DOE/EA-0534

ENVIRONMENTAL ASSESSMENT

FOR

RADIOISOTOPE HEAT SOURCE FUEL

PROCESSING AND FABRICATION

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U.S. Department of Energy
Offices of Special Applications
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1.0 SUMMARY

1.1 PURPOSE AND NEED

The National Environmental Policy Act of 1969 (NEPA), as amended, requires the assessment of environmental consequences of all major Federal actions that may affect the quality of the human environment. The U.S. Department of Energy (DOE) has prepared this Environmental Assessment (EA) to identify and evaluate the environmental consequences of operating existing plutonium-238 (Pu-238) processing facilities at the Savannah River Site (SRS), and fabricating a limited quantity of Pu-238 fueled heat source units at an existing Pu-238 research and development facility at the Los Alamos National Laboratory (LANL).

Pu-238 is used to provide a long-term reliable source of heat which can be converted into electricity when installed in radioisotope thermoelectric generators (RTGs). The electricity produced by the RTGs is used to operate mechanical devices, instruments, and communications equipment onboard National Aeronautics and Space Administration (NASA) spacecraft and for other applications. Planned space missions of this nature include the Cassini mission, scheduled for launch in late 1995, and the Comet Rendezvous Asterioid Flyby (CRAF) mission, scheduled for launch in early 1996. The RTGs are the primary electrical power sources for spacecraft where solar panels are not a viable option. In addition, Pu-238 fueled Light-Weight Radioisotope Heater Units (LWRHUs) can be used as localized heat sources on spacecraft. DOE is responsible for providing the RTGs and LWRHUs to NASA. The use of Pu-238 fueled RTGs and LWRHUs in space applications is a proven technology in which safety considerations have been an inherent part of their design, development, and deployment. This has been demonstrated by an extensive safety testing program; a rigorous, independent flight approval process; and the success of such recent missions as the Galileo and Ulysses missions.

1.2 PROPOSED ACTION

The proposed action addressed in this EA is to operate existing Pu-238 processing facilities at the SRS, and fabricate a limited quantity of Pu-238 fueled heat sources at an existing facility at LANL. This EA does not include the production of new Pu-238, nor the separations activity required for new Pu-238. The proposed action would be accomplished in two stages, involving specific facilities as follows:

- Stage I: SRS processing facilities in the 221-HB-Line located in the H-Area Canyon Building, including the Scrap Recovery Facility and the Plutonium Oxide Facility. These facilities would be used to re-blend existing inventories of Pu-238 into a uniform blend suitable for use.

- Stage II: LANL Plutonium Handling Facility Building 4 (PF-4) at Technical Area 55 (TA-55). This facility would be used to satisfy short-term Pu-238 fabrication needs for the near-term NASA missions during the period of approximately 1991 through 1994. The required facility space, most of the equipment, and personnel are currently available for this purpose.

In accordance with NEPA regulations, DOE has identified the following alternatives to the proposed action:

- Use the Plutonium Fuel Form (PuFF) Facility located in F-Area, Building 235 at SRS rather than PF-4 at LANL. The PuFF Facility requires refurbishment prior to operation, and would not be available for several years.

- Construction of a new building and facilities to replace, rather than refurbish, the existing Building 235-F and the PuFF facility which it houses.

- No action (i.e., do not operate the subject facilities for Pu-238 processing and fabrication).

None of the alternatives considered to the proposed action would provide Pu-238 in sufficient quantity and fabricated form on a schedule that would allow DOE to satisfy Pu-238 requirements for near-term NASA space missions.

NASA is preparing separate NEPA documents for the CRAF/Cassini missions that considers alternatives to the use of RTGs, LWRHUs, and the selected launch window dates. The action proposed in this Environmental Assessment will enable NASA to consider the use of RTGs and LWRHUs as an option.

1.3 AFFECTED ENVIRONMENT

The SRS encompasses approximately 800 square kilometers in southwestern South Carolina. It borders the Savannah River for about 27 kilometers. The SRS has a temperate climate with mild winters and long summers. SRS facilities include production reactors, separations facilities, and support facilities for the production of Federal nuclear materials. Approximately 550,000 persons live within an 80-kilometer radius of SRS that includes portions of South Carolina and Georgia.

The LANL site encompasses approximately 111 square kilometers in north-central New Mexico. It is located on the Pajarito Plateau, a series of mesas and canyons, at an elevation of about 2,200 meters above sea level. LANL has a semi-arid, temperate mountain climate. LANL includes facilities related to Federal nuclear weapons research and development and other scientific research. An estimated 203,000 persons live within an 80-kilometer radius of the LANL site.

1.4 ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

1.4.1 Stage I Impacts

The proposed action is not expected to result in any land use impacts at SRS, as all required buildings and structures exist. Most of the personnel required for operations are currently employed at SRS; thus, socioeconomic and traffic impacts are expected to be small. The proposed action is not expected to affect any sensitive areas, such as floodplains, wetlands, habitats of State- or Federally-listed threatened or endangered species, sole-source aquifers, and cultural resources. Waste management and radiological impacts associated with the proposed action are summarized below.

The projected annual volumes of transuranic waste (TRU) and low-level radioactive waste (LLW) to be generated at SRS resulting from facility operations as part of the proposed action are 94 and 396 cubic meters per year, respectively. These volumes represent less than 8 and 1.3 percent, respectively, of the TRU and LLW generated at SRS on an annual basis. Existing TRU and LLW waste management facilities at SRS were designed to handle wastes generated by all SRS facilities, including the operation of the HB-Line; therefore, there will be no additional burden on existing waste handling capacity by implementation of the proposed action. Any hazardous or radioactive mixed wastes associated with operations will be handled in accordance with Resource Conservation and Recovery Act (RCRA) guidelines.

Radiological doses to the offsite population for all SRS 1988 atmospheric releases have been estimated to be 21 person-rem, and 4.6×10^{-4} rem to the offsite maximally-exposed individual. The proposed action will result in a conservatively estimated offsite dose increase of less than 1 percent.

For comparison, the doses from natural background radiation and all other non-SRS sources to the offsite population living within an 80-kilometer radius of the SRS are 165,000 person-rem per year, and the doses to an individual living in the SRS regional area is 0.3 rem per year.

1.4.2 Stage II Impacts

The proposed action is not expected to result in any land use impacts at LANL, as all required buildings and structures exist. Most of the personnel required for operations are currently employed by LANL; thus, socioeconomic or traffic impacts are expected to be small. The proposed action is not expected to affect any sensitive areas, including floodplains, wetlands, habitats of State- or Federally-listed threatened or endangered species, sole-source aquifers, and cultural resources.

Radioactive liquid waste produced from the proposed action would be treated at the Radioactive Liquid Waste Treatment Plant. The project would increase the liquid flow into the facility by less than 0.0001 percent and the plutonium by about 3 percent. Discharges from this facility remain on-site, are within DOE on-site discharge guideline values and the parameters specified in the NPDES discharge permit, and do not contaminate off-site waters or the deep potable aquifer.

The proposed action would generate approximately 25 drums of TRU waste per year. This would be added to the approximately 700 drums of TRU produced annually from other operations and stored at LANL until treatment or disposal options become available. Any hazardous or radioactive mixed wastes associated with operations will be handled in accordance with the RCRA guidelines.

Radiological dose to the offsite population living within 80-kilometers of LANL from all 1989 LANL releases has been estimated to be 3.1 person-rem and the comparable dose to the offsite individual nearest the location of the proposed action is 1×10^{-4} rem. The proposed action would result in an estimated offsite dose increase of less than 0.00002 percent.

For comparison, the dose from natural background radiation and all other non-LANL sources to the offsite population living within 80-kilometer of LANL is 68,200 person-rem per year and the dose to an individual living within the region is 0.34 rem per year.

1.4.3 Impacts of No Action Alternative

The no action alternative (i.e., do not operate facilities for Pu-238 processing and fabrication) would result in no increase in environmental impacts associated with existing operations at SRS and the LANL. However, DOE would be unable to fulfill its assigned responsibilities to satisfy application needs for Pu-238, and NASA would be unable to use RTGs as sources of electrical power and LWRHUs as localized heat sources in the near term.

2.0 PURPOSE AND NEED FOR ACTION

The National Aeronautics and Space Administration (NASA) has scheduled two space missions, the Comet Rendezvous Asteroid Flyby (CRAF) and the Cassini mission, for 1996 and 1995, respectively. Both may require Pu-238 fueled radioisotope thermoelectric generators (RTGs) as sources of electrical power and Light-Weight Radioisotope Heater Units (LWRHUs) as sources of thermal power. The timing and schedules for these missions are dictated by the interval during which certain planetary bodies will be in the required spatial relationships with one another. The RTGs and LWRHUs would need to be produced and available in time to meet the mission schedules, in order to provide the alternative of using RTGs as electrical power sources and LWRHUs as localized heat sources. The U.S. Department of Energy (DOE) is responsible for providing the Pu-238 fuel in fabricated form required in support of NASA missions.

One type of radioisotope heat source unit, the General Purpose Heat Source (GPHS), has been successfully employed to provide on-board electrical power in two recent spacecraft used on the Galileo and Ulysses interplanetary space missions. The GPHS module produces 253 thermal watts. It has a high level of structural integrity and contains four (4) individual pellets of plutonium oxide enriched in the isotope of mass 238 (Pu-238), each encapsulated or clad in an iridium alloy container. This GPHS module provides a long-term, safe, compact, reliable source of isotopic decay heat. The decay heat is converted to useful electricity when 18 such modules are installed within an RTG. The electricity produced by RTGs is used to operate scientific instruments and communication equipment on board certain NASA spacecraft where solar panels and electrical storage devices cannot be used.

A second, smaller type of radioisotope heat source unit, the LWRHU, was successfully employed on the Galileo spacecraft to keep vital instruments and valves at the required operating temperatures. The LWRHU is a high structural integrity safety unit similar to but smaller than the GPHS, containing a one thermal watt pellet of plutonium oxide also enriched in Pu-238, and encapsulated or clad in platinum/rhodium alloy. The decay heat is used directly to warm spacecraft instruments and valves which operated properly only within particular temperature regimes.

The purpose of the proposed action is to enable DOE to provide the required supplies of Pu-238 fuel in a fabricated form to support NASA near term programs. Pu-238 processing facilities at SRS would need to be operational as soon as possible to process the Pu-238. The Pu-238 inventory as of January 1, 1991 was 61.2 kilograms. The CRAF/Cassini missions will require the use of all of the Pu-238 in inventory, and no new Pu-238 production will be required.

3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 PROPOSED ACTION

The proposed action is for the U.S. Department of Energy (DOE) to operate existing plutonium-238 (Pu-238) processing facilities at the Savannah River Site (SRS), and fabricate a limited quantity of Pu-238 heat source units at an existing Pu-238 research and development facility at the Los Alamos National Laboratory (LANL). These include facilities used in the Pu-238 fuel processing and fabrication from the point at which existing inventories of Pu-238 oxide can be dissolved and re-blended at SRS to the point at which the fabricated Pu-238 fuel forms are shipped from LANL for final integration into end-use system components. The proposed action would be accomplished in two stages, involving specific facilities as follows:

- Stage I: SRS processing facilities in the 221-HB-Line located in the H-Area Canyon Building, including the Scrap Recovery Facility and the Plutonium Oxide Facility. The facilities would be used to re-blend existing inventories of Pu-238 into a uniform blend suitable for use.

- Stage II: LANL Plutonium Handling Facility Building 4 (PF-4) at Technical Area 55 (TA-55). This facility would be used to fabricate Pu-238 oxide into iridium-clad capsules used in the General Purpose Heat Source (GPHS) Radioisotope Thermoelectric Generator (RTG) and into Light-Weight Radioisotope Heater Units (LWRHUs). This work would be undertaken during the time period of approximately 1991 through 1994 in support of the next two NASA near term missions. The required facility space, most of the equipment, and personnel are currently available for Pu-238 fabrication. Comparable work has been previously performed in this facility.

Figure 3-1 is a simplified schematic of the Pu-238 processing and fabrication processes highlighting the facilities that are the subject of this environmental assessment.

3.2 ALTERNATIVES TO THE PROPOSED ACTION

3.2.1 Fabrication Alternatives

An alternative to using PF-4 facility at LANL to satisfy Pu-238 fabrication needs is to use the Plutonium Fuel Form (PuFF) Facility located in F-Area Building 235 at SRS. However, the PuFF Facility needs refurbishment that would require at least several years to complete, and could not meet the near-term requirements to satisfy Pu-238 application needs.

3.2.2 Construct New Building and Facility

An alternative that could potentially meet the need for Pu-238 fabrication and achieve the purpose of DOE's proposed action is the construction of a new building and facilities to replace, rather than refurbish, the existing Building 235-F and the PuFF facility that it houses. However, this could not be accomplished within the time frame needed to satisfy Pu-238 application requirements.

3.2.3 No Action

In accordance with the National Environmental Policy Act (NEPA), the "no-action" alternative is included to provide a baseline condition from which to evaluate the potential environmental impact of the proposed action. This alternative, by definition, would consist of DOE taking no action to operate the subject facilities to produce the Pu-238 fuel forms. It would result in a failure to meet both the purpose and the need of the proposed action.

3.2.4 Other Alternatives

None of the alternatives considered to the proposed action would provide Pu-238 in sufficient quantity and fabricated form on a schedule that would allow DOE to satisfy Pu-238 application needs, for support of NASA near term space missions. The action proposed in this Environmental Assessment will enable NASA to consider all alternatives for the CRAF/Cassini missions.

4.0 PROCESS AND FACILITIES DESCRIPTION

4.1 STAGE I FACILITIES AND PROCESSES

A comprehensive description of facilities and processes at the Savannah River Site (SRS) is presented in the Final Environmental Impact Statement (FEIS) for Continued Operation of K-, L-, and P-Reactors (DOE, 1990a).

The operation of existing Pu-238 Stage I processing facilities at SRS include those used from the point at which Pu-238 oxide can be dissolved and blended to the point at which the re-blended Pu-238 oxide is shipped from SRS to LANL for fuel form fabrication. Stage I facilities include the Scrap Recovery Facility and the Plutonium Oxide Facility located in the HB-Line located on top of H-Area Canyon Building 221-H.

The HB-Line was originally constructed in 1954 and modified in 1960 and 1965. When this facility became obsolete, it was replaced and includes: the Scrap Recovery and the Plutonium Oxide Facilities, completed and operated between 1985 and 1987. All HB-Line facilities have been maintained in a state of operational readiness.

4.1.1 Facilities Descriptions

Building 221-H, which houses the HB-Line, also contains the processes for the chemical separation of highly radioactive materials (i.e., reactor fuel and irradiated targets) from the SRS reactors. The main structure consists of two levels constructed of reinforced concrete exterior walls. Tornado barricades along the east and west walls provide tornado missile protection for the airlocks to the operating area and the maintenance area.

The HB-Line is located on top of Canyon Building 221-H. It replaced the old HB-Line production facility. The present facility incorporated improvements in 1) engineered controls for nuclear safety, 2) cabinet integrity and engineered barriers to contain radioactivity and minimize personnel exposure to airborne contamination, 3) shielding and remote operations to decrease radiation exposure, and 4) equipment and ventilation design to provide flexibility and improved process performance. The HB-Line also contains a vault for the storage of Pu-238 oxide products, and process residues containing recoverable quantities of this materials.

Scrap Recovery Facility

The Scrap Recovery Facility houses a recovery process consisting of two parallel glove box lines that are mirror images of each other. The process area for each line consists of a product entry station and cabinet used for the introduction and physical preparation of scrap. Each line also contains four wing cabinets containing dissolvers, filtrate and product hold tanks and four other cabinets that face the operating areas. Interconnected cabinets in each process line are supplied with modulating dampers to prevent excessive pressure changes. Radiation shielding for the entry station, charge preparation glove box, and wing cabinets consists of water jackets and lead, with acrylic and lead glass windows. The dissolver and product transfer glove box requires only lead shielding with lead glass windows (Du Pont, 1985a).

Plutonium Oxide Facility

The Plutonium Oxide Facility houses the process glove box line, the instrument control room, calorimetry laboratory, welding room, waste handling line, pulse height analyzer room, and a product storage vault on the lower level. The upper level houses the exhaust and filteration systems for glove boxes and rooms, Halon® equipment room, and process air system (Du Pont, 1985b).

HB-Line Vault

The HB-Line Vault is used to store Pu-238 oxide product and scrap materials. The vault is constructed with reinforced concrete walls, ceilings, and floors. The vault has stainless steel product storage tanks, which contain storage locations for plutonium product containers. The vault also has floor space for storing containerized metals, oxides, or compounds of Pu-238, Pu-239, Np-237, and uranium-235 (U-235) (Du Pont, 1986).

Waste Handling Facilities

Both transuranic waste (TRU) and low-level radioactive waste (LLW) solids are produced by the HB Line. LLW consists of such items as shoe covers, rubber gloves, paper, and tape. This waste is collected within the facility in Radioactive Waste Boxes which are subsequently shipped for processing and disposal in welded steel boxes.

TRU waste consists of cast off materials and equipment from within the glove boxes, and cabinets, as well as the waste generated by the decontamination of production facilities and product containers. Waste is packed in lined, 210-liter drums for shipment and storage at the TRU Waste Storage Facility. Disposal of this waste will eventually take place at the Waste Isolation Pilot Plant (WIPP) located at Carlsbad, New Mexico.

Any hazardous or radioactive mixed wastes associated with refurbishment and/or operations will be handled in accordance with Resource Conservation and Recovery Act (RCRA) guidelines.

Waste solutions generated by the HB Line processes are combined with the H-Canyon waste streams. These are transferred to the high-level waste (HLW) tank farm for treatment, storage, and subsequent processing by the Defense Waste Processing Facility (DWPF) (NUS, 1990).

4.1.2 Process Descriptions

Scrap Recovery Process

The Scrap Recovery Facility is designed to routinely generate nitrate solutions of Pu-238 or U-235/Pu-239 recoverable scrap suitable for purification by anion exchange or solvent extraction in the H-canyon separations process (Du Pont, 1985a). Solid material is dissolved in hot nitric acid containing trace fluoride ion, transferred through a filter bag, collected in a tank, sampled for accountability and process control, diluted with nitric acid, and transferred to the appropriate canyon vessel as a nitrate solution.

Recoverable scrap containing Pu-238 is generally received in a stainless steel product container (EP-60) within a stainless steel primary containment vessel (EP-61), both welded and unwelded.

Plutonium Oxide Process

The Plutonium Oxide Facility converts Pu-238 nitrate solution from H-Canyon to plutonium oxide powder by the oxalate precipitation and calcination method. The feed solutions are received and adjusted; then the plutonium is precipitated, separated from the slurry by filtration, and calcined to plutonium oxide. After calcination, the product is packaged in primary containers and temporarily stored (in a storage vault) before being transported to the LANL PF-4. (Du Pont, 1985b).

HB-Line Vault

The HB-Line Vault is used to store actinides, including plutonium oxide and recoverable scraps, which are held in approved containers. The plutonium oxide product and primary containers are held in a water-cooled storage tank in the vault in order to ensure that excess heat is adequately dissipated. All scrap materials are stored on the floor of the vault in shipping containers. The total quantity of plutonium and neptunium stored in this manner is controlled for criticality safety (Du Pont, 1986).

4.2 STAGE II FACILITY AND PROCESS

A comprehensive description of facilities at the Los Alamos National Laboratory (LANL) is presented in the site-wide Environmental Impact Statement (EIS) (DOE, 1979), and updated in the annual Surveillance Reports (LANL, 1989 and 1990). Facility and process information related to Stage II of the proposed action is presented below.

4.2.1 Facility Description

The Plutonium Handling Facility Building 4 (PF-4) at LANL was constructed beginning in 1972 and has been operating continuously since 1978 as a state-of-the-art laboratory facility for research and development on plutonium processing. The facility is located in a secure area at Technical Area 55 (TA-55). The facility and its potential environmental impacts projected from then-expected projects were described in an Environmental Statement issued in 1972 (AEC, 1972).

The PF-4 facility contains 7000 square meters of core area floor space for laboratory operations of which about 790 square meters is dedicated to Pu-238 processing operations.

The ventilation system at PF-4 facility is designed to provide three levels of containment for contamination control. Direction of air flow, maintained by pressure gradients, is from the outermost areas of the building where offices are located, to the laboratory areas, and then to the glove boxes and conveyors that operate using an air atmosphere. All glove boxes operate at lower pressure than the laboratories. All glove box atmosphere is exhausted to the environment through an emissions control system which contains four stages of high efficiency particulate air (HEPA) filters. Within each laboratory module, 10 percent of the air is exhausted to the atmosphere after passing through two HEPA filters and 90 percent is passed through two HEPA filters before being recirculated into the laboratories. Thus, any contamination that might be released is retained within the area of emissions control and air passes through two or more stages of HEPA filters before being released to the environment.

All plutonium processing operations in PF-4 are performed in glove boxes. For this work, the glove box atmosphere for pellet fabrication w k will be inert argon, rather than air. This will prevent unwanted reactions such as combustion. This argon atmosphere will be maintained at a pressure lower than that of the laboratory to prevent radioactive particulate material escaping into the laboratory. Each glove box is equipped with a HEPA filter through which the gas flows before being exhausted into the main emissions control system. Glove boxes used for welding have an atmosphere of helium with conditions maintained by recirculating through an atmosphere purifying system.

Glove boxes are interconnected by conveyor enclosures, mounted on the facing sides of adjacent glove boxes such that the plutonium and the inert atmosphere are contained within the enclosed system at all times. Feedstock is introduced into the system through an airlock in the glove box line and removed from the glove box line through an airlock fitted with a contained removal (bag out) system that prevents contaminated material from escaping into the laboratory.

4.2.2 Process Description

The plutonium oxide processing operations for radioisotope heat source unit production were developed at PF-4 when the prototype General Purpose Heat Source (GPHS) modules were fabricated in 1979. These were refined when the Light-Weight Radioisotope Heater Units (LWRHUs) for the Galileo Mission were produced in 1981 to 1984 and for the recently-completed Milliwatt Project. The technology is understood, and safe operating procedures have been written and tested.

The GPHS and LWRHU pellets will be produced from Pu-238 oxide feedstock supplied as a powder by the SRS from existing inventories. Upon receipt from SRS, the Pu-238 oxide will be stored in the PF-4 vault until moved into the laboratory for processing. The containers of Pu-238 oxide will be opened only in a glove box.

Processing operations produce a uniform powder, press it into 150 gram (GPHS) and 2.7 gram (LWRHU) pellets and encase the pellets in a protective metallic cladding. These processes are described below.

The Pu-238 oxide powder received from SRS will be ground in a ball mill to reduce the differences in surface activity among feedstock lots; cold compressed and granulated to produce properly sized granules for the hot-pressing operation; and then sintered and hot pressed into pellet form.

The GPHS pellets will be welded into iridium alloy cladding using a gas tungsten arc welding system, operated in a helium atmosphere glove box. The LWRHU pellets will be similarly welded into platinum/rhodium cladding. After the cladding capsules are welded, the surfaces will be decontaminated, and the welded capsules will be submitted to the non-destructive testing to ensure all design specifications are met.

4.3 Transportation

The Pu-238 oxide powder that is prepared at SRS will be shipped to LANL in U.S. Department of Transportation (DOT) - approved containers developed for special nuclear material (SNM) transport. The Pu-238 oxide material will have been enriched to 80 to 89 atomic percent Pu-238. The remainder will be about 14 percent Pu-239, up to 2 percent Pu-240, and up to 0.2 percent Pu-241. The oxide will contain less of the isotopic forms of oxygen O-17 and O-18 than are found in normal air. The neutron emission rate is about 6,000 per second per gram of Pu-238. The isotopic form of oxygen is an important factor in reducing the neutron emission rate.

At SRS, about 250 grams of the Pu-238 oxide powder will be placed in each Pu-238 oxide container, called the EP-60 Product Canister. The EP-60 canister will be placed within the EP-61 inner Primary Containment Vessel and the vessel welded shut. The EP-61 will then be sealed within the EP-62, the outer Secondary Containment Vessel. The doubly-contained Pu-238 oxide will be shipped to LANL in a 5320 and/or other DOT-certified shipping container in a Safe Secure Trailer (SST) and will be coordinated by DOE's

Transportation Safeguards Division. A maximum of 24 shipping packages will be shipped per SST.

After the Pu-238 oxide is formed into pellets and encapsulated in iridium or platinum/rhodium alloy cladding at LANL, the encapsulated fuel will be repackage, two fuel capsules per each EP-61 container, sealed in an EP-62, and shipped to the EG&G Mound Applied Technologies Center in Miamisburg, Ohio, for assembly into the RTGs. Approximately 12 trips to and from LANL will be made per year between 1991 and 1994.

5.0 AFFECTED ENVIRONMENT

5.1 STAGE I AFFECTED ENVIRONMENT

A comprehensive description of the Savannah River Site (SRS) and the affected environment is presented in the Final Environmental Impact Statement (FEIS) for Continued Operation of K-, L-, and P-Reactors (DOE 1990a) and in the Reactor Operation Environmental Information Documents (WSRC, 1989). A summary of information relevant to this document is presented below.

5.1.1 Site Location

The SRS encompasses approximately 800 square kilometers in southwestern South Carolina. The SRS borders the Savannah River for about 27 kilometers. Figure 5-1 shows the SRS location in relation to major population centers, the closest being Augusta, Georgia, and Aiken and Barnwell, South Carolina.

SRS facilities include five nuclear production reactors, two chemical separations areas, a reactor fuel and target fabrication facility, a defense waste processing facility, a saltstone waste facility, and various supporting facilities (DOE, 1987). On-site waste storage/disposal facilities include F- and H-Area tank farms for the storage of high-level and liquid radioactive waste and 79 hectares for the burial and storage of low-level radioactive waste (LLW) and transuranic (TRU) waste. The proposed action will occur within existing buildings in the H-Area (Figure 5-2) (i.e., the 221 HB-Line located in the H-Area Canyon Building.

5.1.2 Demography and Land Use

Figure 5-1 also shows the six-county area of South Carolina and Georgia where approximately 83 percent of the current SRS workforce resides. In 1988, the six-county population was 425,000, including a six-county region workforce of 191,364. In 1989, approximately 15,000 SRS workers, or about 8 percent of the available workforce, resided in the six-county area. Approximately 550,000 person reside within an 80-kilometer radius of SRS.

5.1.3 Cultural Resources

Construction activities associated with initial development of the H-Area would have destroyed any historic and archaeological evidence during the 1950s. Thus, there are no cultural resources in the locations affected by the proposed action.

5.1.4 Meteorology and Climatology

The SRS has a temperate climate with mild winters and long summers. The region is subject to continental influences, but is protected from the more severe winters in the Tennessee Valley by the Appalachian Mountains to the north and northwest. The annual average precipitation for the SRS (1952 to 1987) was about 122 centimeters. Although tornadoes have been observed during every month of the year in the SRS area, they occur most frequently in the spring. However, on no occasion has there been tornado damage to any production facility on the SRS.

5.1.5 Geology and Seismology

The SRS is located on the Aiken Plateau of the Upper Atlantic Coastal Plain about 40 kilometers southeast of the Fall Line that separates the Atlantic Coastal Plain and the Piedmont provinces. The Aiken Plateau is underlain by southeast dipping layers of sands, clays, and limestone that lie on top of a harder, older basement.

Two major earthquakes have occurred within 300 kilometers of the SRS. The first was the Charleston earthquake of 1886, which had an estimated Richter magnitude of 6.8 and occurred approximately 145 kilometers from the site. The second major earthquake was the Union County, South Carolina, earthquake of 1913, which had an estimated Richter magnitude of 6.0 and occurred about 160 kilometers from the SRS. The design basis earthquake (DBE) for the SRS is an event with a horizontal peak ground acceleration of 0.2 g. This event has an estimated 2×10^{-4} annual probability of exceedance at the SRS.

5.1.6 Hydrology

The Savannah River forms the western boundary of the SRS and receives drainage from five major tributaries on the SRS: Upper Three Runs Creek, Four Mile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek. These tributaries receive varying types of wastewater discharges from plant processes and sanitary treatment systems, all of which are permitted through the National Pollutant Discharge Elimination System (NPDES). On the SRS, various plant processes also require pumpage of Savannah River water and/or on-site groundwater.

5.1.7 Ecology

Since 1951, when the U.S. government acquired the SRS, forestry management practices and natural succession outside the construction and operating areas at SRS have resulted in increased ecological complexity and diversity of the Site. Forested areas support a diversity of wildlife habitats that are restricted from public use. Forest management practices include controlled burning, harvesting of mature trees, and reforesting. Wildlife management includes protection and enhancement of threatened and endangered species (i.e., wood stork and red-cockaded woodpecker) and population control through supervised hunts. The site contains extensive, widely distributed wetlands, most associated with floodplains, creeks, and impoundments. The SRS, which was designated as a National Environmental Research Park in 1972, is one of the most extensively studied environments in this country.

5.1.8 Radiation Environment

Natural radiation sources contribute about 0.3 rem per year, or 82 percent of the annual radiation dose of 0.36 rem received by an average person residing in the SRS regional area from all sources. Radiation received from medical diagnosis and therapy contributes about 0.053 rem per year, or 15 percent, of this annual radiation dose. SRS releases contribute less than 1.0×10^{-4} rem, or less than 0.03 percent, of this total annual dose to the average individual within 80 kilometers of the SRS. In 1988, the calculated maximum individual annual dose at the SRS boundary from atmospheric releases averaged 4.6×10^{-4} rem.

5.2 STAGE II AFFECTED ENVIRONMENT

A comprehensive description of the Los Alamos National Laboratory (LANL) site and the affected environment is presented in the site-wide Environmental Impact Statement (EIS)

(DOE, 1979) with updated information contained in the annual Environmental Surveillance Reports (LANL, 1989 and 1990). A summary of information relevant to this document is presented below.

5.2.1 Site Location

The LANL site encompasses 111 square kilometers in Los Alamos County in north-central New Mexico, approximately 100 kilometers north-northeast of Albuquerque, as shown in Figure 5-3. The Laboratory is on the Pajarito Plateau, a series of mesas and canyons, at an elevation of about 2,200 meters above sea level.

The Plutonium Handling Facility Building 4 (PF-4) Facility is located in Technical Area 55 (TA-55) as shown in Figure 5-4. No construction will be required. The PF-4 Facility is about 200 meters north of Pajarito Road, a DOE-owned road that is open to the public most of the time.

5.2.2 Demography and Land Use

The present work force at LANL including research staff, protective force, and support services personnel is 11,330 individuals drawn from areas shown in Figure 5-1. Of this work force, 6,200 live in Los Alamos County, 2,320 live in Santa Fe County, 1,930 live in Rio Arriba County, 280 live in Sandoval County, 170 live in Bernalillo County, and the remainder live in other counties or out of state. The total population living within 80 kilometers of LANL is 203,000 (LANL, 1989).

5.2.3 Cultural Resources

Although numerous historical and archaeological sites are found in the LANL site vicinity, none are in evidence at the location of the proposed action. Construction activities associated with the earlier development of TA-55 and PF-4 would have removed any such evidence.

5.2.4 Meteorology and Climatology

Los Alamos has a semiarid, temperate mountain climate with about 45 cm annual precipitation. Forty percent of this precipitation occurs during July and August from thundershowers. Winter snow accumulation is about 130 cm annually. Because of the complex terrain, surface winds vary greatly with time of day, season, and location. The irregular terrain and nearby forests increase atmospheric dispersion which promotes greater dilution of materials released into the atmosphere. Historically, no tornadoes have been reported to touch down in Los Alamos County; however strong winds with gusts exceeding 27 m/s are common in spring.

5.2.5 Geology and Seismology

The Pajarito Plateau is 16 to 24 kilometers wide and 40 to 48 kilometers long, lying along the eastern flank of the Jemez Mountains. The eastern edge of the plateau stands 90 to 300 meters above the Rio Grande River. The plateau is formed of basalt flows and overlying consolidated ash (tuff) from volcanic eruptions that occurred during the Middle Miocene to Pliocene epoch (12 to 25 million years ago), from centers southwest of Los Alamos.

The Los Alamos area lies in the Rio Grande depression, a structural trough near large faults. The area is classed as Seismic Zone 2 in the Uniform Building Code (UBC, 1988).

The design basis earthquake (DBE) for a high-hazard facility at LANL has a peak ground acceleration (PGA) of 0.38 g and a probability of occurrence of 2×10^{-4} per year (Coats, 1984).

5.2.6 Hydrology

Water occurs at LANL as on-site surface waters, shallow groundwaters in alluvial fill, and the main aquifer which is 180 to 360 meters deep, below dry tuff and volcanic sediments. The shallow groundwater occurs in perched zones that do not extend beyond the boundaries of the Laboratory. These are tapped only by monitoring wells. Off-site surface flow is seasonal. Monitoring of discharges, shallow groundwater, and surface flows within the site boundary indicates that contamination due to LANL activities is well below DOE guidelines, typically 0.1 to 5 percent of the Derived Concentration Guide (DCG) for controlled areas. Monitoring at off-site perimeter stations indicates that radioactivity in surface and groundwaters is less than 1 percent of the DCG for uncontrolled areas. No connections between on-site surface waters or shallow aquifers and the underlying aquifer have been found. The underlying aquifer which is the source of municipal drinking water for Los Alamos is routinely monitored; no contamination from LANL activities has been found.

5.2.7 Ecology

The varied terrain of the Pajarito Plateau supports six major vegetative complexes. Within the confines of LANL, the predominant ecological community types are ponderosa pine in the western third (2100 to 2300 meters altitude), pinon-juniper in the central third (2000 to 2100 meters altitude), and juniper grassland in the eastern third (1700 to 2000 meters altitude). Sheer canyon walls at lower elevations serve as important nesting habitats for birds of prey (raptors). One federally listed endangered species, the peregrine falcon, has an airie within Los Alamos County north of LANL and is known to hunt on the LANL reservation. No other state or federally listed threatened or endangered species of plants or animals have been confirmed present on the LANL site. Before the LANL site was withdrawn as federal property in 1943, the area had been farmed and cut over by Native American and European settlers. The disturbed areas are in various stages of succession. In 1976, LANL was designated a National Environmental Research Park.

5.2.8 Radiation Environment

LANL supports an ongoing environmental surveillance program, as required by DOE orders (DOE 1981, 1988a). This program includes routine monitoring programs for radiation, radioactive emissions and effluents, and hazardous materials management at LANL. Information developed under the monitoring program is presented in detail in the annual Environmental Surveillance Reports (LANL 1989 and 1990).

The radiological doses from natural background radiation and all other non-LANL sources to the offsite population living within an 80-kilometer radius of LANL are 68,200 person-rem per year and the average dose to an individual living within the region is 0.34 rem per year. The additional dose to the population living within 80 kilometers due to LANL operations during 1989 was estimated to be 3.1 person-rem; the additional dose to the maximally-exposed individual was 0.0039 rem (LANL, 1990).

6.0 ENVIRONMENTAL IMPACTS

The environmental impacts of the proposed action at the Savannah River Site (SRS) associated with Stage I and at the Los Alamos National Laboratory (LANL) associated with Stage II are described below.

6.1 ENVIRONMENTAL IMPACTS OF STAGE I

6.1.1 Normal Operations

6.1.1.1 Waste Management Impacts

The projected annual volumes of transuranic waste (TRU) and low-level radioactive waste (LLW) to be generated at SRS as a result of the operation of facilities included in the proposed action are 94 and 396 cubic meters per year, respectively (Dillon, 1990; Gouge, 1990). These volumes represent about 8 percent and 1.3 percent of the approximate 1,130 and 30,980 cubic meters of TRU and LLW, respectively, generated at SRS on an annual basis (DOE, 1990a). Existing TRU and LLW waste management facilities at SRS were designed to handle wastes generated by all SRS facilities, including the operation of the HB-Line; therefore, there will be no additional burden on existing waste handling capacity by the implementation of the proposed action. The TRU waste will be disposed of permanently in the Waste Isolation Pilot Plant (WIPP).

Any hazardous or radioactive mixed wastes associated with operations will be handled in accordance with Resource Conservation and Recovery Act (RCRA) guidelines.

6.1.1.2 Radiological Impacts

The 1988 annual release of Pu-238 and -239 to the atmosphere from SRS was approximately 1.3×10^{-3} Curies. Radiological doses to the off-site population for all SRS 1988 atmospheric releases have been estimated to be 21 person-rem, and 4.6×10^{-4} rem to the off-site maximally-exposed individual (Davis, Martin, and Todd, 1989). The proposed action will result in a conservatively-estimated off-site dose increase of less than 1 percent.

Exposure of operating personnel to radiation during normal operations is monitored by the Savannah River Health Protection Department. Exposure includes both external radiation and inhalation or ingestion of radionuclides. Normal operating procedures require that operating personnel wear dosimeters, which measure the radiation exposure received while on the SRS. Individual worker exposures are limited to and maintained below 3 rem/year whole-body.

6.1.1.3 Nonradiological Impacts

There are no land use related impacts associated with the proposed action at SRS, as buildings and structures required presently exist. Most of the personnel required for operations are currently employed at SRS. Thus, any socioeconomic or traffic impacts are expected to be small. The proposed action is not expected to affect any sensitive areas, such as floodplains, wetlands, habitats of State- or Federally-listed threatened or endangered species, sole-source aquifers, and cultural resources.

No surface waters are to be used for operations associated with the proposed action. All process water used by the HB-Line will be obtained from the Black Creek and Middendorf Formations using existing water wells and distribution systems.

6.1.3 Accidents

All non-reactor nuclear facilities associated with the processing of Pu-238 at SRS have been analyzed to identify potential accidents and abnormal events, and their consequences to SRS personnel and the public. Abnormal events include those events, such as certain maintenance and change-out operations, that do not occur on a continuous basis during normal operations.

Each phase of the HB-Line operations covered by this EA have been studied to estimate the potential radiological risks from accidents and abnormal events, as documented in the Safety Analysis Reports (SARs) for the Scrap Recovery and Plutonium Oxide Facilities (Du Pont, 1985a and b). The HB-Line facilities incorporate 1) engineered controls for nuclear criticality, 2) cabinet integrity and engineered barriers to contain radioactivity and minimize personnel exposure to airborne contamination, 3) shielding and remote operations to decrease radiation exposure; and 4) equipment and ventilation design to provide flexibility and improved process performance. The SARs for the Scrap Recovery and Plutonium Oxide Facilities have been revised and are currently undergoing review within DOE. The preliminary results based on the use of updated information and methods are presented below.

The potential for radioactivity releases due to abnormal events at the Scrap Recovery Facility involve low-energy events involving process equipment leaks, transfer errors, overflows, and spills were found to be the major contributors to risk, with a combined expected frequency of 0.21 per year. These accidents could release 1.7×10^{-2} Curies to the stack and result in a dose to the maximally-exposed individual of 7.6×10^{-3} rem. The doses to the on-site population would be 17 person-rem and 62 person-rem to the off-site population.

For the Plutonium Oxide Facility, a low-energy accident with a failure of both HEPA filters was determined to be the largest contributor to risk, with an expected frequency of 6.0×10^{-2} per year. This scenario would result in 9.5×10^{-4} Curies released to the stack and a dose to the maximally-exposed individual of 2.7×10^{-4} rem. The doses to the on-site population would be 0.6 person-rem and 2.1 person-rem to the off-site population.

6.2 ENVIRONMENTAL IMPACTS OF STAGE II

6.2.1 Normal Operations

6.2.1.1 Waste Management Impacts

Up to 25 drums of TRU waste per year will be generated by the proposed action. This waste will be stored in Area G, Technical Area 54 (TA-54) until treatment or disposal options became available. This will not be a significant increase in the quantity of TRU waste handled annually at LANL; approximately 700 drums of TRU waste were placed in storage during 1989. The proposed action will not significantly increase the cumulative impact of interim TRU waste storage at the LANL.

Radioactive liquid wastes produced at TA-55 are pretreated to precipitate about 95 percent of the plutonium as sludge before the supernatant is transferred by subsurface pipeline to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. There, additional contaminants are removed. In 1990, the Pu-238 discharge concentration from the RWLTF on the LANL site was about half the derived concentration guide (DCG) for discharges to an uncontrolled, or off-site, area. Discharges from this facility are made in compliance with a NPDES permit and with DOE Order 5400.5 and do not contaminate the potable aquifer.

For the proposed project, about 250 liters per year of used acid decontamination solution will be treated at PF-4 with an equal volume of caustics to precipitate the Pu-238 as sludge. The sludge is treated as solid radioactive waste. The remaining supernatant will be discharged to the RWLTF inflow pipeline. The increases in volume and in radioisotope content due to the proposed action will not be a significant burden on the RLWTF treatment capacity and the cumulative impact of LANL operations will be unchanged.

Small amounts of nonradioactive solid waste, including office trash, packing material, and garbage, will be disposed in the Los Alamos County sanitary landfill. The increase will be about 0.2 percent, proportional to the increase in personnel of 12 to 15 individuals, compared with the present LANL population of about 11,300 persons and will not increase the cumulative impact of LANL operations significantly.

Any hazardous or radioactive mixed wastes associated with operations will be handled in accordance with RCRA guidelines.

6.2.1.2 Radiological Impacts

In the Plutonium Handling Facility Building 4 (PF-4), the exhaust from the glove box line flows through four stages of high efficiency particulate air (HEPA) filters before being exhausted to the environment. All room air from the plutonium processing areas flows through two banks of HEPAs before being discharged and is continuously sampled for radioactive particulate matter content after the final HEPA filter. Information on annual radioactive emissions from LANL locations is presented in the annual Laboratory Environmental Surveillance Report; for 1988 the plutonium emissions from LANL as a whole were 7.23×10^{-5} Curies of which 1.53×10^{-5} Curies came from Technical Area 55 (TA-55), where PF-4 is located (LANL, 1989).

Some particulate Pu-238 oxide will become suspended in the glove box atmosphere during fabrication operations. Based on a maximum annual throughput of 25 kilograms (4.3×10^{5} Curies) and a resuspension rate of 10^{-3} (EPA, 1989), 430 Curies Pu-238 could be resuspended within the glove box line per year. Using 99.95 percent removal factors for the first of the four stages of HEPA filters and 99.90 percent for each of the remaining three (Gonzales 1976), about 2.1×10^{-10} Curies of Pu-238 could be released to the atmosphere per year. This would not be a significant increase in the current annual emissions from TA-55 of about 1.53×10^{-5} Curies.

Personnel working with this project in PF-4 will be included in the health physics monitoring program maintained at TA-55. Although all work will be performed in extensively shielded glove boxes, some of the energetic decay products penetrate the shielding and cause some exposure to the workers. Because considerable manipulation of plutonium, annual individual doses are estimated to be 2 to 3 rem. Doses will be maintained as low as reasonably achievable below the annual 5 rem occupational dose limit (DOE, 1988b).

Radioactive emissions from this project would cause small annual increases in dose to off-site individuals. A person who lives in Royal Crest Trailer Park would receive a dose of 1.9×10^{-11} rem/year. This is very small compared with the background dose in Los Alamos of 0.34 rem/year, the U.S. Environmental Protection Agency (EPA) dose limit of 10 mrem/year through the air pathway (EPA, 1989), and the DOE limit of 100 mrem/year through all pathways (DOE, 1986). The dose to the average Los Alamos resident from all Laboratory operations was 1.2 x 10^{-4} rem in 1988 (LANL, 1989). The population of approximately 203,000 who live within 80 kilometers of the LANL would receive an additional 1.3 x 10^{-7} person-rem/year due to the proposed action.

6.2.1.3 Non-Radiological Impacts

There are no land-use related impacts associated with the proposed action at the site, as an existing building will be used, and no additional construction will be required. The proposed activities are not expected to affect any sensitive areas, such as floodplains, wetlands, habitat of State- or Federally-listed threatened or endangered species, sole-source aquifers, and cultural resources.

The proposed action will require an increase of 12 to 15 in the present staff of 500 at PF-4. Some or all of these individuals may be relocated from other areas within TA-55 or LANL. Any resulting socioeconomic or traffic impacts are expected to be small. This increase will not be a significant burden on the sanitary waste treatment system now in place.

Several liters of ethanol used each year will be collected by the Laboratory Waste Management Group for disposal in accordance with RCRA and LANL procedures. The increase will not be significant and the cumulative impact of LANL operations will be unchanged.

Nonradioactive air emissions are mainly glove box atmosphere gases argon and helium. These are inert, nonhazardous, and are not addressed by the New Mexico Environmental Improvement Board (NMEIB) in state air quality control regulations (AQCR 702). Ethanol, to be used as a solvent, is not regulated under AQCR 702 either. Vapors of hydrofluoric (HF) and nitric acids (HNO_3) used in decontamination, could be emitted at rates of 0.013 kilograms/hour and 0.019 kilograms/hour respectively. Both emissions rates are well below the threshold values, 0.0758 kilograms/hour for HF and 0.151 kilograms/hour for HNO_3 (EIB, 1988).

Workers will not be exposed to fumes of acid decontamination solutions because the work will be carried out in glove boxes. Emissions rates are well below NMEID limits and adverse effects to other on-site individuals are not expected.

6.2.2 <u>Accidents</u>

For the proposed action, accidents that could cause radioactive material to be released into the work area and the environment have been selected using the Final Safety Analysis Report (FSAR) for PF-4 (LASL, Undated); the October, 1990 draft of the new FSAR for PF-4; the draft Preliminary Hazard Analysis for the project; and the experience of LANL staff members involved with heat source production. Scenarios that describe a high-probability, low-consequence event (airborne release from contaminated equipment) and a low-probability, high-consequence event (fire that breaches the glove box line) are selected to represent the range of credible accidents, defined as those with a probability of greater than 10^{-6} per year (NRC, 1988; DOE, 1987; Elder 1986).

The PF-4 facility is qualified for earthquake (AEC, 1972). The facility was designed to withstand an earthquake approaching 1.0 g peak ground acceleration (PGA) without loss of building integrity; no failures of ventilation system, ductwork integrity, or equipment mounts are expected from the design basis earthquake (DBE) which has a design basis PGA of 0.38 g and a probability of 2 x 10^{-4} per year (Coats, 1984). The vault racks may fail at 0.22 g, however since all plutonium oxide will be stored in double, welded containers, no release would occur.

Criticality accidents are precluded by administratively limiting the plutonium handled to Type 83 which contains greater than 75 percent Pu-238. The following discussions assume that all suppression and protection systems function according to design expectations. Individual and population doses are calculated following standard methodology (Moore, 1979; LANL, 1989).

Maintenance-Related Airborne Release Into Laboratory

During routine maintenance of contaminated equipment, glove box window change, or waste bag-out a handling error could occur and 1.0×10^{-5} grams of plutonium-238 could be released into the PF-4 laboratory atmosphere. This type of release has occurred at PF-4 but releases have been 2.0×10^{-6} to 3.0×10^{-6} grams. The probability is estimated to be 0.2 per year for the entire heat source fabrication process. The air within the laboratory (250 cubic meters) becomes contaminated, the continuous air monitor (CAM) alarm sounds, and personnel evacuate into the corridor within 30 seconds of the release. In evacuation drills, personnel typically evacuate within 5 seconds. The contaminated atmosphere is released to the environment through two stages of HEPA filters, assumed to have a removal efficiency of 99.95 percent and 99.90 percent (Gonzales 1976). The release to the environment is 5.0×10^{-12} grams, or 8.5×10^{-11} Curies.

The worker performing the maintenance activity would receive a dose of approximately 1.9 rem; however, if the worker were wearing a respirator, the dose would be decreased to 0.04 rem. A worker in the next building, PF-3, could receive a dose of 3.8×10^{-8} rem.

The maintenance-related accidental release could cause an individual who happened to be at the Pajarito Road site boundary, 200 meters away, to receive a dose of 2.3×10^{-11} rem. No adverse effects would be expected. The dose to the population living within 80 kilometers of LANL would be 2.8×10^{-7} person-rem.

Fire Breaches Glove Box

This scenario considers a fire in one of the glove boxes. The probability of this type of accident is estimated to be 1×10^{-4} to 1×10^{-6} per year; such an accident has never occurred in PF-4. Safe operating procedures for glove box operators and administrative controls on quantities of flammable materials in glove boxes make the event extremely improbable. However, the fire might be initiated by a hot storage container melting a glove and allowing oxygen to enter the glove box or the furnace might ignite combustible material in the glove box. A maximum inventory of 350 grams of powdered Pu-238 divided among one or more open containers could be exposed to the fire. Using a release factor for fire and powdered plutonium of 0.053 percent (NRC, 1988), 0.186 grams (3.16 Curies) becomes airborne in the glove box line and 10 percent could be carried by expanding hot gases through the burned-out glove opening into the laboratory, 250 cubic meters in air volume. This 10 percent release estimate is based on studies conducted at a Rocky Flats. Of the 0.019 grams (0.32 Curies) released into the laboratory, the respirable fraction is 20 percent (0.004 grams or 0.063 Curies) and the remainder becomes attached to equipment in the room or to larger airborne particles created by combustion of flammable material. This material is released to the atmosphere through two stages of HEPA filters. However, the removal efficiency of the HEPA filters could be degraded to 99.9 percent for the first stage and 99.8 percent for subsequent stages by the smoke (Elder, 1986). The remaining 90 percent of the airborne material remains in the glove box ventilation system and is released to the atmosphere through four stages of HEPA filters, similarly degraded in removal efficiency. The release to the environment is 8×10^{-9} grams (1.3×10^{-7} Curies) Pu-238. Personnel within the laboratory respond immediately to a warning or to the CAM alarm and evacuate to the corridor within 10 seconds. During regularly conducted drills at PF-4, evacuation times are 5 seconds or less.

The worker standing at the glove box where the fire occurs could receive a dose of 240 rem if the exposure time were 10 seconds. The worker in the next building, PF-3, could receive a dose of 1.1×10^{-5} rem.

The fire-related release could cause an individual at the site boundary to receive a dose of 7.4×10^{-6} rem. The dose to the population living within 80 kilometers of LANL would be 9.4×10^{-5} person-rem.

If a more conservative approach defined in NRC Regulatory Guide 1.52 (NRC, 1978) is used for this analysis, with the removal efficiency of the first stage of the degraded HEPA filter assumed to be 99.0 and no credit is taken for subsequent filters, the resulting release to the environment is 6.3×10^{-3} Curies. The worker in the next building, PF-3, would receive a dose of 0.56 rem. The resulting dose to the maximally exposed individual at the site boundary would be 0.37 rem and the dose to the population living within 80 kilometers of LANL would be 4.7 person-rem.

6.3 ENVIRONMENTAL IMPACT OF TRANSPORTATION

The protection of the public and transport workers from hazards associated with the shipment of the Pu-238 is achieved by a combination of limitations on the contents, the package design, and the method of shipment. All of the aspects are regulated at the Federal level by the Department of Transportation (DOT). In addition, certain aspects, such as limitations on gross weight of trucks, are regulated by the States.

Pu-238 oxide will be shipped to LANL from SRS in fully-certified 5320 shipping containers or other DOT-approved containers as specified in Section 4.3. Shipments will be made in Safe Secure Trailers (SST's) and will be coordinated and escorted by DOE's Transportation Safeguards Division (TSD). A maximum of 24 shipping packages will be shipped per SST. All shipping packages used in transporting the Pu-238 will satisfy DOT regulations (49 CFR 171-179) and therefore be fully certified Type B packages providing double-containment.

6.3.1 Normal Operation

The certified packages are designed to remain leak-tight under normal conditions of transport. The packages are also designed to provide sufficient radiation shielding under normal conditions. All shipments will be made according to DOT standards which limit the dose rate at the surface of the transportation container to 200 mrem/hour. However, the actual dose rates to personnel in any normally occupied position in the transport vehicle will not exceed 2 mrem/hour.

Each 5320 shipping container has a maximum allowable heat rate of 203 watts. For comparison, 10 kilowatts is about equal to the heat released from an air-conditioner in an average size home. Because the amount of heat is small and is being released over the entire transportation route, no appreciable thermal effects on the environmental will result.

6.3.2 Accidents

The certified packages are designed to minimize any leakage of material in accident situations. Prototypes of certified shipping packages must survive an extensive postulated accident test sequence consisting of impact, puncture, and fire testing, as well as an immersion test in water. Packages designed to carry Pu-238 must be shown to have a post-accident leak-rate not exceeding 0.003 curies per week. In addition, the packages are designed to maintain adequate radiation shielding under accident conditions.

The DOE TSD safety standards will help reduce the probability of accidents. DOE-TSD has never experienced a radiological accident in over several million miles of highway transport and the DOE-TSD safety record is several times better than that of the commercial trucking industry. Shipments of material are constantly monitored and tracked to ensure prompt attention and proper notification of authorities in the event of an accident. If an accident occurs, drivers are trained to make a preliminary assessment of the situation. If necessary, radiological assistance teams are available to help mitigate the consequences of the accident.

6.4 IMPACTS OF NO ACTION ALTERNATIVE

The no action alternative (i.e., do not refurbish and/or operate facilities for Pu-238 processing and fabrication) would result in no increase in environmental impacts associated with existing operations at the SRS and LANL. However, DOE would be unable to fulfill its assigned responsibilities to satisfy application needs for Pu-238, and NASA would be unable to launch spacecraft requiring RTGs as sources of electrical power, and LWRHUs as localized heat sources.

7.0 AGENCIES AND PERSONNEL CONSULTED

This document was compiled in part from information contained in LANL, 1991 and DOE, 1991. Information was provided by, discussed with, and/or reviewed by personnel in the following organization:

- U.S. Department of Energy (DOE), Savannah River Office
  - Environmental Division
- Los Alamos National Laboratory
  - Health, Safety, and Environmental Division
  - Nuclear Materials Technology Division
  - Laboratory Environmental Review Committee
- Westinghouse Savannah River Company
  - Separation Project Management Team
- DOE, Office of Special Applications
- NUS Corporation
  - Gaithersburg Environmental Division
  - Consulting Division
  - Savannah River Center

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