Plutonium Disposition

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Background

- **End of cold war brings arms reductions**
  - Excess plutonium accumulate in U.S. and Russia
  - Potential for theft by terrorists and rogue nations declared to be a “clear and present danger”

Berlin Wall comes down -- 1989 End of Cold War

- **U.S. commits to eliminate surplus plutonium**
  - Disposition of surplus plutonium in an environmentally safe and timely manner
  - Surplus plutonium is plutonium no longer needed for defense or other programmatic purposes

Weapons dismantlement

U.S Plutonium Disposition

- 1999 Surplus Plutonium Disposition Environmental Impact Statement (EIS)
  - Reduce the threat of nuclear weapons proliferation worldwide by conducting disposition of surplus plutonium in the United States in an environmentally safe and timely manner.
  - Actions are needed to ensure that surplus plutonium is converted into a form that cannot be used in a nuclear weapon.
  - More than 2/3 surplus plutonium is in nuclear weapon pits stored at Pantex in Texas.

U.S. Plutonium Disposition (continued)

National Nuclear Security Administration

- Scope of the SPD Supplemental EIS
  - Evaluates four Action Alternatives and a No Action Alternative for plutonium disposition that include:

    Options to disassemble pits and convert plutonium metal to an oxide for disposition

    Options to disposition 13.1 metric tons of surplus plutonium (7.1 metric tons of pit plutonium and 6 metric tons of non-pit plutonium); and

    Irradiating MOX fuel in commercial nuclear reactors.

  - Updates the Surplus Plutonium Disposition EIS (1999) analysis for 34 metric tons via the Pit Disassembly and Conversion Facility (PDCF), MOX Fuel Fabrication Facility (MFFF), and commercial reactors.

U.S. Plutonium Disposition (continued)

National Nuclear Security Administration

- Scope of the SPD Supplemental EIS (continued)
  - SPD Supplemental EIS is not reconsidering previous decisions to disposition 34 metric tons of surplus plutonium other than:

    Decision to construct a stand-alone PDCF at SRS; and

    Options for reactor irradiation of MOX fuel.

U.S. Plutonium Disposition (continued)

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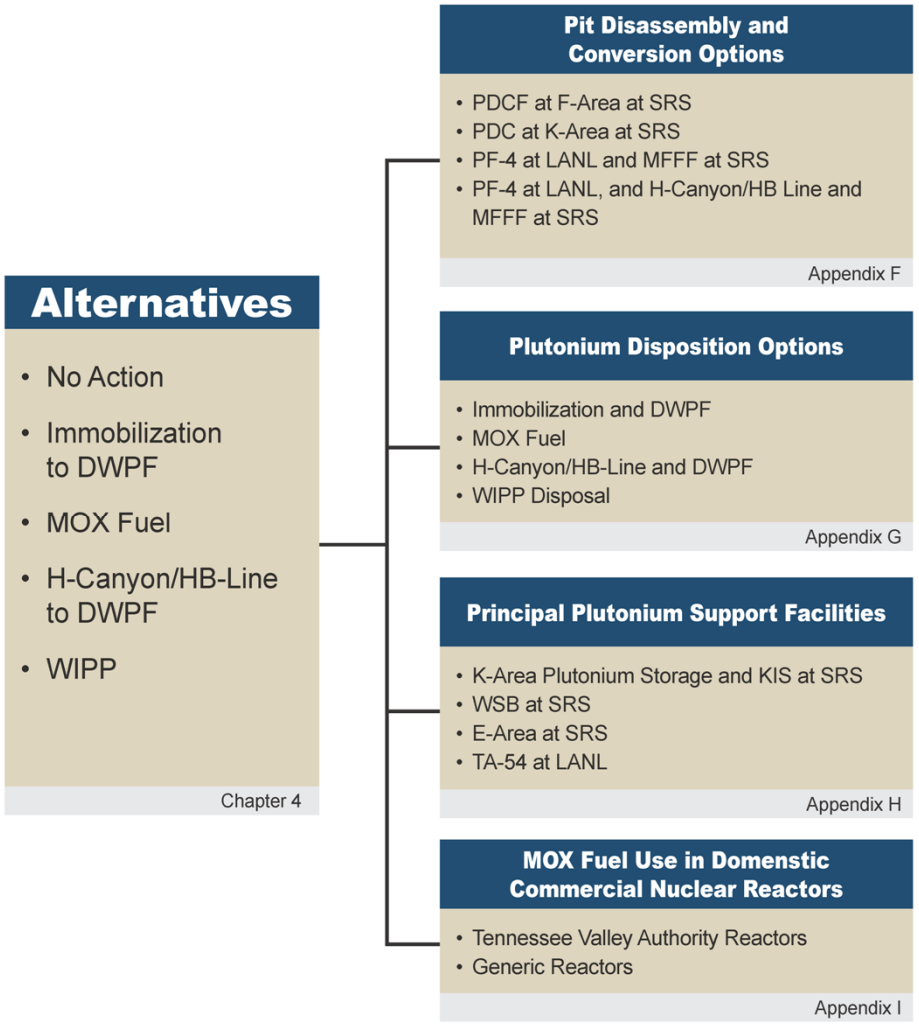
Surplus Plutonium Disposition Alternatives and Options



DWPF = Defense Waste Processing Facility
KIS = K-Area Interim Surveillance
LANL = Los Alamos National Laboratory
MFFF = Mixed Oxide Fuel Fabrication Facility
MOX = mixed oxide
PDC = Pit Disassembly and Conversion Project
PDCF = Pit Disassembly and Conversion Facility
PF-4 = Plutonium Facility
SRS = Savannah River Site
TA = technical area
WIPP = Waste Isolation Pilot Plant
WSB = Waste Solidification Building

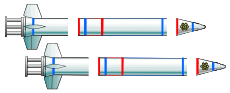
Note: Appendices C and D provide details about the analyses of human health effects at DOE facilities under normal and accident conditions, respectively, while Appendix E provides details about the analysis of human health effects from transportation of materials. Appendix J provides details about the analysis of human health effects at domestic commercial nuclear power reactors from facility accidents.

U.S. Plutonium Disposition (continued)

National Nuclear Security Administration

- Preferred Alternative
  - The MOX Fuel Alternative is DOE's preferred alternative for surplus plutonium disposition. DOE's preferred alternative for disposition of surplus plutonium that is not suitable for MFFF is disposal at the Waste Isolation Pilot Plant in New Mexico.
  - DOE's preferred option for pit disassembly and conversion of surplus plutonium metal, regardless of its origins, to supply feed for MFFF, is to use some combination of facilities including PF-4 at LANL, K-Area at SRS, H-Canyon/HB-Line at SRS, and MFFF at SRS, rather than to construct a new stand-alone facility. This would likely require the installation of additional equipment and other modifications to some of these facilities.
  - TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

U.S. Plutonium Disposition Pathway



Weapons Dismantlement at Pantex

Surplus Plutonium Pits

Interim Storage at Pantex

Clean Plutonium Metal

Disassembly and Conversion Capability for Pits and Clean Metal

LLNL

LANL

Hanford

Rocky Flats

SRS

K Reactor Non-Pit Plutonium Storage

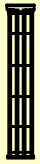
Plutonium Oxide Feed

Waste

Waste Solidification Building

Waste Isolation Pilot Plant

SRS Waste Management Infrastructure



MOX Fuel Fabrication at SRS

Purification Capability

MOX Fuel

Commercial Nuclear Reactors

Spent fuel is unsuitable and unattractive for use in nuclear weapons

LLNL – Lawrence Livermore National Laboratory

LANL – Los Alamos National Laboratory

SRS – Savannah River Site

WIPP – Waste Isolation Pilot Plant

Key Facilities Being Constructed at SRS

- MOX Fuel Fabrication Facility: Fabricates plutonium oxide and depleted uranium oxide into mixed oxide (MOX) fuel for subsequent irradiation in existing commercial nuclear power plants.

- Waste Solidification Building: Processes radioactive and mixed liquid waste streams from the MOX facility and pit disassembly and conversion operations. Must be available to support cold start-up operations for the MOX facility.

- Alternatives being evaluated for disassembling nuclear weapons pits and converting the plutonium metal to oxide form; a preferred alternative was announced by the Department in January 2012, which utilizes some combination of existing facilities, including LANL and H-Canyon, with options to add capabilities to the MFFF.

MOX Fuel Fabrication Facility

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Waste Solidification Building

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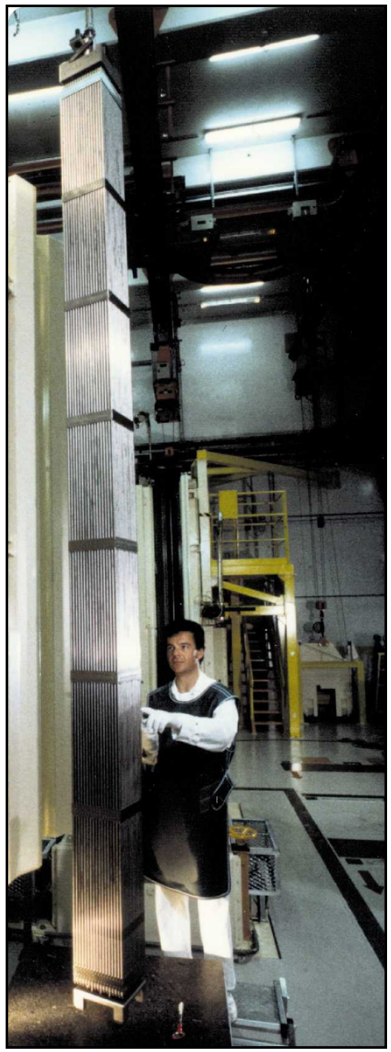
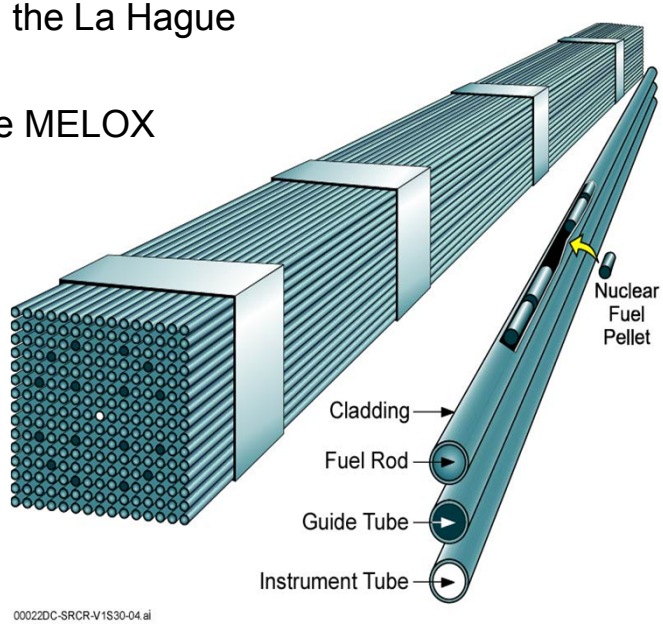
MOX Fuel Experience



- MOX fuel is used in ~30 reactors world wide.
- MOX fuel assemblies look identical to uranium fuel assemblies used in commercial nuclear power reactors.
- Once irradiated, spent MOX fuel will be treated the same as conventional spent LEU fuel.
- U.S. MOX facility is based on the design of two French facilities:
  - Aqueous polishing process from the La Hague reprocessing plant; and
  - Fuel fabrication process from the MELOX facility.



U.S.-Russia Plutonium Disposition

- United States and Russia signed a Plutonium Management and Disposition Agreement (PMDA)
  - Both countries committed to dispose of at least 34 metric tons each of surplus weapon-grade plutonium—enough for more than 17,000 nuclear weapons.
  - Disposition would be subject to a monitoring & inspection regime.
  - The plutonium must meet the “spent fuel standard” and be unusable for nuclear weapons.

Russian Plutonium Disposition

- In April 2010, the U.S. and Russia signed a Protocol to amend the PMDA based on the use of fast reactors operated under certain nonproliferation conditions

  - Nonproliferation conditions include: limits on reprocessing and plutonium separation; monitoring and inspections; breeding blanket removal
  - U.S. contribution capped at $400 million subject to future appropriations; Russia to fund $2+ billion
  - The U.S. and Russia are working with the IAEA to develop a monitoring and inspection regime

BN-800 Fast Reactor in Beloyarsk, Russia

Summary of Plutonium Disposition

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- The plutonium disposition program is the final step to permanently dispose of this dangerous material.
- Demonstrates that the U.S. is living up to its nonproliferation commitments by drawing down its nuclear arsenal in a transparent and irreversible manner.
- Meets U.S. national security & nonproliferation objective to dispose of surplus weapon-grade plutonium.
- Reduces security & storage costs.

Questions

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