Light Water Reactor

A nuclear reactor in which circulating water consisting of light water (hydrogen oxide [H_2O]) is used to cool the reactor core and reduce the energy of neutrons created in the core by fission reactions. All commercial reactors in the United States are LWRs.

Canadian Deuterium Uranium Reactor

A Canadian nuclear reactor in which the circulating water consists of heavy water (deuterium oxide). Deuterium is an isotope of hydrogen having twice the mass of hydrogen. All commercial reactors in Canada are heavy water reactors.

S.2 PREFERRED ALTERNATIVE

STORAGE

The Department's Preferred Alternative for storage is to reduce, over time, the number of locations where the various forms of Pu are stored, through a combination of storage alternatives in conjunction with a combination of disposition alternatives. DOE would begin implementing this Preferred Alternative by moving surplus Pu from RFETS as soon as possible, transporting the pits to Pantex as early as 1997, and the non-pit Pu materials to SRS beginning in 2002. Over time, DOE would store Pu in upgraded facilities at Pantex and in an expanded, planned new facility at SRS, and store nonsurplus HEU and surplus HEU pending disposition in upgraded and consolidated facilities at ORR. Storage facilities would also be modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy*. Accordingly, DOE's Preferred Alternative for storage would call for the following actions:

- **Phase out storage of all weapons-usable Pu at RFETS beginning in 1997; move pits to Pantex, and non-pit materials to SRS.** At Pantex, DOE would repackage pits from RFETS in Zone 12, then place them in existing storage facilities in Zone 4, pending completion of facility upgrades in Zone 12. At SRS, DOE would expand the planned new Actinide Packaging and Storage Facility (APSF), and move non-pit Pu materials from RFETS, after stabilization at RFETS, to the expanded APSF upon completion. The small number of pits currently at RFETS that are not in shippable form would be placed in a shippable condition in accordance with existing procedures prior to shipment to Pantex. Additionally, some pits and non-pit Pu materials from RFETS could be used at SRS, LANL, and LLNL for tests and demonstrations of aspects of disposition technologies (see Preferred Alternative for disposition as discussed later in this section). All non-pit weapons-usable Pu materials currently stored at RFETS are surplus.

- **Upgrade storage facilities at Zone 12 South (to be completed by 2004) at Pantex to store those pits currently stored at Pantex, and pits from RFETS, pending disposition. Storage facilities at Zone 4 would continue to be used for these pits prior to completion of the upgrade.** This action would place pits at a central location where most pits already reside and where expertise and infrastructure exist to accommodate pit storage.

- **In accordance with the Preferred Alternative in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (Stockpile Stewardship and Management PEIS), store Strategic Reserve pits at Pantex in the facilities discussed above. To the extent not reflected above, store Strategic Reserve materials in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS.**

- **Expand the APSF (Upgrade Alternative) at SRS to store those surplus, non-pit Pu materials currently at SRS and surplus non-pit Pu materials from RFETS, pending disposition** (see Preferred Alternative for disposition as discussed later in this section). The APSF would be built by 2001 pursuant to the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (IMNM EIS) (DOE/EIS-0220) and ROD, and the expansion to accommodate RFETS material would be completed by 2002. The RFETS surplus non-pit Pu materials would be moved to SRS after stabilization is performed at RFETS under corrective actions in response to recommendation 94-1 by the DNFSB, and after completion of the APSF expansion. This action would place non-pit Pu materials in a new storage facility, in a location with existing expertise and Pu handling capabilities and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). Strategic pits currently located at SRS would be stored in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS. There are no strategic non-pit materials currently located at SRS.

- **Continue current storage (No Action) of surplus Pu at Hanford and INEL, pending disposition** (or movement to lag storage[7] at the disposition facilities). This action would allow surplus Pu to remain at the sites with existing expertise and Pu handling capabilities, and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). There are no nonsurplus weapons-usable Pu materials currently stored at either site.

- **Continue current storage (No Action) of surplus Pu at LANL, pending disposition** (or movement to lag storage at the disposition facilities). This Pu would be stored in stabilized form with the nonsurplus Pu in the upgraded Nuclear Material Storage Facility pursuant to the No Action Alternative for the site.

- **Take No Action at the Nevada Test Site (NTS).** DOE would not add Pu to sites that do not currently have Pu in storage.

- **Upgrade storage facilities at the Y–12 Plant (Y–12) (to be completed by 2004, or earlier) at ORR to store nonsurplus HEU and surplus HEU pending disposition.** Existing storage facilities at Y–12 would be modified to meet natural phenomena requirements, as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). Storage facilities would be consolidated and the storage footprint would be reduced as surplus HEU is dispositioned and blended to low-enriched uranium, pursuant to the HEU EIS. Consistent with the Preferred Alternative in the Stockpile Stewardship and Management PEIS, HEU strategic reserves would be stored at the Y–12 Plant.

DISPOSITION

The Department's Preferred Alternative for the disposition of surplus Pu is to pursue a disposition strategy that allows for immobilization of surplus weapons Pu in glass or ceramic forms and burning of the surplus Pu as mixed oxide (MOX) fuel in existing reactors. The disposition of the surplus Pu using these technological approaches would depend on the results of future technology development and demonstrations, site-specific environmental analyses, and detailed cost proposals as well as nonproliferation considerations. The results of

[7] Lag storage is temporary storage at the applicable disposition facility.

these efforts and negotiations with Russia and other nations will ultimately determine the timing and extent to which either or both technologies are deployed.[8]

Under this Preferred Alternative, the U.S. policy not to encourage the civil use of Pu and, accordingly, not to itself engage in Pu reprocessing for either nuclear power or nuclear explosive purposes will not change. Although under the Preferred Alternative some Pu may ultimately be burned in existing reactors, every possible means will be pursued to ensure that Federal support for this unique disposition mission does not encourage other civil uses of Pu or Pu reprocessing. The United States, however, will maintain its commitments regarding the use of Pu in civil nuclear programs in Western Europe and Japan.

Proceeding with this strategy would provide increased flexibility to initiate Pu disposition promptly, and help assure disposition efforts could be accomplished in a timely manner. Establishing the means for expeditious Pu disposition would also help provide the basis for an international cooperative effort that can result in reciprocal, irreversible Pu disposition actions by Russia. DOE's preferred disposition strategy signals a strong U.S. commitment to reducing its stockpile of surplus Pu, thereby effectively meeting the purpose of and need for the Proposed Action.

To accomplish the Pu disposition mission, DOE would consider, to the extent practical, new as well as modified existing buildings and facilities for portions of the disposition activities. The PEIS analyzes new facilities for most disposition alternatives to obtain bounding environmental impacts. DOE would analyze and compare existing and new buildings and facilities for the technologies chosen as part of this strategy in subsequent, tiered NEPA review. In addition, all disposition facilities would be designed or modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy*. Accordingly, DOE's Preferred Alternative for Pu disposition involves the following strategy and supporting actions:

- **Immobilize Pu materials using vitrification or ceramic immobilization.** The immobilization technology could be used for processing pure or impure forms of Pu. Vitrification or ceramic immobilization could include the can-in-canister variant, which could utilize the existing high-level wastes (HLW) and the Defense Waste Processing Facility (DWPF) at SRS, or new facilities at Hanford or SRS. DOE would continue the R&D leading to the demonstration of the can-in-canister variant at the DWPF using surplus Pu.

- **Convert Pu materials into MOX fuel for use in existing reactors.** Pure materials including pits, pure metal, and oxides could be converted without extensive processing into MOX fuel for use in existing commercial reactors. Other, already separated forms of surplus Pu would require additional cleanup (not reprocessing of spent nuclear fuel). The MOX fuel would be used in existing light water reactors (LWRs) with a once-through fuel cycle, with no reprocessing and subsequent reuse of the spent fuel. If partially completed LWRs were to be completed by other parties, they would be considered for this mission. The MOX fuel would be fabricated in a domestic, government-owned facility at a DOE site.

  The Department would retain using MOX fuel in Canadian Deuterium Uranium (CANDU) reactors in Canada in the event that a multilateral agreement to use CANDU reactors is negotiated among Russia, Canada, and the United States. DOE would engage in a test and demonstration for CANDU MOX fuel as appropriate and consistent with future cooperative efforts with Russia and Canada.

With regard to the above, for purposes of analysis of an approach involving a combination of both technologies, approximately 70 percent of the surplus Pu was identified to be in forms (metals and other pure forms) suitable

[8] Through these efforts, the President would be provided the basis and flexibility to initiate disposition efforts either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

for MOX fuel. The actual percentage and timing for disposition of the surplus Pu using either or a combination of both of the technological approaches would depend on the results of international agreements, future technology development and demonstrations, site-specific environmental assessments, and detailed cost proposals to be completed within the next 2 years. The results of these efforts, as well as nonproliferation considerations and negotiations with Russia and other nations, will ultimately determine the timing and extent to which either or both technologies are deployed for disposition of surplus Pu. In the event both technologies are deployed, and because the time required for Pu disposition using reactors would be longer than that for immobilization, it is probable that some surplus Pu would be immobilized initially, prior to completion of reactor irradiation for other surplus Pu. Deployment of this strategy would involve the following supporting actions:

- **Constructing and operating a Pu vitrification or ceramic immobilization facility at either Hanford or SRS.** DOE would analyze alternative locations at these two sites for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. SRS has existing facilities and infrastructure to support an immobilization mission, and Hanford has existing plans for constructing and operating immobilization facilities for the wastes in Hanford tanks. DOE would not create new infrastructure for immobilizing Pu with HLW or cesium (Cs) at INEL, NTS, ORR, or Pantex.

- **Constructing and operating a Pu conversion facility[9] at either Hanford or SRS.** DOE would collocate the Pu conversion facility with the vitrification or ceramic immobilization facility discussed above. In subsequent, tiered NEPA reviews, DOE would analyze alternative locations at Hanford and SRS, for constructing new or potentially using modified existing buildings.

- **Constructing and operating a pit disassembly/conversion facility[10] at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. DOE would demonstrate the Advanced Recovery and Integrated Extraction System (ARIES) concept at LANL for pit disassembly/conversion beginning in fiscal year 1997.

- **Constructing and operating a domestic, government-owned, MOX fuel fabrication facility at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. The MOX fuel fabrication facility would serve only the finite mission of fabricating MOX fuel using surplus Pu for the purpose of Pu disposition. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS, for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review.

Depending upon decisions in the ROD and pursuant to appropriate NEPA review(s), DOE would continue R&D and engage in further testing and demonstrations of Pu disposition technologies which may include: dissolution of small quantities of Pu in both glass and ceramic formulation; experiments with immobilization equipment and systems; fabrication of MOX fuel pellets for demonstrations of reactor irradiation at INEL; mechanical milling and mixing of Pu and feed forms; and testing of shipping and storage containers for certification, in addition to the testing and demonstrations previously described for the can-in-canister immobilization variant

[9] The Pu conversion facility would convert surplus non-pit Pu material (using a wet chemical process) into a metal or oxide form suitable for use at the next facility in the disposition process.

[10] The pit disassembly/conversion facility would dissemble, reshape, and convert surplus Pu pits (using a dry chemical process) into an unclassified metal or oxide form suitable for use at the next facility in the disposition process. In addition, some non-pit Pu material may also be processed in this facility.