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Disposal of Surplus Plutonium at the Waste Isolation Pilot Plant

In response to a request from Congress, the National Academies of Sciences, Engineering, and Medicine has appointed an expert committee to evaluate the general viability of the U.S. Department of Energy’s¹ conceptual plans for disposing of 34 metric tons (MT) of surplus plutonium in the Waste Isolation Pilot Plant (WIPP), a deep geologic repository near Carlsbad, New Mexico.

WHAT IS SURPLUS PLUTONIUM?

The U.S. government defines surplus plutonium as plutonium that “...is no longer needed for U.S. national security or programmatic purposes.” The U.S. stockpile currently exceeds 60 metric tons (MT) and exists in many forms, including reactor fuel, pits² from retired nuclear weapons, used nuclear fuel, and scraps and residues from nuclear weapons production.

DISPOSAL OPTIONS

These materials are being disposed of in accordance with the Plutonium Management and Disposition Agreement (PMDA), signed by the United States and the Russian Federation in 2000 and amended in 2010, which requires that surplus plutonium be converted into forms unusable for nuclear weapons. The agreement requires both countries to dispose of surplus plutonium

by integrating it into mixed oxide (MOX) fuel³ followed by irradiation in commercial nuclear reactors. The United States began construction of a facility to manufacture MOX fuel at the Savannah River Site in South Carolina in 2007, but construction has encountered substantial schedule delays and cost overruns. In October 2018, the Department of Energy cancelled the construction project for the MOX plant. A central element of DOE’s rationale for this decision is that a different approach—the dilute and dispose process—would cost less than half of the MOX option and would meet the intent of the PMDA.

CONCEPTUAL PLANS FOR DILUTION AND DISPOSAL

The dilution process entails first the oxidization of surplus plutonium metal and then the dry blending of the plutonium oxide with an adulterant to dilute the plutonium-239 content. In the conceptual plan, the blended material will be packaged to make it suitable for transport to, and disposal in, the WIPP. The dilute and dispose process has been demonstrated at a small scale by DOE as it begins to process 6 MT of surplus plutonium. Additionally, DOE reports that 4.8 MT of plutonium similarly processed is emplaced at WIPP.

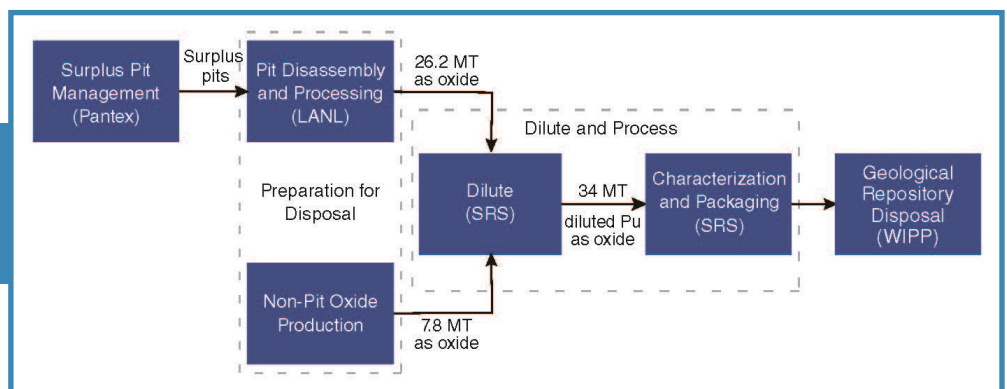
WIPP opened in 1999 after approximately 20 years of testing and development for the disposal of radioactive defence waste produced by the U.S. government (transuranic (TRU) waste). The disposal of waste in WIPP occurs deep underground, in the middle

3 MOX fuel contains plutonium and uranium, both in oxide form.

1 The U.S. Department of Energy’s National Nuclear Security Administration
2 A “pit” is the core of an implosion-type nuclear weapon (DOE 2015, S-1).

Figure 1.

Conceptual flowsheet for the DOE dilute and dispose processes. (Kay 2018)



of a large salt formation near the New Mexico's border with Texas. Waste panels are mined out of the salt to allow space for TRU waste. As salt naturally creeps to fill in voids, the TRU waste emplaced in WIPP will eventually be encased in salt.

A conceptual flowsheet for the dilute and dispose process is shown in Figure 1. A total of 26.2 MT of pits from disassembled nuclear weapons will be shipped from the Pantex Plant in Texas, where U.S. weapons grade plutonium is stored, to the Los Alamos National Laboratory (LANL) in New Mexico via Office of Secure Transport (OST). At LANL, the pits will be disassembled, converted into plutonium oxide, and packaged and shipped via OST to the Savannah River Site in South Carolina for further processing. A total of 7.8 MT of non-pit plutonium stored in different DOE sites will be either oxidized and sent directly to the Savannah River Site for further processing or shipped first to Los Alamos to be oxidized before being shipped to and processed at the Savannah River Site. The dilution and packaging steps will occur at the Savannah River Site. Once packaged and certified to meet the WIPP Waste Acceptance Criteria, the waste will be shipped to WIPP to be emplaced in the underground repository.

DOE currently estimates that the effort to dilute and dispose of 34 MT of surplus plutonium will take 31 years to complete, beginning with conceptual design in 2018 and ending after the emplacement of all 34 MT of diluted plutonium at WIPP is completed in 2049.

ABOUT THIS STUDY

This review by the National Academies of Sciences, Engineering, and Medicine includes an interim report, which provides a high-level review of the proposed diluted and dispose process, current WIPP capacity, and requirements of the PMDA. The second report, to be issued after the committee receives additional planning documents from DOE will address the statement of task in its entirety (see Box 1).

Box 1. Statement of Task for this Study

The National Academies will evaluate the general viability of DOE's conceptual plans for disposing of surplus plutonium in the Waste Isolation Pilot Plant (WIPP) to support U.S. commitments under the Plutonium Management and Disposition Agreement. This evaluation will specifically address the following issues:

1. DOE's plans to ship, receive, and emplace surplus plutonium in WIPP.
2. DOE's understanding of the impacts of these plans on the following:
 - a. Transportation safety, security, and regulatory compliance.
 - b. Current and future WIPP operations, including the need to construct additional waste disposal panels^a and/or operate WIPP beyond its currently planned closure date.
 - c. Disposal of other potential waste streams in WIPP, for example other plutonium wastes, Greater-than-Class-C-like wastes, and tank wastes.
 - d. WIPP pre- and post-closure safety and performance.
 - e. Compliance with WIPP waste acceptance criteria; Environmental Protection Agency disposal regulations; and The Land Withdrawal Act, National Environmental Policy Act, and Resource Conservation and Recovery Act requirements.

The Academies may examine policy options but should not make policy recommendations that require nontechnical value judgments.

^a WIPP's waste disposal area is comprised of multiple waste disposal panels. Currently, WIPP contains a total of eight panels; each panel contains seven disposal rooms. See Figure 2 in the main text of the report.

COMMITTEE ON DISPOSAL OF SURPLUS PLUTONIUM AT THE WASTE ISOLATION PILOT PLANT

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* resigned from the committee on September 20, 2018

For More Information . . . This Consensus Study Report Highlights was prepared by the National Academies of Sciences, Engineering, and Medicine based on the Consensus Study Report *Disposal of Surplus Plutonium at the Waste Isolation Pilot Plant: Interim Report* (2018). The study was sponsored by the Department of Energy–National Nuclear Security Administration and the National Academy of Sciences. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the Consensus Study Report are available from the National Academies Press, (800) 624-6242; <http://www.nap.edu> or via the Nuclear and Radiation Studies Board web page at <http://www.nationalacademies.org/nrsb>.

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