos National Lab and the Savannah River Site (SRS) and skipped the required PEIS. The mandated PEIS would include an overview of all DOE sites that would have pit-production impacts, then the site-specific documents would be prepared. The PEIS would review capacity of the Waste Isolation Pilot Plant to receive TRU from pit production and that document would thus be integrally related to other plutonium and TRU waste streams designated for WIPP.

The second PEIS that is needed and hereby requested would be on generation and disposal of transuranic waste (TRU) from the various plutonium-related programs in the Waste isolation Pilot Plant (WIPP) or a second TRU repository. Three plutonium-centered projects will generate large volumes of TRU which, along with existing TRU, may cause the WIPP capacity to be over subscribed. Those projects are: 1) plutonium disposal as discussed in the NOI now at hand (plus future amounts of plutonium designated for disposal), 2) TRU from fabrication of plutonium pits for nuclear warheads and 3) TRU from fabrication of fuel for the Versatile Test Reactor (VTR), either at SRS or Idaho National Lab. None of those three plutonium projects can be analyzed in a stand-alone manner so as to ignore the significant amounts of TRU waste generated and the impacts of such generation and disposal by all the projects. Thus, a PEIS on overall plutonium management and disposal issues is needed. That PEIS would include a full review of WIPP and planned and future TRU going to that facility, with the 2024 New Mexico Environment Department license renewal date in mind.

Given WIPP license renewal complications and the volume cap of WIPP under the Land Withdrawal Act (LWA), there may well be no place for all TRU to go unless a new repository is constructed or unless TRU generation is curtailed (such as cancellation of the proposed Plutonium Bomb Plant at SRS or termination of the VTR project).

Given WIPP volume pressures, plans for a second TRU waste repository must be considered in the draft EIS.

The National Academies of Sciences is supportive of a PEIS on plutonium disposal in WIPP, as recommended in *Review of the Department of Energy's Plans for Disposal of Surplus Plutonium in the Waste Isolation Pilot Plant (2020)*, by the Committee on Disposal of Surplus Plutonium at the Waste Isolation Pilot Plant, Nuclear and Radiation Studies Board, Division on Earth and Life Studies). See pertinent recommendation on page 101 of the report:

> RECOMMENDATION 5-5: The Department of Energy should implement a new comprehensive programmatic environmental impact statement (PEIS) to consider fully the environmental impacts of the total diluted surplus plutonium transuranic (DSP-TRU) waste inventory (up to an additional 48.2 MT) targeted for dilution at the Savannah River Site and disposal at the Waste Isolation Pilot Plant (WIPP). Given the scale and character of the diluted surplus plutonium inventory, the effect it has on redefining the character of the WIPP, the involvement of several facilities at several sites to prepare the plutonium for dilution, a schedule of decades requiring sustained support, and the environmental and programmatic significance of the changes therein, a PEIS for the whole of surplus plutonium that considers all affected sites as a system is appropriate to address the intent and direction of the National Environmental Policy Act and would better support the need for public acceptance and stakeholder engagement by affording all the opportunity to contemplate the full picture.

The *Final Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina (SRS Pit Production EIS)* (DOE/EIS-0541) states this about the significant volume of TRU from pit production for nuclear weapons at SRS and Los Alamos:

> TRU Waste: Under the Proposed Action, significant quantities of TRU waste could be generated at SRS and shipped to WIPP for disposal. It is estimated that approximately 22,950 cubic meters (30,000 cubic yards) of TRU waste could be

> generated over the life of the project (i.e., 50 years) at SRS, assuming a production rate of 50 pits per year. In addition, approximately 5,350 cubic meters (6,998 cubic yards) of TRU waste could be generated over the life of the project (i.e., 50 years) at LANL, assuming a production rate of 30 pits per year. For NEPA purposes, it is assumed that the available volume capacity of the WIPP facility would accommodate the conservatively estimated TRU waste volume from pit production that could be generated over the next 50 years. (page S-32)

The *Draft Versatile Test Reactor Environmental Impact Statement* (VTR EIS) (DOE/EIS-0542) also reveals a large amount of TRU as a by-product of fuel fabrication at either SRS or Los Alamos:

> The Waste Isolation Pilot Plant (WIPP) is currently the only disposal option for TRU waste. WIPP's Land Withdrawal Act total TRU waste volume limit is 175,564 cubic meters. As of the reporting date for the 2019 *Annual Transuranic Waste Inventory Report* (ATWIR), 67,400 cubic meters of TRU waste were disposed of at the WIPP facility. The alternatives and options evaluated in this EIS would generate an estimated 24,000 cubic meters of TRU waste. TRU waste volume estimates such as those provided in NEPA documents, cannot be used to determine compliance with the WIPP Land Withdrawal Act TRU waste volume capacity limit. These wastes and waste from other actions will be incorporated, as appropriate, into future ATWIR TRU waste inventory estimates. (page S-40)

If pit production were to produce 28,300 cubic meters of TRU and VTR fuel fabrication were to produce 24,000 cubic meters of TRU, for a total of 52,300 cubic meters, about 120,000 cubic meters remains in WIPP for all other TRU disposal. As the Land Withdrawal Act volume cap may not be increased, or may not be increased without constraints on the license by the New Mexico Environment Department, there may not be adequate space in WIPP for plutonium disposition. The draft EIS on surplus plutonium disposition simply can't assume that more drifts will be added to WIPP to accommodate the vast amount of plutonium slated for disposal in WIPP.

If about 6 MT of plutonium are TRU waste from VTR fuel fabrication - a figure from an expert on the matter - then this could imply that disposal of 34 MT of plutonium will create a far larger amount of waste than 24,000 cubic meters. Thus, how many cubic meters of TRU would disposal of 34 MT of plutonium in WIPP comprise? How many cubic meters of TRU would be generated by disposal of 40 MT of plutonium in WIPP? What percentage of the LWA volume cap would plutonium disposal compromise?

Taking into account all other TRU planned for disposal in WIPP, the draft EIS on surplus plutonium disposition must decisively prove that there is space for 34 MT or 40 MT of surplus plutonium in WIPP. Unless the ill-conceived VTR project were to be canceled, which is very possible, or if the proposed and unjustified SRS Plutonium Bomb Plant (PBP) were to be canceled, a growing possibility, there simply isn't volume in WIPP for all the surplus plutonium slated for disposal. This underscores the urgent need for preparation of a PEIS addressing all plutonium to WIPP, to be prepared before the *Environmental Impact Statement for the Surplus Plutonium Disposition Program* is prepared.

DOE has ignored the recommendation by the NAS concerning the PEIS but it is unknown why the suggested approach has been rejected. The NOI failed to explain this but the draft EIS must do so.

Does DOE have a "pecking order" of the various planned plutonium waste streams to WIPP, including from the pit project, the VTR project, surplus plutonium disposition and other TRU?

To reiterate, considering the above, large impacts to WIPP of the three above-named plutonium projects, I request that the PEIS be conducted before any site-specific EIS for plutonium disposition is conducted.

A NNSA official has stated that WIPP is a "choke point" for the pit project (for nuclear weapons) and this also may apply to surplus plutonium disposition and disposal of TRU from the VTR project. See Exchange Monitor article of September 10, 2020: *TRU Waste 'Far and Away' Largest Challenge for NNSA Pit Mission, Official Says*: "Far and away the biggest challenge for NNSA is to make sure that the disposal system for transuranic waste is robust enough to not become a choke point for our mission," McConnell said." (James McConnell, NNSA's Associate Administrator for Safety, Infrastructure and Operations) This underscores the need for the PEIS on WIPP volume. Is WIPP also a "choke point" for the 34 MT of plutonium covered in the NOI?

As part of the draft EIS on "plutonium disposition," a stand-alone review of overall WIPP volume and impacts of other TRU disposal programs must be conducted. 34 metric tons or more of plutonium, when downblended, will take up a huge volume in WIPP and put pressure on the legal volume cap as stipulated in the LWA. An expansion of WIPP to receive more volume that currently specified by the LWA cannot be assumed. Likewise, a NMED license extension for WIPP, especially with no conditions attached, cannot be assumed.

What would happen to the surplus plutonium disposition project if disposal space at WIPP is limited? Would the SRS project slow down or be halted? Would shipments of plutonium or storage of plutonium at SRS or other sites be impacted? If WIPP volume were to be a limiting factor, how would space be assigned to plutonium from the surplus plutonium disposition project (and the other plutonium TRU-generating projects, such as plutonium pits for nuclear weapons and from the VTR project)? These issues would be covered in the requested PEIS as well as the draft EIS at hand.

The PEIS and draft EIS must consider the need for a second TRU repository. For plutonium disposition, is NNSA counting on either a second repository of an increase by Congress in the volume cap as legally established by the Land Withdrawal Act? Is DOE counting on no constraining conditions being applied by the New Mexico Environment Department on any WIPP license extension, or not?

I request that the draft EIS report anticipated TRU waste amounts both in weight and in cubic meters.

**Sources of plutonium to be disposed of?**

Where is the plutonium stored that is slated to undergo disposition? Does it primarily consist of plutonium pits now stored in bunkers at Pantex? How will the plutonium scheduled for disposition be selected? Are some pits unable to be used again in a nuclear warhead and therefor at the top of the list for disposition?

How much of the approximately 11.5 metric tons of plutonium now stored at SRS - see attached DOE document confirming this amount - will undergo disposition? Will this material already at SRS be processed before more plutonium is brought into South Carolina? What is the schedule for bringing more plutonium into South Carolina, processing it and shipping it out?

I request that no more plutonium be brought to SRS until the 11.5 MT now at the site are removed. Is this the plan or not?

What are the amounts of plutonium to be shipped to SRS and processed on an annual basis and cumulative basis and in what form will the incoming plutonium be?

Will more plutonium be declared surplus?

How will such plutonium be shipped to SRS? Will pits or other plutonium need to be processed into unclassified forms before transport? Will intact pits be transported to SRS? (Have any pits ever been shipped to SRS or stored or processed at SRS?) How much plutonium slated for disposition will be at SRS at any given time? Please present plutonium amounts to be at SRS from now to the end of the plutonium disposition n project.

What firm guarantee can DOE give that "new" plutonium brought into South Carolina will not be stranded at SRS? What would be the environmental impacts be of additional "stranded" plutonium at SRS? Will DOE/NNSA agree to a formal agreement with the State of South Carolina concerning removal of all plutonium imported for D&D (as well as for VTR fuel fabrication and pit production)? As this has environmental impacts, these matters must be discussed in the draft EIS.

As the VTR would operate for 60 years and use about 0.5 MT of plutonium per year, likely from surplus pits, for fuel fabrication, it could create around 6 MT of TRU in fuel fabrication. Would any of this TRU from VTR fuel fabrication be counted as part of the 34 MT covered in the NOI? Would that VTR TRU undergo dilute & dispose? If not, what process would prepare that waste for disposition?

Please explain the role of TA55 and PF4 at LANL in plutonium disposition. Which facilities or equipment would be located there? How much plutonium could be staged at those facilities, for plutonium disposition as well as for pits and what is the relationship between the pit and disposition programs? For example, is any facility or any equipment common to both programs? If there are common facilities and/or equipment which project gets priority in their use?

**How much plutonium has undergone "dilute & dispose" at SRS and how much of that has been disposed of it WIPP?**

The "dilute & dispose" process for surplus plutonium has been underway at SRS at low processing rates for a numbers of years. When did it begin? What has the performance of this project been? How much plutonium has been processed via this manner? In what type of containers has disposal taken place, and in what amounts, such as via Pipe Overpack Containers or Criticality Control Overpacks? How many POCs and CCOs from SRS have been disposed of it WIPP? How much plutonium from SRS been disposed of in WIPP?

Are there plans as plutonium disposition expands at SRS for use of containers with larger amounts of plutonium? In the past, SRS officials have said that containers with 1 kilogram of D&D plutonium had been considered. Is this still the case? Are plans for direct disposal of plutonium metal being considered, including pits? Are plans for direct disposal of plutonium-bearing 3013 cans being considered? Would these forms meet the WIPP WAC?

What type of safeguards are in place or will be put in place to monitor the amount of plutonium that goes into WIPP? Will such safeguards be part of the US-Russia plutonium disposition agreement (which Russia has abrogated)? Will the International Atomic Energy Agency (IAEA) monitor disposal of plutonium in WIPP and verify the amounts of plutonium processed at SRS going into WIPP? What will be the steps used for termination of safeguards at SRS, or upon disposal in WIPP? How will implementation of IAEA safeguards impact processing and packaging of plutonium at SRS and will there be associated environmental impacts?

I note that the NAS *Review of the Department of Energy's Plans for Disposal of Surplus Plutonium in the Waste Isolation Pilot Plant* underscores the importance of IAEA safeguards for the processing of plutonium and emplacement in WIPP of plutonium containers, see page 82:

> **5.1.1 Uncertain Protocols for International Inspection and Verification for Emplaced Waste**
> IAEA monitoring and inspections are an important component of the PMDA requirements and they could also provide enhanced public and international confidence that the material is properly accounted for and emplaced in WIPP. As noted in Chapter 2, the director of the Office of International Nuclear Safeguards at

> the DOE-NNSA reported to the committee that the DOE-NNSA is in the process of working with the IAEA to discuss what role, if any, IAEA involvement might play in the disposition of DOE-EM's 6 MT (Veal, 2019). Typical international safeguards (monitoring and verification) use accountancy to ensure that declared nuclear material is present as intended, coupled with a containment and surveillance system to ensure that no changes occur between inspections. Implementation of IAEA protocols for verification and monitoring of materials for pre-disposal are well established, but IAEA verification protocols for material emplacement in any repository are still under development. Inspection and verification protocols for repository emplacement, where access for monitoring may be a challenge and remote devices may compromise required passive safety measures, could have a significant impact on both repository operations and design (Haddal et al., 2014).
>
> The DOE-NNSA dilute and dispose Master Schedule for the 34 MT (see Figure 3-1; DOE-NNSA, 2018a) indicates verification protocols for the activities at SRS are to be in-place in in FY 2022 and for WIPP in FY 2023, yet the DOE-NNSA may emplace DSP-TRU waste with or without IAEA inspection protocols in place. Therefore, substantial uncertainty remains on the applicability and possible implementation of IAEA monitoring and verification protocols. Resolution of this uncertainty holds substantial implications for WIPP operations and future design changes (such as the new shaft and panels now under development), and therefore this issue remains a significant system vulnerability.

The issues raised by the NAS about impacts at SRS and to WIPP of IAEA monitoring and verification must be addressed in the draft EIS. Have comments in response to the NOI been solicited from the IAEA?

Additionally, as some plutonium already stored at SRS is under IAEA monitoring, will processing and packaging of this material be handled in any special way?

I request that the IAEA be involved in safeguards matters concerning plutonium disposition and that such a role be discussed in the draft EIS.

**What facilities at SRS are involved in plutonium receipt storage and processing?**

All the facilities at SRS that are currently being used or that have been used for plutonium receipt, storage and processing must be discussed in the draft EIS. Facilities that might be involved in the future obviously need full discussion.

At the "category 1" facility at the K-Reactor, are there plans to expand category 1 security in the K-Area or beyond the K Area? Would this include any new plutonium container storage pad outside the K-Reactor building? Would the E-Area continue to be used for staging of CCOs?

Are there low-level waste streams or chemical waste streams from the D&D process? The status of creation of any chemical or nuclear waste streams during the D&D process and how they will be disposed of needs discussion. Would D&D result in any on-site disposal of waste at SRS or disposal at other DOE or private waste disposal sites? Would there be disposal of D&D waste in unlined trenches at SRS? Which federal laws would apply to disposal of this waste?

It has been stated that the goal at SRS is to increase the number of gloveboxes involved in dilute and dispose. Please discuss how many gloveboxes would be installed, where they would be installed and discuss the capacity and schedule and timetable of ramping up the D&D process in them. How many kilograms of plutonium would be processed per year in the gloveboxes until the 34 MT or 40 MT have been disposed of?

How many jobs would be involved at SRS as the D&D rate increases? How many jobs would D&D entail at WIPP and at other sites or DOE offices (such as transport, via the Office of Secure Transportation)? How much would D&D cost on an annual basis from start to finish?

Could the shell of the mixed oxide fuel plant at SRS be considered for the D&D process or plutonium feedstock preparation? It is not a given that the proposed SRS Plutonium Bomb Plant (PBP), for pit production for old and new nuclear warheads, would be located in the old MOX plant, thus making it potentially available for other uses. Could the MOX building be used for staging of D&D containers before shipment off site?

Could the mothballed Waste Solidification Building (WSB) at SRS, built as part of the failed MOX project, have a role in the D&D projects, such as staging for D&D containers or other waste?

What are risks, including corrosion and gas generation, to plutonium storage containers over lengthy periods of storage? What is the monitoring program of the inner and outer containers holding plutonium slated for D&D?

**Plutonium for Dilute & Dispose process?**

From which site(s) and which processes would plutonium oxide or pulverized plutonium originate? Will the ARIES process be used to prepare plutonium for disposal?

Could the ARIES process or other processes to prepare plutonium for D&D be located at Los Alamos, SRS and/or Pantex? Would the entire D&D process itself be located at Los Alamos, Pantex or another site? A full evaluation of locating all the D&D process at LANL or Pantex, in addition to SRS, must be included in the draft EIS. (See attached paper for more discussion about the Pantex-only option.)

How is ARIES adopted to process plutonium with different levels of impurities, e.g. pits vs non-pit "alternate feedstock?" What level of plutonium purity is needed for the dilute & dispose process? How much impurities are allowed in plutonium feedstock?

Are there plans for the ARIES process to be made more efficient or improved? If the ARIES process is modified in any way, will this be communicated to the public as part of a NEPA analysis?
Could an aqueous process be used for plutonium purification? Could the 66-year-old H-Canyon reprocessing plant at SRS be used for this purpose?

As plutonium pits that would be processed for disposal are located at Pantex, does it makes sense to locate the entire D&D program at Pantex? Locating all D&D activities at Pantex, as well as the process to produce plutonium oxide, would mean far less distance that plutonium would be shipped for processing and disposal, resulting in less risk in transport and less security risks. Additionally, security at Pantex is high. I request that an all-Pantex option be considered.

The Virtual Test Reactor fuel fabrication process at SRS or LANL would produce a large amount of plutonium waste and this material might have to be downblended and under safeguards. Would the D&D process for surplus plutonium disposition be applied to VTR TRU and would there be any overlap with D&D and management of VTR TRU waste?

The nature of the "inert material" known as "stardust" (also called a "multicomponent adulterant" by NNSA) used in the dilute & dispose process needs full discussion. What is the nature of the "inert material" into which the plutonium would be downblended? Has the make-up of the stardust material changed since the initial D&D was implemented? What is the "proliferation resistance" of this material to the removal of weapon-grade plutonium, via reprocessing or other techniques? Does the material itself pose health or environmental risks in handling or disposal? Could the formulation of stardust change in the future?

The plutonium currently undergoing D&D at SRS is going into CCOs, which may hold 300-380 grams of plutonium per container. How many grams/container will be analyzed in the draft EIS? Will larger amounts of plutonium be considered for loading into CCOs or larger containers? Will plutonium be approximately 10% or less of the material in the D&D container? How will the amount of plutonium per container be verified by DOE/NNSA (and the IAEA)? What will be the "attractiveness level" of plutonium containers going into WIPP?

For plutonium already disposed of in WIPP, whether from Rocky Flats or in POCs or CCOs from SRS, have there been shown to be risks of such disposal in WIPP? Such as heat or gas generation of concern or chemical reactions of concern? How is placement of plutonium POCs or CCOs taken into consideration in WIPP? Is such placement near to containers that could be at risk of explosion?

Will containers additional new plutonium brought into SRS for disposal undergo "destructive examination" or "non-destructive examination" during storage? What are the environmental impacts of this? Will SRS have the capacity to weld shut the 3013 cans that might be examined via DE, for long-term storage? Will cans that are not welded shut be stored and for how long?

Does dilute & dispose meet the "spent fuel standard" or "stored weapons standard" as established by the National Academies of Sciences in 1995 and in the DOE's initial plutonium disposition EIS process? If not, why not? Has DOE/NNSA established an equivalent of the "spent fuel standard" or "stored weapons standard" with the D&D process now being deployed? Have the "spent fuel standard" and "stored weapons standard" been abandoned?

Will some form of proliferation risk assessment of disposing of D&D container of plutonium in WIPP be prepared and made a part of the draft EIS record? If not, why not? I request preparation of this proliferation assessment as part of this NEPA process. Is WIPP at risk of becoming a "plutonium mine?"

What happens if the D&D project for 34 MT/40 MT is begun and stops midstream? How will the plutonium already at SRS be managed? Will it be returned to the site of origin? How long can such plutonium safely be stored at SRS and in which type of container?

What are the criticality risks of operating various gloveboxes for D&D? What are risks to workers and the environment in case of an accidental release of plutonium or unanticipated nuclear criticality? Would a plutonium fire be possible and what would be the impacts?

How many shipments of both pure plutonium and downblended plutonium and how many shipment miles would be involved in the various disposition options?

**Immobilization**

The most promising method to process and dispose of plutonium was immobilization of ceramic pucks containing plutonium in vitrified high-level waste as SRS. The process evidently was killed for political reasons in 2002, by those backing the failed, mismanaged plutonium fuel (MOX) project.

Discuss why the can-in-canister immobilization project was killed. Discuss the possibility of reviving such immobilization at SRS.

Another approach to immobilization was transfer to high-level waste tanks of plutonium, for direct vitrification along with high-level waste. In 2009, DOE issued an "Interim Action Determination" - *Processing of Plutonium Materials in H-Canyon at the Savannah River Site -*

authorizing disposal of 420 kg of plutonium materials via H-Canyon into the SRS tank system. How much plutonium was vitrified in this manner and what were the results of such vitrification? What was the impact to systems at the Defense Waste Processing Facility (DWPF) with this program? Was a criticality risk posed at DWPF or any other point in the tank-waste system? How much of that plutonium transferred to HLW tanks remains there? Why was that approach terminated? Can it be revived? There must be a full discussion of this in the draft EIS.

**Other processes for plutonium processing?**

Other processes for the plutonium downblending process should be considered, such as mixing into a stainless steel matrix or using a ceramic form, such as the Hot Isostatic Pressing (HIP) process that has been developed in the United Kingdom.

For unique surplus plutonium materials, is processing directly through the H-Canyon into the SRS waste tanks being considered? For example, SRS is evidently planning to process the stainless-steel-clad Fast Critical Assemblies (FCAs) from Japan, containing about 331 kilograms of plutonium, directly into the waste tanks, as part of the 6 MT designated for disposal. Would other such unique materials, such as plutonium from Europe, be part of the 34 MT being considered for disposal in this NEPA process?

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<u>Attachments submitted into the record and for consideration and response in the draft EIS:</u>

#1 "Charting the Best Path Forward for Surplus Plutonium Disposition," paper presented at the July 2020 meeting of the Institute for Nuclear Materials Management (INMM), by Dr. Edwin S. Lyman, Director of Nuclear Power Safety, Climate and Energy Program, Union of Concerned Scientists, Washington, DC.

#2 DOE document "2020 Savannah River Site Plutonium Inventory Update"

**Thank you for consideration of these comments submitted by:**

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Attachment1 to Clements scoping comment 1/28/2021

# CHARTING THE BEST PATH FORWARD FOR SURPLUS PLUTONIUM DISPOSITION

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## ABSTRACT

The United States has a stockpile of nearly 60 metric tons of weapons-grade plutonium that has been designated as excess to military needs and is slated for disposition. In 2007, the Department of Energy (DOE) began constructing the Mixed-Oxide (MOX) Fuel Fabrication Facility at the Savannah River Site (SRS) in South Carolina in order to process the plutonium into MOX fuel for use in light-water reactors. However, in 2018, as the result of extensive delays and ballooning costs, the Department of Energy (DOE) terminated the trouble MOX project. Instead, DOE has proposed using a process called "dilute and dispose" (D&D) to convert the plutonium to a form less attractive for nuclear weapons use and suitable for disposal in the Waste Isolation Pilot Plant (WIPP), a deep geologic repository in New Mexico. The current plan entails shipping plutonium pits from the Pantex Plant in Texas to Los Alamos National Laboratory (LANL) in New Mexico for conversion to plutonium oxide, shipping the oxide to SRS for dilution and preparation of waste packages, and then shipping the waste product back to WIPP in New Mexico. Given the security risks associated with separated plutonium transport, DOE should reconsider this plan. Installation of process lines at Pantex for oxide production and dilution would eliminate two cross-country transport links and would be far more efficient. In addition, there is the possibility that some (or all) of the plutonium will be shipped instead to Idaho National Laboratory (INL) for conversion to fuel for the proposed Versatile Test Reactor. This alternative would also expose the plutonium to additional risks of theft or diversion during storage, transport, and processing. DOE should ensure that the approach it selects for plutonium disposition does not create unnecessary security risks. The Nuclear Regulatory Commission (NRC) is undertaking numerous activities related to the licensing and oversight of small modular light-water reactors (SMRs) and non-light-water reactors.

## INTRODUCTION

The U.S. has around 59 MT of surplus plutonium (Pu) requiring secure long-term disposition. Major categories of the material include

- 34 MT of surplus weapons-grade Pu covered by the now-suspended 2000 Plutonium Management and Disposition Agreement (PMDA) with Russia
    - 26.2 MT of plutonium in the form of weapon components, or "pits" (Pantex)
    - 7.8 MT of non-pit plutonium metal and oxide (SRS and LANL)
- 7.1 MT of surplus weapons-grade pit Pu not covered by the PMDA (Pantex)
- Up to 6 MT of mostly non-weapons-grade Pu (various sites)
- 4 MT in Zero Power Physics Reactor (ZPPR) fuel (INL)

The DOE has committed to disposing of 34 MT of surplus weapons plutonium in a form meeting the "spent fuel standard"—that is, to render it "roughly as inaccessible for weapons use as the much larger and growing stock of plutonium in civilian spent fuel." [1]

The spent fuel standard concept was rooted in the observation that plutonium contained in typical light-water reactor (LWR) spent fuel is protected by intrinsic barriers that render it highly difficult to be stolen, extracted in a concentrated form and used in weapons. Spent fuel assemblies (1) contain plutonium at a low concentration (about one percent by weight); (2) stand over 4 meters tall and weigh hundreds of kilograms; and (3) emit an intense field of gamma radiation that precludes unshielded contact. (One characteristic of the plutonium in spent fuel that the DOE judged was *not* a significant barrier to weapons use is its isotopic composition relative to weapons-grade plutonium.)

In the 1990s, the DOE identified two technical options that met the spent fuel standard and were acceptable disposition approaches. One was irradiation of plutonium in the form of mixed-oxide (MOX) fuel in LWRs; the other was immobilization of plutonium together with vitrified high-level radioactive wastes in a glass-and-ceramic matrix. Accordingly, in 2000 DOE decided to pursue both methods as part of a "dual-track" disposition strategy. However, only two years later, the DOE cancelled the immobilization program and decided to focus exclusively on MOX, claiming that the country could not afford to pursue both options. This decision was imprudent given that the DOE had also determined immobilization could have gotten the job done more quickly and cheaply than MOX.

DOE began building the Mixed Oxide Fuel Fabrication Facility (MFFF), a plant to produce MOX fuel for LWRs, at SRS in 2007. The MFFF was designed to use plutonium dioxide feedstock. Since much of the excess plutonium is in the form of metal pits, additional facilities would have been required to disassemble the pits and convert the metal to oxide before it could be accepted at the MFFF. One option to do this was the ARIES process developed by LANL.

The MFFF project soon experienced massive cost overruns and delays due to poor planning, mismanagement, and contractor fraud. The total cost estimate for the program skyrocketed from $5 billion in 2002 to $57 billion in 2018. This corresponds to a production cost of around $1.5 million per kilogram of plutonium or $67,000 per kilogram of MOX—nearly fifty times the cost of low-enriched uranium fuel. No utility had committed to using MOX fuel, even though the DOE had promised to provide the fuel at the same cost as LEU fuel and subsidize the difference. By the end of FY 2017, $7.6 billion had been spent but the plant was only about 30% complete, and the DOE projected that the facility would not be operational before 2048.

Given the massive cost escalation and delay, DOE decided in 2016 to cancel the MOX program. However, elected officials from South Carolina fought in Congress and the courts to block its termination. The DOE was finally provided an off-ramp in the FY 2018 National Defense Authorization Act, allowing the agency to terminate the MOX program if, among other things, it could identify an alternative approach with a life-cycle cost less than one-half that of the remaining MOX life-cycle cost.

In October 2018, the DOE certified that that an alternative called "dilute and dispose" (D&D) would cost around $18 billion, satisfying the NDAA condition.[2] The DOE then proceeded to terminate the MOX program.

## THE DILUTE-AND-DISPOSE BASELINE PLAN

In technical terms, the dilute and dispose (D&D) process is relatively simple. Plutonium oxide powder is mechanically blended with non-radioactive materials at room temperature. The mixture is packed into cans, which in turn are placed in so-called "criticality control overpacks" and loaded into standard 55-gallon waste drums. These are then shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico, the U.S. repository for transuranic (TRU) waste, for permanent geologic disposal.

The DOE approved this disposition pathway for 6 MT of mostly non-weapons-grade surplus Pu in a Record of Decision (ROD) issued in 2016. However, in order to move forward with a program to dispose of the 34 MT of weapons-grade Pu that the DOE had previously decided to dispose of as MOX fuel, the DOE will have to conduct an environmental review in accordance with the National Environmental Policy Act (NEPA). Initially the DOE said that it would be issuing a Notice of Intent (NOI) for a Supplemental Environmental Impact Statement to analyze the proposed change in 2018. However, as of July 2020 the NOI has not yet been issued. The DOE recently said it was rethinking its NEPA strategy for disposition of this material, in light of the recommendation by a National Academy of Sciences panel that the DOE undertake a more comprehensive Programmatic Environmental Impact Statement instead to better capture the "proper scope and scale" of the proposed change.[3]

Dilute and dispose does not technically meet the spent fuel standard, primarily because it does not include the self-protecting radiation barrier characteristic of civil spent fuel. However, the method introduces other barriers designed to increase the difficulty an adversary would encounter in attempting to steal and separate sufficient plutonium to build an improvised nuclear device. No barrier would be capable of making recovery of the plutonium impossible; instead, the objective is to introduce sufficient delay to enable authorities to respond in time to prevent an act of nuclear terrorism. The DOE asserts that the additional time and resources needed to recover diluted Pu is comparable to that for required for material meeting the spent fuel standard, even without a radiation barrier.

To accomplish this, the plutonium oxide is diluted with an adulterant (formerly known as "stardust") in order to reduce the attractiveness of the material to adversaries. Nominally, the plutonium is diluted to less than 10 weight-percent (and perhaps closer 7 weight-percent) and the amount of plutonium per waste drum is limited to 380 grams. In practice, the actual limit is 300 grams per drum. The resulting material is then defined as transuranic waste (TRU) and therefore can be buried in WIPP.

An early stardust composition used for plutonium residues from Rocky Flats was described as "a mixture of cementing, gelling, thickening and foaming agents" that makes it "more difficult and complex to recover, concentrate and purify the plutonium."[4] The reference to "cementing agents" here suggests that the final mixture may undergo a room-temperature curing process to become a solid. By crediting these properties, the DOE was able to reduce the attractiveness level of the resulting waste form from C to D. More recently, different adulterant compositions have been developed, the details of which are classified.

Although the DOE's baseline strategy for D&D is technically simple, it is logistically complex and involves shipping dangerous materials back and forth across the continental U.S. In order to dispose of surplus plutonium pits by this method: (1) the pits would have to be shipped from Pantex to LANL by the DOE Office of Secure Transportation (OST) for disassembly and conversion to plutonium oxide using the ARIES process, a distance of 650 km (400 miles); (2) Pu oxide would then be shipped from LANL to SRS by OST for dilution and packaging at K-Area, a distance of 2790 km (1730 miles); and (3) the diluted plutonium waste would have to be shipped back across the country again to WIPP by commercial transport (OST resources would not be required, according to Reference [2]), a distance of 2340 km (1450 mi).

The strategy was developed in part to minimize the D&D life-cycle cost by leveraging existing facilities and personnel at SRS and LANL so that the option could easily fulfil the FY 2018 NDAA condition for cancelling the MFFF. But although this strategy may save some time and money, it involves a large number of shipments of plutonium, much of which would be in highly attractive forms. Based on estimates provided in the 1999 Surplus Plutonium Disposition EIS, disposition of the 26.2 MT of surplus plutonium pits included in the 34 MT tranche would require 160 shipments of Pu oxide and a somewhat larger higher number of pit shipments.[5] Also, 2000 shipments of diluted pit material would be needed. Although the D&D shipments would not require the degree of security provided by OST by virtue of their lower attractiveness level, they would still require more physical protection measures than typical TRU waste in order to ensure timely retrieval of stolen material.

**REVISING THE APPROACH: CONSOLIDATION OF D&D AT PANTEX**

Now that the MFFF has been canceled, however, the DOE should take a hard look at the current D&D baseline strategy and consider whether there are alternatives that may be more efficient and reduce the plutonium transport risk. It does not take an experienced systems engineer to observe that there would be significant advantages to consolidating all pit processing activities needed for D&D at Pantex—pit disassembly, oxide conversion, dilution and TRU packaging. Doing so would eliminate all off-site transport of pits; eliminate most off-site transport of attractive Pu metals and oxides; and reduce the D&D waste form shipping distance by 70 percent (2340 km to 713 km). The total shipping distance requirement for D&D would decrease by 72 percent for disposition of the 26.2 MT of pits and around 60 percent for the entire 34 MT.

The overall transportation security risk associated with the program would decrease significantly, as no OST resources would be required for pit D&D. (The need for OST would not be eliminated, however, since some surplus Pu is not located at Pantex and might require inter-site shipment, depending on their disposition path.) Also, the total shipping distance for the D&D waste drums would be significantly reduced, providing some additional security benefit.

Primary obstacles to this approach are that Pantex does not currently have plutonium bulk processing operations or a TRU waste management program. The cost, time, and effort needed to establish both would be non-trivial. However, Pantex was considered in the past for hosting processing facilities for both plutonium disposition and pit production missions – both of which would have required more complex operations and considerably more process area than D&D.

The tradeoffs between establishing plutonium processing operations at Pantex and expanding processing at facilities that already have the infrastructure, such as SRS and LANL, were the subject of vigorous debate when the DOE was evaluating siting alternatives for the surplus plutonium disposition facilities in the 1990s. Texas senators Kay Bailey Hutchinson and Phil Gramm argued that pit disassembly and oxide conversion operations should be situated at Pantex because "… transportation [of plutonium] in non-classified form to SRS is far preferable to the perils that would be incurred by unnecessarily shipping plutonium in a weapons-ready form."[6] On the other hand, South Carolina senator Lindsey Graham argued that "SRS has unparalleled expertise in dealing with plutonium and currently has the necessary plutonium infrastructure in place … that Pantex does not have."[7]

Subsequently, SRS won out when the DOE decided to site facilities for both pit disassembly and conversion and MOX fuel fabrication there. However, the DOE later cancelled the planned stand-alone Pit Disassembly and Conversion Facility (PDCF), eventually defaulting to LANL as the sole site for those processes. This locked in the cumbersome, multi-facility disposition strategy that the D&D program inherited after cancellation of the MFFF.

Today the DOE has the opportunity to revisit those decisions. In fact, the FY 2021 National Defense Authorization Act passed by the Senate in July 2020 directs the NNSA to provide a report to Congress by March 2021 on "options for continued plutonium oxide operations, including continuing the mission in PF-4 and moving it to the SRS." The Senate's concerns, however, are not directly related to the costs and risks of the plutonium disposition program but rather to the potential for oxide production to interfere with the "priority mission of plutonium pit production" at LANL, given plutonium storage and process area constraints at PF-4.[8] However, while moving pit disassembly and conversion to SRS would eliminate the need for shipment of plutonium oxide there from LANL, it would still require shipment of pits from Pantex to SRS. The NNSA report should also evaluate the Pantex option.

Although the baseline D&D approach takes advantage of existing infrastructure and capabilities at SRS and LANL, the capital cost of the additional equipment needed to scale up oxide production and D&D for the baseline is significant: $1.2 billion (2017 dollars) at LANL and $620 million (2017 dollars) at SRS.[9] If the necessary operations for disassembly, oxide conversion, and D&D for 26.2 MT of pits were transferred to Pantex, about $1 billion of that amount would be available for building the Pantex infrastructure without increasing the estimated program capital cost. (The remainder would be needed to expand D&D and provide a metal oxidation capability for the surplus plutonium already at SRS.) Also, the operating cost savings from reducing the need for secure transportation are not negligible: the cost of OST resources to ship plutonium from Pantex to LANL to SRS is approximately $150 million (2017 dollars). If the DOE chooses D&D for disposition of the additional 7.1 MT of pit plutonium designated as surplus, the Pantex consolidation option would look even more attractive.

It may also be possible to increase the total plutonium D&D rate by establishing pit D&D at Pantex. For political reasons SRS may not be able to receive new plutonium until its current plutonium inventory is shipped out of state, in which case disposition of pit plutonium now at Pantex would have to wait until after the D&D of non-pit plutonium at SRS was complete. In contrast, pit D&D at Pantex could be conducted in parallel with non-pit plutonium D&D at SRS.

There are challenges associated with establishing a capability for plutonium bulk processing at Pantex other than the capital cost and time required for constructing the necessary facilities and support systems. For example, the safety hazards, including high-temperature processes such as furnace oxidation, would need to be evaluated for their impact on warhead dismantlement and other essential Pantex operations.

Another important consideration is whether International Atomic Energy Agency (IAEA) monitoring of the D&D process would be feasible at Pantex, in view of the site's defense mission. Although D&D is likely to proceed in the U.S. without a verifiable bilateral agreement, given the low probability that the PMDA will be revived, IAEA monitoring of D&D to confirm U.S. declarations of surplus weapons plutonium disposition will be a critical measure to provide assurances to the international community. One advantage of maintaining D&D at SRS is that the IAEA already safeguards 2 MT of surplus plutonium at the K-Area Material Storage Facility (KAMS), and the U.S. has committed to IAEA monitoring of the D&D process for 6 MT of surplus plutonium at SRS not included in the 34 MT tranche.

The DOE should consider whether it would be feasible to locate oxide conversion and D&D operations at Pantex with sufficient separation from other areas to enable the IAEA to conduct managed access inspections and other monitoring activities. In the late 1990s the DOE did consider the option of construction of a new Pit Disassembly and Conversion Facility in Zone 4 at Pantex, which is the area where surplus pits and warheads are stored away from production operations. The DOE did consider parts of the facility IAEA-eligible, so IAEA inspections at Pantex were considered possible in concept at the time.[10]

Another potential obstacle to changing the baseline D&D plan is politics, as is provides for a maximal distribution of project funding across DOE sites in different states. The required facility expansions and associated activities at SRS and LANL would partially compensate South Carolina for the cancellation of the MFFF and New Mexico for the additional plutonium waste burden that the state would have to accept at WIPP.

However, SRS has already received a consolation prize for the MOX program cancellation: a project to repurpose the partially built MFFF for plutonium pit production. Moreover, SRS will still require capacity upgrades to dilute up to 11.5 metric tons of Pu currently stored at the site, which would be preferable to shipping the undiluted material off-site to another facility such as Pantex with regard to transport risk.

And at LANL, as already discussed, NNSA would likely prioritize pit production at PF-4 over plutonium disposition, so the site may not consider the additional mission desirable in any event, even with the funding it would bring.

**THE VERSATILE TEST REACTOR: THE WRONG OPTION FOR SURPLUS PU**

In past evaluations, both the NAS and the DOE considered and rejected the possibility of building a fast spectrum reactor for surplus plutonium disposition, which was Russia's preferred alternative, on cost and feasibility grounds. However, today the DOE is effectively revisiting that conclusion by pursuing construction of the Versatile Test Reactor, a sodium-cooled fast spectrum reactor with a rated power of around 300 MWth. In 2019, the DOE issued an approval of "mission need" for the VTR, and is now reviewing the conceptual design, cost estimate, and schedule. Planned startup of the VTR, which most likely will be constructed at Idaho National Laboratory (INL), is in the 2026-2030 timeframe, and its operational lifetime will be 40-60 years. The preliminary project cost estimate ranges up to $6 billion.

The VTR metal fuel will be a zirconium-based alloy. Although the reactor could operate on high-assay LEU fuel, the project's preferred option is a Pu-LEU mixture in order to maximize the test reactor's fast flux. For the current conceptual design, the first VTR core will require 330-510 kg WG-Pu for the first core or 475-555 kg RG-Pu. Subsequently 330 kg Pu (of either isotopic composition) would be required for 6 percent burnup, or 660 kg/yr for 3 percent burnup.[11]

Although the DOE initially said little about the sources of the plutonium that it was considering, it has recently been publicly disclosed that "initial studies assumed that the source of Pu would be from excess weapons-grade material, with a nominal enrichment of 93.5% Pu-239" but "competition for the available supply of this material has led to consideration of other materials, including lower-grade metals, fuel-grade and reactor-grade oxides."[12] However, these other materials, such as Zero Power Physics Reactor (ZPPR) fuel, would generally require more processing to render them suitable for VTR fuel fabrication. Thus the preferred source will likely remain WG-Pu from the excess stockpile.

The VTR would require about 16-40 MT Pu for 40-60 years of operation depending on burnup (and not accounting for irrecoverable process losses)—a considerable fraction of the excess WG-Pu inventory. Thus the DOE may well decide to withdraw some or all of this material from the excess stockpile for programmatic use as VTR fuel.

For many reasons, this would be a step in the wrong direction. First, it would not reduce the transport risk problem. The DOE is currently considering locating the VTR fuel fabrication facility at INL or SRS. If pit plutonium were to be a source, off-site shipments of pits to one of these sites would be necessary. And even if the fuel fabrication site were located at Pantex, the fresh metal fuel itself would be highly attractive (20 wt-% Pu) and would likely require OST transport to the VTR.

Second, the achievable plutonium disposition rate would be low compared to D&D—only one-third to two-thirds of a MT per year, compared to up to 1.5 MT per year for D&D.

Third, current processes for metal fuel fabrication generate a huge amount of difficult-to-recycle scrap and waste, resulting in net plutonium losses above 25 percent of throughput.[13] This is not only wasteful but is problematic for material control and accountability.

Fourth, the VTR fuel will contain a metallic sodium bond similar to EBR-II fuel. The DOE maintains that EBR-II spent driver fuel cannot be directly emplaced in a geologic repository, which it has used as the justification for its disastrous, multi-decade campaign to pyroprocess EBR-II spent fuel. INL considers electrometallurgical treatment for (pyroprocessing) as "a leading option" VTR spent fuel management—which would undermine the fundamental disposition objective off "unseparating" separated plutonium.[14]

And finally, the prospects for IAEA monitoring of plutonium disposition at the VTR appear dim at the moment. There is no indication that the DOE has any interest in making the VTR and its associated fuel cycle facilities eligible for IAEA safeguards, and no sign that the DOE is communicating with the IAEA about design verification for these facilities. These activities would increase the already high project cost, as the U.S. would be responsible for paying for them.

**CONCLUSIONS**

The DOE should develop a new Programmatic Environmental Impact Statement, as recommended by the 2020 NAS report. Alternatives to the baseline that should be analyzed include the Pantex option for pit D&D. The option of returning some or all of the excess plutonium to programmatic use as VTR fuel should NOT be considered. Also, compatibility with IAEA verification should be a primary consideration for any surplus plutonium disposition plan.

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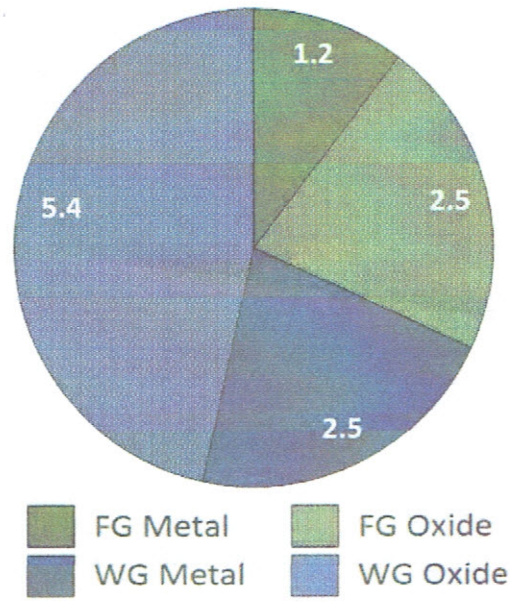
Attachment 2 to Clements scoping comment
1/28/2021

# 2020 Savannah River Site Plutonium Inventory Update

The inventory of surplus plutonium managed by the K-Area Materials Storage (KAMS) facility at the Savannah River Site (SRS) was approximately 11.5 metric tons (MT) at the end of FY 2019.[1] The KAMS inventory contains ~3.7 MT of fuel-grade plutonium (approximately one-third of the inventory) and ~7.9 MT of weapon-grade plutonium (approximately two-thirds of the inventory) as shown in Figure 1.[2]

Under the MOX law, the Department of Energy (DOE) is required to remove an amount of surplus plutonium equivalent to the amount that was brought into the State of South Carolina (SC) after April of 2002. This amount is approximately 10.5 MT. In FY 2019, the Department of Energy (DOE) completed removal of 1 MT of plutonium by transferring this material to other DOE facilities. As a result, approximately 9.5 MT of surplus plutonium inventory, that is subject to the terms of the MOX law, remained in KAMS at the end of FY 2019.

**Figure 1. Breakdown of KAMS Surplus Plutonium Inventory**




The surplus plutonium materials stored in KAMS include a wide range of plutonium-bearing materials with various chemical and radiological impurities, material forms, and plutonium isotopes. These variations create complexities in the rate at which disposition activities (i.e., downblending) are performed and present operational challenges when handled (i.e., radiation dose to workers) that must be addressed to achieve the NNSA plutonium disposition objectives.

In keeping with U.S. international nuclear safeguards commitments, approximately 2.8 MT of the KAMS plutonium inventory remains under International Atomic Energy Agency (IAEA) safeguards. This material is included in the inventory.

The KAMS inventory also includes approximately 0.7 MT of unirradiated mixed oxide fuel which contains fuel-grade plutonium and is stored in Type B shipping casks. The Department is evaluating alternative approaches for processing of this fuel-grade plutonium material which significantly reduces handling time and the associated worker radiation dose for removal from SC and final disposition.



[1] Note: This inventory data is current as of September 2019.
[2] Note: Inventory breakdown does not sum to 11.5 MT based on rounding of inventory values.