SUMMARY

The Atomic Energy Commission (AEC), a predecessor agency of the Department of Energy (DOE), established the Savannah River Site (SRS) in the early 1950s for the production of special radioactive isotopes. The primary SRS mission was to produce strategic isotopes (plutonium-239 and tritium) used in the development and production of nuclear weapons for national defense. The Site produced other special isotopes (californium-252, plutonium-238, americium-241, etc.) to support research in nuclear medicine, space exploration, and commercial applications. The historic production cycle at the SRS involved the fabrication of metal fuel and target assemblies for irradiation in the Site reactors, followed by chemical dissolution, separation, and conversion of the radioisotopes into solid forms for use at the SRS or other DOE sites.

In March 1992, DOE suspended chemical separations activities at the SRS to address a potential safety concern regarding the survival of the ventilation system in F- and H-Canyons in the event of an earthquake. That concern was addressed; however, before the resumption of reprocessing, the Secretary of Energy directed that the SRS phase out defense-related chemical separations activities in these facilities (DOE 1992). World events during the late 1980s and early 1990s resulted in the end of the Cold War and a reduction in the demand for new material for nuclear weapons. DOE has not processed nuclear materials at the SRS chemical separations facilities to recover special isotopes since March 1992, with the exception of scrap materials containing plutonium-238. DOE continued these plutonium-238 operations to support future National Aeronautics and Space Administration (NASA) exploratory space missions.

The cessation in processing operations resulted in a large inventory of nuclear materials caught in various stages of the historic SRS production (fabrication, irradiation, reprocessing, and recovery) cycle. These materials include irradiated and unirradiated reactor fuel, targets, and components; solutions containing dissolved nuclear materials and recovered isotopes in stainless-steel tanks; and product and scrap forms of metals or oxides in containers (cans, drums, etc.) typically used for temporary storage or shipment off the Site.

Purpose and Need for Action

With the end of the Cold War, the primary mission of the nuclear production facilities at the SRS has changed to the storage and management of nuclear materials until DOE can make and implement decisions on the ultimate disposition of the materials. DOE is evaluating various strategies for the long-term management of nuclear material. Section 1.6 describes these evaluations. DOE anticipates that it might need as long as 10 years to make and fully implement disposition decisions on all these materials. Until DOE can implement these decisions, the large inventory of nuclear materials at the SRS requires continued safe management.

At the time DOE suspended the SRS nuclear material production cycle, many nuclear materials were in a form or were stored in a manner that was acceptable only for a temporary period (e.g., 1 to 2 years). The continued storage of some of these materials in their current form poses risks to the environment or the safety and health of SRS workers or the public. In some cases, the material's physical or chemical form poses the risks; in other cases, the material simply requires repackaging or movement to another location to ensure its safe storage. DOE needs to either eliminate (if possible) or reduce the risks posed by the continued storage of these materials.

In addition, although the end of the Cold War has greatly diminished the need for strategic isotopes, some nuclear materials currently stored at the SRS contain special isotopes that support continuing DOE programs. These materials require additional processing or conversion into forms that are suitable for their continued safe storage at the SRS and eventual use at other DOE sites.

The purpose of the actions described in this environmental impact statement (EIS) is for DOE to manage the existing

SRS nuclear materials in a safe and environmentally sound manner while supporting national requirements for an inventory at the SRS of usable forms of special isotopes. DOE must consider actions to repackage, relocate, or convert some materials at the SRS to a form appropriate for safe interim storage or future use. The DOE objectives are to (1) eliminate or reduce risks from accidents that could occur during continued storage of the nuclear materials, and (2) convert plutonium-242, americium, curium, and neptunium-237 to usable forms that it can store safely.

Categories of Nuclear Materials

Within the last 18 months DOE completed two major studies to identify existing or potential environmental, safety, or health vulnerabilities associated with the storage of spent fuel or plutonium at DOE facilities nationwide (DOE 1994a,b). The studies identified a number of vulnerabilities associated with nuclear materials currently stored at the SRS. The materials include radioactive solutions stored in the chemical separations facilities, plutonium oxides and metals stored in vaults, and irradiated fuel and target assemblies stored in water-filled basins. In May 1994, the Defense Nuclear Facilities Safety Board recommended to the Secretary of Energy that DOE develop an integrated management plan to alleviate safety concerns associated with the materials at the SRS and other materials that remain from the nuclear weapons production cycle (DNFSB 1994). On the basis of the DOE evaluations and the Board's recommendation, DOE believes that it should consider actions necessary to ensure that these materials are placed in forms that are safe for interim storage. This EIS describes these materials as "candidates for stabilization."

Materials that are candidates for stabilization are in forms (e.g., liquid) that present inherent risks for management, are stored in facilities that were not designed for indefinite storage intervals (e.g., reactor disassembly basins), or both. In general, materials stored in liquid form are unsuitable for extended storage because of the strong potential for events (e.g., criticality) that could result in releases of radioactive materials to the environment and exposure to workers and the public. Certain solid materials represent similar concerns due to their chemical composition (which in some cases is unknown), physical condition, or packaging composition. In most cases, concerns result from storage periods longer than the periods for which the packaging was designed. Similarly, fuel and targets stored in reactor disassembly basins have been there for as long as 6 years; in the past, such items were typically stored for approximately 6 months before processing. The extended wet storage of the fuel and targets has produced surface corrosion that has affected the integrity of the cladding, resulting in continued releases of radioactivity to the surrounding water.

DOE has evaluated the various activities that support its mission and has determined that there is a continuing need for the plutonium-242, americium, curium, and neptunium-237 currently stored at the SRS, primarily in solutions. DOE would use these materials to support such ongoing activities as the production of thermal power sources or special isotopes for medical applications and research. DOE has categorized these as "programmatic materials."

DOE has evaluated the other nuclear materials at the SRS and believes that it can store them safely in their current forms and locations over the period evaluated in the EIS. DOE has categorized these materials as "stable" materials. DOE does not propose any actions for these materials at this time except continued storage (i.e., No Action).

Table S-1 summarizes the nuclear materials at the SRS included in these categories. The "programmatic" and "candidates for stabilization" categories group the nuclear materials into subcategories due to differences in the physical or chemical composition of the materials and the corresponding alternatives for each.

Table S-1. SRS nuclear materials.

Description	Quantity	Location(s)
Stable		
Spent fuel	1,500 elements	Receiving Basin for Offsite Fuels
Unirradiated fuel, targets, reactor	315,000	Buildings 305A, 313-M, 315-M, 320-M, 321-M,

components, and scrap from fabrication operations	items	322-M, and 341-M
Unirradiated fuel, targets, and reactor components	6,900 items	K- and L-Reactors
Unirradiated and irradiated reactor components and control rods	420 items	C-, K-, L-, and P-Reactors
Depleted uranium oxide	36,000 drums	R-Reactor, Buildings 221-1F, 221-12F, 221-21F, 221-22F, 707-R, 714-7N, 728-F, 730-F, and 772-7B
Depleted uranium solutions	300,000 liters (78,000 gallons)	F-Canyon, F-Area Outside Facilities, and TNX
Sources, standards, and samples	20,000 items	Sitewide
Laboratory materials used in research and development	260 items	Savannah River Technology Center
Programmatic		
Plutonium-242 solutions	13,000 liters (3,500 gallons)	H-Canyon
Americium and curium solutions	14,000 liters (3,800 gallons)	F-Canyon
Neptunium solutions and targets	6,100 liters (1,600 gallons) 9 targets	H-Canyon Building 321-M
Candidates for Stabilization		
Plutonium-239 solutions	34,000 liters (9,000 gallons)	H-Canyon
HEU solutions	228,000 liters (60,000 gallons)	H-Canyon and H-Area Outside Facilities

Plutonium vault materials	2,800 packages	FB-Line, HB-Line, Building 772-F, Building 235-F, and SRTC
Irradiated Mark-31 targets	16,000 slugs	K-Reactor, L-Reactor, and F-Canyon
Irradiated Mark-16 and Mark-22 fuels	1,900 assemblies	K-, L-, and P-Reactors and H-Canyon
Other irradiated targets	900 targets	K-, L-, and P-Reactors

Alternatives

Table S-2 lists the alternatives that DOE considered in this EIS for each material category or subcategory. An open check mark indicates the preferred alternative for each material. The following paragraphs describe the alternatives:

- **Continuing Storage (No Action).** DOE would continue to store the material in its current physical form.
- **Processing to Metal.** DOE would use the existing F-Canyon and FB-Line facilities to dissolve materials containing significant amounts of plutonium-239 and convert the plutonium-239 to a metal. This would entail dissolving solids and purifying solutions before processing. The resulting plutonium metal would be packaged in a dry or inert atmosphere suitable for storage for as long as 50 years. The packaging and storage of the metal would be in either a modified facility (FB-Line or Building 235-F) or a new Actinide Packaging Facility in F-Area, but this packaged metal would not be used in weapons.
- **Processing to Oxide.** DOE would convert existing solutions containing neptunium-237 and plutonium-239 to oxides using either FB- or HB-Line, and would convert solutions containing highly enriched uranium to oxide using the Uranium Solidification Facility. Solid materials containing significant amounts of plutonium-239 or uranium-235 would be dissolved and the resulting solutions converted to an oxide in the same manner. Plutonium oxide would be packaged and stored in either an existing vault facility (FB-Line, HB-Line, Building 235-F or 247-F), a modified facility (FB-Line or Building 235-F), or a new Actinide Packaging Facility in F-Area. Highly enriched uranium oxide would be stored in a vault in the Uranium Solidification Facility. Neptunium oxide would be packaged and stored in F-Canyon or an SRS vault.
- **Blending Down to Low Enriched Uranium.** For those materials suitable for stabilization by this method, DOE would use depleted uranium to dilute highly enriched uranium to a low enrichment suitable for conversion to uranium oxide. Solid materials with enriched uranium (e.g., Mark-16 and -22 fuels) would be dissolved through traditional separation processing prior to this blending down activity; solutions of highly enriched uranium already being stored would be purified prior to the blending down. Low enriched uranium oxide would be stored in existing warehouses on the Site or in a new warehouse constructed in either F- or H-Area.
- **Processing and Storage for Vitrification in the Defense Waste Processing Facility.** DOE would perform technical studies to determine the chemical adjustments required to enable the transfer of existing solutions continuing significant amounts of fissile materials (e.g., plutonium-239, uranium-235) to the high-level waste tanks in F- or H-Area at the SRS. The solutions would subsequently be vitrified in the proposed Defense Waste Processing Facility. Solid materials would be dissolved using existing chemical separations facilities (F- and H-Canyons) and the resulting solutions would be transferred and vitrified in the same manner.
- **Vitrification in F-Canyon.** DOE would modify an existing portion of the F-Canyon facility to install equipment to produce a glass composite, similar to that proposed for production in the Defense Waste Processing Facility. Existing solutions would be combined with molten borosilicate glass and poured into stainless-steel canisters. The canisters would be placed in storage in the canyon or in heavily shielded casks or vaults. Solid materials would be dissolved using existing F-Canyon or FB-Line facilities and the resulting solutions would be vitrified in a similar manner.
- **Improving Storage.** DOE would repackage existing forms of solids. For small plutonium-bearing materials currently stored in vaults, DOE would modify the existing FB-Line facility or construct a new Actinide

Packaging Facility to provide the capability to repackage such materials in a nonreactive atmosphere suitable for storage for as long as 50 years. For large irradiated materials (e.g., reactor fuel or targets), DOE would construct a new Dry Storage Facility with the capability to both repackage and store the materials. This would include the capability to can materials currently being stored in water in reactor disassembly basins.

Comparison of Alternatives

DOE would select a management alternative for each category of nuclear material listed in Table S-1. This would result in the implementation of a specific combination of the alternatives described and analyzed in this EIS. Tables S-3 through S-12 compare the environmental impacts for each alternative by nuclear material type and summarize how each alternative compares to the others. Choosing No Action for the management of each nuclear material group is likely to result in the smallest impacts for the 10-year period. Taking action to stabilize materials would entail some increased exposure and risk compared to No Action during the 10-year period. However, over the long term, choosing No Action could result in greater impacts than those that would occur by choosing another alternative. This is because choosing No Action would result in the need for

greater management vigilance and consequent worker exposures and because of the increased possibility that continued changes in material chemistry could result in releases to the environment. Furthermore, DOE eventually would have to take some type of stabilization action, and the attendant risks and exposures from these actions would occur at that time.

Affected Environment

The SRS occupies an area of approximately 800 square kilometers (300 square miles) adjacent to the Savannah River, primarily in Aiken and Barnwell Counties in South Carolina. The Site is approximately 40 kilometers (25 miles) southeast of Augusta, Georgia, and 32 kilometers (20 miles) south of Aiken, South Carolina. All alternatives (including No Action) would occur within existing industrial areas (e.g., F- and H-Areas) at the SRS.

Environmental Impacts

Tables S-3 through S-12 list the potential environmental impacts associated with each of the nuclear materials for the environmental factors that historically have held the most interest for the public. The tables list only the most significant chemical impact for air and water resources. Radiological impacts for air and water resources are not listed specifically; however, those impacts are used to estimate latent cancer fatality impacts, which are listed.

DOE expects the environmental impacts to be small for any of the scenarios because the alternatives would rely on the use of existing facilities and technologies at the SRS to the extent possible.

None of the alternatives would involve the construction of a new facility outside an existing industrialized area (e.g., F-Area) of the SRS with the exception of the Improving Storage Alternative for reactor fuel or targets, which would involve the construction of a new facility to dry the assemblies and package them for continued storage. The new facility would be on a previously undisturbed site on the SRS. If DOE chose this alternative, it would prepare a project-specific environmental assessment or impact statement for the construction and operation of that facility.

Several alternatives would require modifications to existing facilities. DOE would confine the modifications within the existing facility structure(s). For alternatives that would involve new facilities to package and store plutonium or uranium materials, DOE would construct the facilities within the already industrialized F- or H-Area. The new facility, which would be near existing nuclear facilities in those areas, would be a warehouse or concrete vault-type structure. Because construction would be confined to developed areas that have already been previously disturbed, DOE expects little or no environmental impacts in the following areas:

- Geological Resources
- Ecological Resources

Cultural Resources
- Aesthetics and Scenic Resources
- Noise

Because any construction projects would be limited to modifications of existing facilities or construction of warehouse or vault-type facilities (i.e., not complex major nuclear facilities), DOE anticipates that the existing SRS workforce would support these construction projects. Similarly, DOE would use the existing Site workforce to implement any of the alternatives considered. As a result DOE does not expect any socioecomomic impacts from actions proposed in this EIS.

In addition to comparing alternatives to the environmental criteria listed in Tables S-3 through S-12, DOE considered the following factors related to the stabilization of nuclear materials:

- New facilities required
- Security and nonproliferation
- Implementation schedule
- Technology availability and technical feasibility
- Labor availability and core competency
- Aging facilities
- Minimum custodial care

These factors are representative of the issues addressed by the National Academy of Science in its study of the managed disposition of plutonium (NAS 1994), the Office of Technology Assessment plutonium study (OTA 1993), and comments received during the scoping period for this EIS.

In general, DOE selected the preferred alternatives because they would minimize the need for DOE to construct new facilities, rely on existing technology, involve the use of existing personnel, and minimize future custodial care for the materials, and they could be completed within the 10-year period. The preferred alternatives would also minimize continued reliance on aging facilities because DOE would move or consolidate nuclear materials posing concerns into modified or new storage facilities.

Some additional weapons-usable material could result from actions proposed in this EIS. The amount would be a small fraction of the current SRS inventory and an even smaller fraction of that held at other DOE sites. All the alternatives would involve the use of facilities inside controlled industrial areas of the SRS, which are supported and protected by an armed guard force. DOE has committed to prohibit the use of plutonium-239 and weapons-usable highly enriched uranium separated or stabilized during the phaseout, shutdown, and cleanout of weapons complex facilities for nuclear explosive purposes (DOE 1994c).

References

DNFSB (Defense Nuclear Facilities Safety Board), 1994, "Recommendation 94-1 to the Secretary of Energy Pursuant to 42 U.S.C. 228a(5), Atomic Energy Act of 1954, as Amended," letter to Honorable Hazel R. O'Leary from John T. Conway, Chairman, Washington,., May 26.

DOE (U.S. Department of Energy), 1992, "ACTION: A Decision on Phaseout of Reprocessing at the Savannah River Site (SRS) and the Idaho National Engineering Laboratory (INEL) is Required," memorandum to the Secretary of Energy from Assistant Secretary for Defense Programs, Washington, D.C., April 28.

DOE (U.S. Department of Energy), 1994a, *Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fuel and Other Reactor Irradiated Nuclear Materials and Their Environmental, Safety, and Health Vulnerabilities*, Washington, D.C.

DOE (U.S. Department of Energy), 1994b, *Draft Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated with the Department's Plutonium Storage*, DOE/EH-0415, Washington, D.C.

DOE (U.S. Department of Energy), 1994c, "ACTION: Commitment To Prohibit the Use of Plutonium-239 and Highly Enriched Uranium Separated and/or Stabilized During Facility Phaseout, Shutdown and Cleanout Activities for Nuclear Explosive Purposes," memorandum to the Secretary of Energy from Assistant Secretary for Defense Programs and Assistant Secretary for Environmental Management, Washington, D.C., December 20.

NAS (National Academy of Sciences), 1994, *Management and Disposition of Excess Weapons Plutonium*, National Academy Press, Washington, D.C.

OTA (Office of Technology Assessment), 1993, *Dismantling the Bomb and Managing the Nuclear Materials*, OTA-0-572, U.S. Government Printing Office, Washington, D.C.