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United States Department of Energy

Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities

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U.S. Department of Energy
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1.0 INTRODUCTION

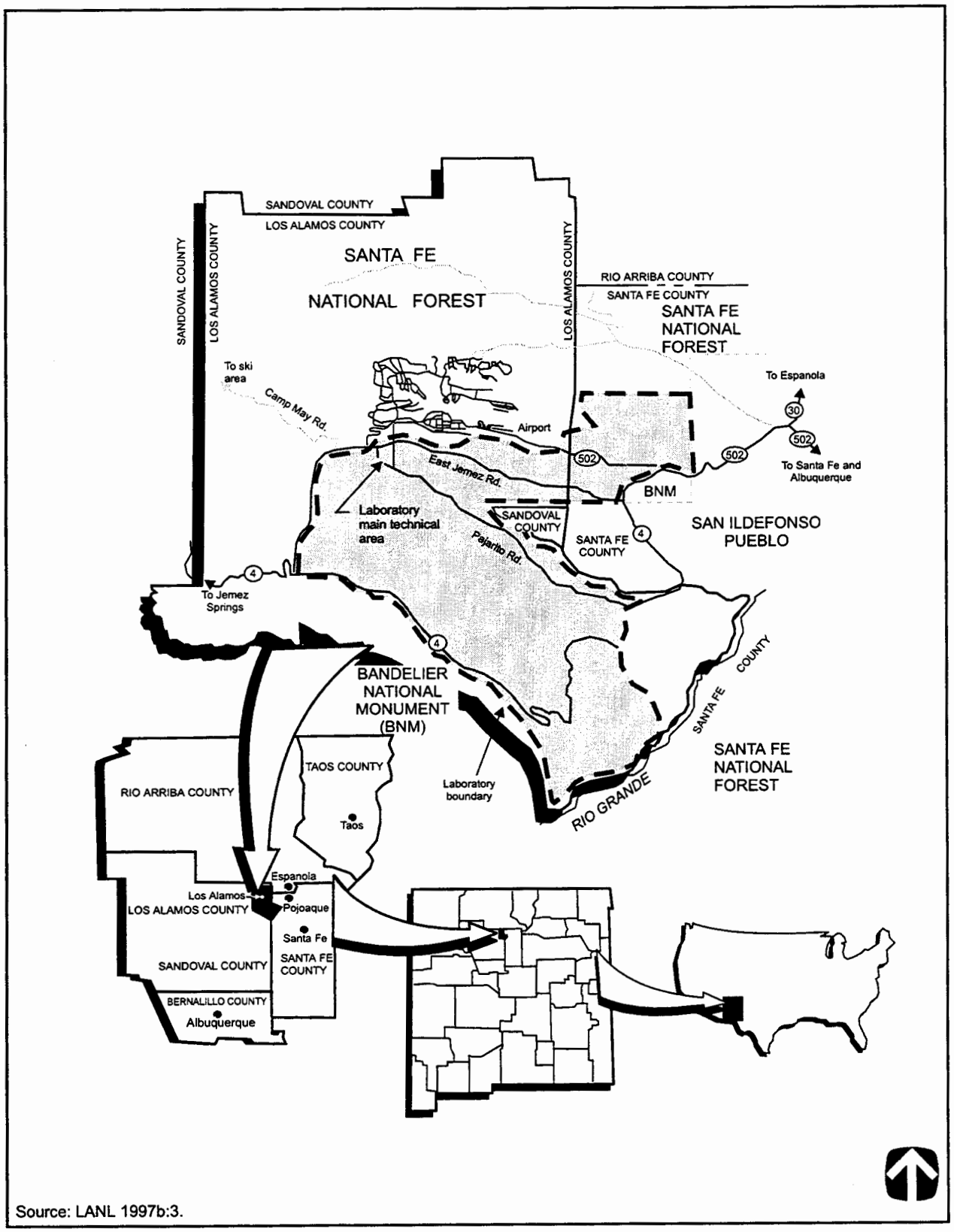
The Department of Energy (DOE) is implementing a long-term program to provide safe and secure storage of weapons-usable fissile materials, and is pursuing a strategy for the timely disposition of weapons-usable plutonium declared surplus to national security needs. The program's goal is to ensure that there is a high standard of security and accounting of these materials while in storage, and that the surplus plutonium is never used again in nuclear weapons.

In January 1997, DOE issued the Record of Decision (ROD) for the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (PEIS)*. In the PEIS ROD, DOE announced a decision to pursue a strategy to dispose of surplus United States plutonium that allows for two separate approaches: 1) immobilization of some (and potentially all) of the surplus plutonium; and 2) using some of the surplus plutonium as mixed oxide (MOX) fuel in existing commercial reactors. In that decision, DOE explained that the timing and extent to which either or both of the disposition approaches are ultimately deployed would depend in part on a follow-on environmental impact statement (EIS), as well as technology development and research. The *Storage and Disposition Final PEIS* ROD also explained that DOE would continue research and development (R&D), and engage in further testing and demonstrations of plutonium disposition technologies, pursuant to appropriate National Environmental Policy Act (NEPA) review. This environmental assessment (EA) is part of the NEPA review for such proposed and continuing research and demonstration activities, occurring prior to the completion of the follow-on *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) (Draft issued July 1998), contemplated in the *Storage and Disposition Final PEIS* ROD. Both the *Storage and Disposition Final PEIS* and the SPD EIS evaluate a nominal 50 metric tons of surplus plutonium.

A significant portion of the surplus plutonium is in the form of pits, a nuclear weapons component. Pits are composed of plutonium which is sealed in a metallic shell. These pits would need to be safely disassembled and permanently converted to an unclassified form that would be suitable for long-term disposition and international inspection. To determine the feasibility of an integrated pit disassembly and conversion system, a Pit Disassembly and Conversion Demonstration is proposed to take place at the Los Alamos National Laboratory (LANL). LANL is located about 40 kilometers (25 miles) northwest of Santa Fe, New Mexico (see Figure 1–1). This demonstration would be done in existing buildings and facilities, and would involve the disassembly of up to 250 pits and conversion of the recovered plutonium to plutonium metal ingots and plutonium dioxide. This demonstration also includes the conversion of up to 80 kilograms of clean plutonium metal to plutonium dioxide because, as part of the disposition process, some surplus plutonium metal may be converted to plutonium dioxide in the same facility as the surplus pits. The demonstration would start during August 1998 and continue for up to four years.

For a number of years, LANL has had a capability to disassemble pits and convert the plutonium to a form that could be used for a variety of purposes. The equipment needed to accomplish this work was in existence before the start of the plutonium disposition program. LANL in recent years assembled this capacity into a system called Advanced Recovery and Integrated Extraction System (ARIES) using components and equipment that were drawn from several other DOE programs (e.g., pit surveillance). The equipment to be used for the proposed demonstration addressed in this EA would use some parts of the ARIES capability, other existing equipment/capacities, plus new equipment that was developed at other sites.

In addition, small-scale R&D activities are currently underway as part of the overall surplus plutonium disposition program. These R&D activities are related to pit disassembly and conversion, MOX fuel fabrication, and immobilization (in glass and ceramic forms). They are described in Section 7.0.



Source: LANL 1997b:3.

Figure 1–1. Regional Location of Los Alamos National Laboratory

On May 16, 1997, the Office of Fissile Materials Disposition (MD) notified potentially affected states and tribes that this EA would be prepared in accordance with NEPA. This EA has been prepared to provide sufficient information for DOE to determine whether a Finding of No Significant Impact (FONSI) is warranted or whether an EIS must be prepared.

1.1 Related National Environmental Policy Act Reviews

The *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229, December 1996; ROD, January 1997) analyzed the environmental impacts of alternatives for the long-term storage (up to 50 years) and disposition of weapons-usable fissile materials under the responsibility of DOE. The ROD encompassed two categories of decisions: (1) the sites and facilities for the storage of non-surplus weapons-usable plutonium and highly enriched uranium (HEU), and storage of surplus plutonium and HEU pending disposition; and (2) the programmatic strategy for disposition of surplus weapons-usable plutonium. This ROD did not encompass the final selection of sites for plutonium disposition facilities, nor the extent to which the two plutonium disposition approaches (immobilization or MOX fuel) would ultimately be implemented. Those decisions would be made pursuant to a follow-on EIS (the SPD EIS). However, DOE did announce in the ROD that the list of candidate sites for plutonium disposition has been narrowed.

The *Surplus Plutonium Disposition Draft Environmental Impact Statement* (DOE/EIS-0283, July 1998) examined reasonable alternatives and potential environmental impacts of the proposed siting, construction and operation of three types of facilities for plutonium disposition: a facility to disassemble and convert pits into plutonium dioxide suitable for disposition; a facility to immobilize surplus plutonium in a glass or ceramic form for disposition in a geologic repository pursuant to the Nuclear Waste Policy Act; and a facility to fabricate plutonium dioxide into MOX fuel. The draft EIS analyzed alternative locations, including LANL, for the fabrication of lead MOX fuel assemblies.

The *Draft Site-Wide Environmental Impact Statement on the Continued Operation of the Los Alamos National Laboratory* (DOE/EIS-0238, April 1998) examined the environmental impacts, including cumulative impacts, of alternatives for ongoing and reasonably foreseeable new operations and facilities at LANL in support of DOE missions, including operations at Technical Area-55 (TA-55) and the proposed demonstration. This *Draft LANL Site-Wide EIS* updates the *LANL Site-Wide EIS* issued in 1979.

The *Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment*, Predecisional Draft, (DOE/EA-1216, August 18, 1997) examined DOE fabrication of a limited amount of MOX test fuel at LANL and shipment to the Atomic Energy of Canada Limited National Research Universal test reactor in Canada as part of the Parallex Project. This proposed action would allow DOE to test and demonstrate the feasibility of burning MOX fuel in Canadian Deuterium Uranium reactors as part of its ongoing mission to evaluate the disposition of surplus weapons-usable fissile materials. DOE has not yet finalized the EA or determined, based on the EA, whether a FONSI is warranted for the Proposed Action or whether an EIS must be prepared.

The *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS) (DOE/EIS-0200-F, May 1997) examined the potential environmental impacts of alternative strategies for managing five types of radioactive and hazardous wastes that have resulted, and would continue to result, from nuclear defense and research activities at a variety of sites around the United States. The WM PEIS provides information on the impacts of various siting alternatives that DOE would use to decide where to locate additional treatment, storage, and disposal capacity for each waste type. Any waste resulting from actions taken in this EA would be treated, stored, and disposed of in accordance with the decisions resulting from the WM PEIS.

The *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE/EIS-0225, November 1996; ROD, January 27 1997), is a site-wide EIS that covers current and proposed facilities and activities at the DOE Pantex Plant in Amarillo, Texas, where plutonium pits are currently stored. The EIS analyzed the environmental impacts associated with continuing to conduct nuclear weapons operations at Pantex. Included in the EIS is an analysis of the effects of increasing the number of pits in interim storage from 12,000 to 20,000. In the ROD, DOE decided to implement the preferred alternative by: 1) continuing nuclear weapon operations involving assembly and disassembly of nuclear weapons at the Pantex Plant; 2) implementing facility projects, including upgrades and construction consistent with conducting these operations; and 3) continuing to provide interim pit storage at the Pantex Plant and increasing the storage level from 12,000 to 20,000 pits.

The *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September 1994; FONSI, September 1995) evaluated the continued receipt, prestorage processing, and interim storage of enriched uranium in quantities that would exceed the historic maximum storage level. The Y-12 Plant EA was issued in September 1994 and was followed by a FONSI in September 1995. DOE decided that the Y-12 Plant would store no more than 500 metric tons of HEU and no more than six metric tons of low-enriched uranium.

2.0 PURPOSE AND NEED FOR ACTION

2.1 Background

Since the early 1990s, the United States has been examining various ways to safely and securely disposition its surplus weapons-usable fissile materials. For the purposes of this EA, the term "disposition" relates to actions taken to meet nonproliferation goals by converting surplus plutonium to a form that meets the "Spent Fuel Standard."[1] To support this effort, in December 1996, DOE published the *Storage and Disposition Final PEIS* which assessed the environmental impacts of various disposition alternatives for surplus weapons-usable plutonium.

In the *Storage and Disposition Final PEIS* ROD, DOE announced that it had decided to pursue a plutonium disposition strategy that allows for both immobilization of surplus weapons plutonium in glass or ceramic forms and the use of some of the surplus plutonium as MOX fuel in existing commercial reactors (DOE 1997c:1). The ROD also committed to a subsequent EIS, the SPD EIS, to evaluate the site-specific impacts associated with pursuing these disposition alternatives. Additionally, the ROD stated, "Based on appropriate NEPA review, DOE anticipates demonstrating the Advanced Recovery and Integrated Extraction System (ARIES) concept at LANL for pit disassembly/conversion ..." (DOE 1997c:20). Accordingly, this EA is being undertaken to determine whether there are any potentially significant environmental impacts associated with conducting, as an interim action before issuance of the SPD Final EIS ROD, the Pit Disassembly and Conversion Demonstration.[2]

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[1] The "Spent Fuel Standard" is defined by DOE as follows: The surplus weapon-usable plutonium should be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors (DOE 1996a: 1-5).

[2] The purpose of this EA is also to discuss other ongoing, small-scale R&D activities. As discussed in Section 7.0, these R&D activities are needed to refine technical and feasibility information related to surplus plutonium immobilization, potential MOX fuel fabrication, and plutonium conversion.

2.2 Purpose and Need for Action

The United States has declared 38.2 metric tons of weapons-usable plutonium surplus to national security needs. Additional quantities of plutonium may be declared surplus in the future; therefore, the *Storage and Disposition Final PEIS* analyzed (as does the SPD Draft EIS) the disposition of a nominal 50 metric tons of plutonium (DOE 1997c:2; DOE 1997a:7). Approximately 33 of the 50 metric tons of surplus plutonium are expected to come from clean metal including pits from dismantled nuclear weapons. The remainder would consist of plutonium in other forms (e.g., oxides and alloyed metal).

DOE is continuing to dismantle nuclear weapons (separating the plutonium pits from the rest of the weapons components), thereby increasing the inventory of surplus weapons pits. While these additional surplus pits are placed in safe, secure storage, the plutonium metal contained therein could readily be reused in nuclear weapons. Therefore, safe, secure storage alone would not meet the nonproliferation goals of the fissile materials disposition program.

Disposition of surplus plutonium metal, either through immobilization or through use as MOX fuel in commercial reactors, would require that it first be converted to an oxide form. Because the surplus plutonium would be subject to international safeguards, it must be unclassified. Therefore, for disposition, the surplus pits must be disassembled and converted to an unclassified oxide form.

DOE is currently dismantling a limited number of pits as part of weapons surveillance and rebuild efforts. However, the existing DOE infrastructure is only capable of dismantling a very limited number of pits and does not include the capability of converting the resulting plutonium metal to an unclassified oxide. Additionally, because of this limited throughput, the existing pit disassembly process has not been optimized and consists of a series of operations in a variety of separate (non-integrated) gloveboxes, which results in a burdensome, man-hour intensive operation and higher than desirable radiation exposure to involved workers.

DOE needs to develop the capability to disassemble surplus pits and convert the surplus plutonium metal to a suitable oxide form safely and efficiently. In order to develop this capability in a timely manner, safety and operational design information must be obtained from the actual disassembly of up to 250 representative pits and the conversion of the recovered plutonium to plutonium metal ingots and plutonium dioxide. A complicating factor is that there are many different types of pits of varying ages and therefore, the dose to which the workers would be exposed could vary considerably. In order to adequately protect workers in the potential pit disassembly and conversion facility, a wide range of spacing and shielding specifications needs to be developed, integrated, and tested. Concurrently, process parameters must be developed for the conversion of different pits to produce an unclassified oxide form that could be used in MOX fuel or immobilized.

The basic objectives of this demonstration are to:

- Demonstrate the feasibility of the pit disassembly and conversion process;
- Test various processes for the different parts of the pit disassembly and conversion process to optimize procedures and parameters and reduce dose to workers (as the number of pits to be dismantled would significantly increase);
- Develop processes, procedures and equipment for the disassembly of all types of surplus pits; and

- Demonstrate that the plutonium metal from pits of varying types and ages can be consistently converted to an oxide form that is suitable for use as feed for MOX fuel and for immobilization.

The resulting experience would be used to supplement information developed to support the design of the full-scale disassembly and conversion facility should it be decided in the SPD EIS ROD to construct that facility.

3.0 PROPOSED PIT DISASSEMBLY AND CONVERSION DEMONSTRATION

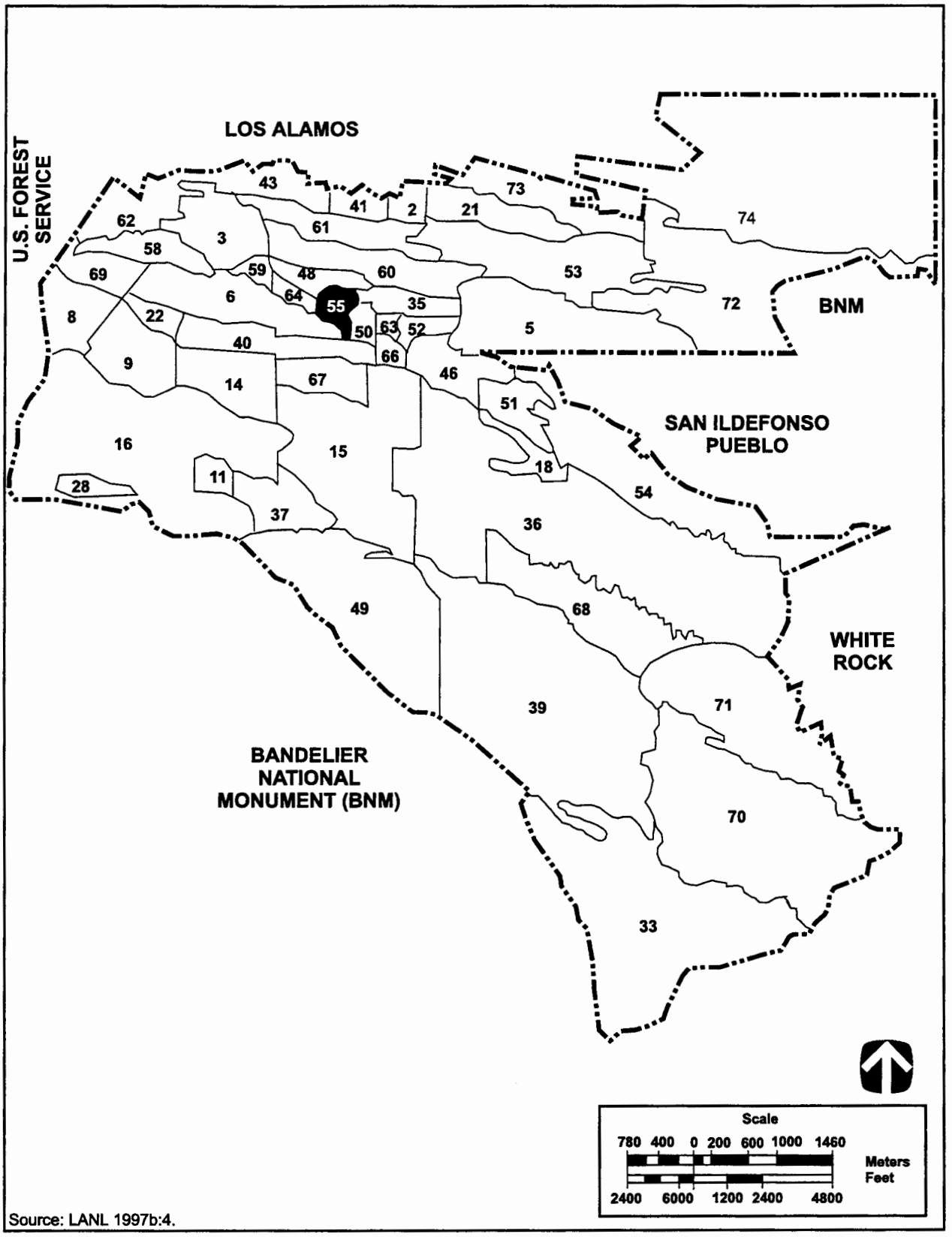
In order to meet the purpose and need for the action described in Section 2.2, DOE proposes to test an integrated pit disassembly and conversion process on a relatively small sample of pits and non-pit, clean plutonium metal at LANL. The pits processed as a part of this demonstration would represent the diverse range of pits that DOE proposes to disassemble over the coming years.

The demonstration would be accomplished at LANL's Plutonium Facility-4 (PF-4) in TA-55, see Figure 3–1. No new facilities are needed to support this demonstration; however, minor internal modifications would be made to existing facilities. These minor modifications, relating to the installation of new gloveboxes, would not involve worker exposure.

Most work would be performed in a series of interconnected gloveboxes using remote handling, automation and computerized control systems, where possible, to minimize operator exposure, increase safety, and minimize the amount of waste generated by the process.

Implementation of this demonstration would require direct demonstration activities, such as pit bisection. Implementation would also require general support operations, such as packaging, receipt, and storage that are typical support activities at LANL and the originating sites, which have been analyzed in the *Draft LANL Site-Wide EIS* (DOE 1998a) and in other NEPA documentation. These direct and support activities include the following:

- shipment of pits and non-pit, clean plutonium metal from offsite to LANL;
- receipt, unpackaging, and placement into storage of offsite pit and non-pit, clean plutonium metal;
- interim storage of pit and non-pit, clean plutonium metal, awaiting use in the demonstration;
- removal of any external pit features;
- bisection and disassembly of pits;
- processing pit hemishells to separate the plutonium from other materials;
- recasting the plutonium to metal ingots or converting it to plutonium dioxide;
- thermally processing the plutonium to remove gallium and other impurities;
- sealing the plutonium in an appropriate container for storage;
- decontaminating the container;



Source: LANL 1997b:4.

Figure 3-1. Technical Areas of Los Alamos National Laboratory

- sealing the decontaminated container in a second container;
- performing nondestructive assay on all components for material accountability purposes; and
- storing the resulting plutonium metal and plutonium dioxide until an ultimate disposition decision is made.

All these direct and support activities are analyzed in this EA to capture the cumulative impact of this demonstration.

Some of the non-pit, clean plutonium metal to be processed in this demonstration would be derived from pit material separately processed through the Special Recovery Line (SRL) as part of Stockpile Stewardship activities to remove tritium contamination. This demonstration does not result in an increase in the number of pits processed through the SRL and therefore, does not increase total tritium releases or any other impacts associated with SRL operations. The impact of these SRL operations are included in the *Draft LANL Site-Wide EIS* (DOE 1998a) and are also included in this EA to capture the total cumulative impact of the demonstration activities, support activities, and precursor activities at LANL (e.g., SRL).

TA-55 has historically performed plutonium processing activities similar to those required in this demonstration, and currently disassembles pits in a series of individual gloveboxes. Most of the plutonium, in the form of pits or metal, to be used in the demonstration would be taken from storage at LANL. Additional surplus pits may be shipped from the Pantex Plant near Amarillo, Texas or the Rocky Flats Environmental Technology Site (RFETS) near Golden, Colorado if there is a need to test additional types of pits. Additional plutonium in the form of metal would be shipped, if needed, from the Idaho National Engineering and Environmental Laboratory (INEEL) near Idaho Falls, Idaho; the Savannah River Site (SRS) near Aiken, South Carolina; or the Lawrence Livermore National Laboratory (LLNL) in Livermore, California.

The pits and non-pit, clean plutonium metal to be used in the demonstration would be staged in existing special nuclear material storage facilities at LANL. The plutonium metal and dioxide that would be produced during the demonstration would also be staged in existing special nuclear material storage facilities at LANL. No new storage construction would be required and there would be no need to increase the storage limits of the existing facilities. The demonstration would result in a small net increase[3] in the amount of surplus plutonium at LANL.[4] DOE intends to ship LANL's total surplus plutonium to the disposition site or sites that are chosen as a part of the ROD for the SPD Final EIS (DOE/EIS-0283), which was issued as a draft in July 1998. DOE expects to make that decision in early 1999. HEU would be recovered from some of the pits during the disassembly process[5] and shipped to DOE's Oak Ridge Reservation (ORR) for storage

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[3] The net increase would be the result of pits and metal being shipped to LANL for use in the demonstration. Some of the existing surplus pits and metal at LANL would also be used in the demonstration. The amount of plutonium used in the demonstration would not cause an equal increase in the total surplus plutonium at LANL.

[4] The Secretary of Energy's 1994 Openness Initiative stated that there was 1.5 metric tons of surplus weapons-usable plutonium at LANL.

[5] The HEU recovery process would include electrolytic decontamination, which results in the buildup of solids that would be packaged as waste. The human health impacts of this recovery process are included in Section 6.1.3 and waste impacts in Section 6.1.5.

in accordance with DOE's Y-12 Plant EA[6] and the *Storage and Disposition Final PEIS*.

Currently, routine waste is produced at LANL in the following categories: transuranic waste (TRU), low-level waste (LLW), mixed low-level waste (MLLW), and hazardous waste. It is expected that small amounts of these types of waste would be produced by the proposed Pit Disassembly and Conversion Demonstration. In addition, small amounts of plutonium, americium and tritium may be released to the atmosphere.

4.0 NO ACTION ALTERNATIVE

Under the No Action Alternative, an integrated pit disassembly and conversion line would not be demonstrated at LANL. Research related to these activities would continue to be performed in a series of individual gloveboxes. Information that would be generated as a result of the proposed Pit Disassembly and Conversion Demonstration (e.g., specifications for the main operating line and information needed to optimize the layout in terms of shielding, residence time in the gloveboxes, and distance between gloveboxes) would not be available under the No Action Alternative.

Other DOE sites were considered for this proposed demonstration. The only other site that was a potential alternative was LLNL because it is the only other DOE national laboratory with extensive, operating plutonium facilities that could be used to conduct the demonstration. LLNL was eliminated from further consideration because among other things, LLNL's plutonium administrative limits are significantly lower and would restrict the proposed demonstration. Furthermore, because much of the plutonium that would be used in the demonstration is already located at LANL, it would need to be transported to LLNL. In addition, the capabilities at LANL were readily available during the timeframe in which DOE needed the work to be conducted. Also, the majority of the gloveboxes that would be used in the demonstration are already at LANL. Consequently, there would be no need to decontaminate LANL gloveboxes for the express purpose of sending them to LLNL for use in the demonstration.

DOE has also considered other potential disassembly and conversion options as alternatives to the proposed demonstration. However, as explained below, none of the potential options are reasonable alternatives and, therefore, are not analyzed in detail in this EA. As one potential option, DOE has considered a demonstration that would involve disassembling a fewer number of pits. However, this option would not encompass all of the types of surplus pits that would be involved in surplus plutonium disposition (immobilization or MOX fuel) or continued safe storage. As such, this option would not meet the purpose and need for the proposed demonstration and would not generate complete information. For conversion, DOE has considered the potential alternative of converting only plutonium from pits, but not non-pit plutonium metal, to plutonium dioxide. Because this option would exclude plutonium metal, this option would not test and demonstrate conversion of all types of surplus plutonium material that may be subject to disposition under the MOX or immobilization approaches, would not generate complete information, and would not fully meet the purpose and need for the proposed demonstration. In addition, DOE has considered converting plutonium to a metal form only. This option would not test and demonstrate conversion of pit plutonium to the oxide form most suitable for either immobilization or MOX fuel. Thus, this option would not generate complete information, and would not fully meet the purpose and need for the proposed action.

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[6] The amount of HEU to be shipped to ORR for storage is within the bounding limit of 1.9 metric tons of HEU from LANL as set forth in the Y-12 Plant EA (DOE 1994b:3-3).

5.0 AFFECTED ENVIRONMENT

5.1 History and Current Mission of Los Alamos National Laboratory

In March 1943, a small group of scientists came to Los Alamos, New Mexico, located on a remote plateau high above the Rio Grande River for Project Y of the Manhattan Project. Their goal was to develop the world's first nuclear weapon. By 1945, when the first nuclear device was tested at Trinity Site in southern New Mexico, more than 3,000 civilian and military personnel were working at Los Alamos Scientific Laboratory, which became LANL in 1981. LANL is owned by DOE and operated by the University of California under contract with DOE.

LANL's original mission to design, develop, and test nuclear weapons has broadened and evolved as technologies, United States priorities, and the world community have changed over time. It is now a multi-disciplinary science and technology research facility. DOE programs supported by LANL include nuclear weapons stockpile stewardship and management; fissile materials disposition; environmental management; nonproliferation and international security, verification R&D, nuclear safeguards and security, arms control and intelligence; energy research and energy technologies; and work for other government agencies such as the Department of Defense and the Nuclear Regulatory Commission (NRC) (DOE 1996a:3-304).

5.2 Project Area, Facilities, and Infrastructure

The Pit Disassembly and Conversion Demonstration line would be installed and operated within PF-4 in TA-55 at LANL. The facilities at TA-55 are located on a 40-acre site about one mile southeast of LANL's core technical area, TA-3. TA-55 is situated adjacent to a LANL-owned and -controlled roadway, Pajarito Road, that is accessible to the public and passes along one side of and below TA-55.

Most of TA-55, including the main complex, is situated inside a restricted area surrounded by a double security fence and is considered a Category I safeguards and security facility.[7] The TA-55 main complex has several major connected buildings: the Support Building; the Warehouse; the Plutonium Facility (PF-4), and the Calcium Building (see Figure 5–1). Various administrative, support, storage, security, and training structures are located throughout the main complex. The cornerstone R&D facility at TA-55 is PF-4. Plutonium processing and research on plutonium metallurgy occurs in this facility, which is a two-story laboratory of approximately 151,000 square feet. Work in PF-4 includes:

- plutonium recovery (converting recovered material to plutonium metal);
- disassembly of weapons components;
- fabrication of ceramic-based reactor fuels (including MOX fuel);[8]
- processing plutonium-238 to produce heat sources for use in space, among other uses;
- development of materials control and accountability techniques;
- activities related to pit surveillance;
- plutonium component fabrication; and
- materials and properties R&D.

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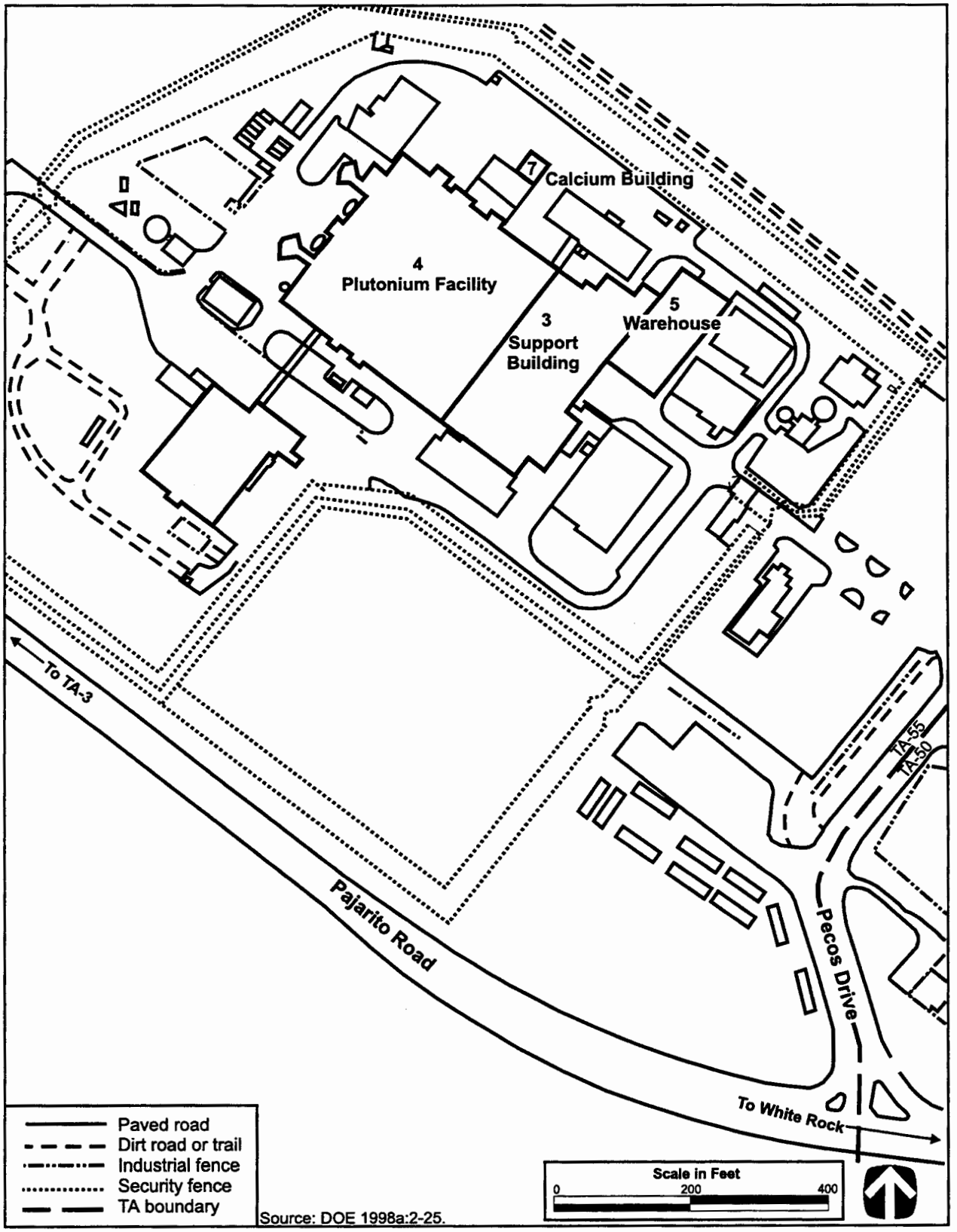
[7] Category I safeguards and security facilities are required to meet the highest security standards in the DOE complex. These facilities are used to house assembled weapons or pure products, such as pits and directly convertible plutonium materials in quantities of two kilograms or higher.

[8] The fabrication of such MOX fuel is discussed in the *Predecisional Draft Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment* and the *Draft Site-wide Environmental Impact Statement on the Continued Operation of the Los Alamos National Laboratory.*



Source: DOE 1998a:2-25.

Figure 5-1. Technical Area-55 Facilities at Los Alamos National Laboratory

PF-4 is a reinforced concrete structure that complies with all required seismic standards. The overall design concept for PF-4 separates the building in halves, each of which contains its own ventilation systems and electrical substations. Half of the building is comprised of Areas 100 and 200 that contain the plutonium research and development laboratories, plutonium-238 operations, and the personnel decontamination area. Areas 300 and 400 constitute the remainder of the building and contain plutonium recovery, metal preparation and fabrication, and nondestructive assay laboratories. Large central corridors span the length of the four main areas of PF-4. Each of the processing areas is divided into rooms that contain gloveboxes for working with plutonium. The ventilation systems supporting the gloveboxes and all other building-related utilities are located in the basement of the facility, which also contains the packing/unpacking room, the waste-handling areas, and the plutonium storage vault. This arrangement provides flexibility in meeting the ever changing needs of a R&D facility (LANL 1996b:1).

The Pit Disassembly and Conversion Demonstration requires minor modifications to PF-4, relating to the installation of new gloveboxes, which would not involve worker exposure. The demonstration would utilize approximately 1,500 square feet of PF-4. Existing facility infrastructure at PF-4 would be used, including: utilities, environmental systems, systems for incoming pit assay, vault storage, special pit handling, and materials control and accountability. Analytical laboratory work on small samples (10 grams or less) from the demonstration would be conducted in the Chemical and Metallurgy Research (CMR) facility at LANL. It is expected that a total of 2,000 samples would be analyzed in TA-55 and CMR during the demonstration.

Infrastructure and supporting systems at TA-55 are required for the operating reliability, safety, and environmental integrity of PF-4. The supporting systems for PF-4 include:

- a confinement system that consists of three layers to prevent accidental releases of nuclear materials; these layers are gloveboxes, laboratory rooms, and the building (PF-4);

- a ventilation system with appropriate high-efficiency particulate air (HEPA) filtering that contains four zones, all of which are maintained at a lower pressure than outside air to ensure that leaks are contained within the building and not released to the atmosphere;

- a conveyor system that transports contaminated materials and equipment to almost any point on the first floor, thereby limiting worker contact and exposures;

- a criticality detection system that monitors operations on the main processing floor of the plutonium facility, as well as in the basement vault, to detect gamma energy released from any fission of special nuclear material and to alert personnel to immediately evacuate PF-4;

- a continuous air monitoring system that samples and analyzes air from multiple points throughout PF-4 laboratory areas, basement, ductwork, and exhaust stacks to ensure that personnel are warned of the release of radioactive material; and

- a radioactive liquid waste piping system that allows liquid low-level radioactive waste to be shipped directly to LANL's treatment facility at TA-50.

Additional supporting systems for the entire TA-55 site, including PF-4, that enhance the overall safety of PF-4 include:

- two water storage tanks with capacities of 100,000 and 500,000 gallons;
- a fire detection system consisting of smoke detectors, thermal detectors, manual pull stations, and drop-box alarm stations;
- a fire suppression system consisting of a wet-pipe, automatic sprinkler protection system fed by two 150,000 gallon tanks;
- chilled-water systems for air tempering, heat absorption, and glovebox cooling;
- a glovebox vacuum system consisting of wet vacuum, dry vacuum, and ultrahigh vacuum;
- separate acid, caustic, industrial, and sanitary waste lines connected directly to LANL's waste treatment facilities; and
- process gas control systems (i.e., argon, helium, oxygen, nitrogen, hydrogen) (LANL 1996b:23).

5.3 Environmental Resources

The proposed Pit Disassembly and Conversion Demonstration would be located within an existing building, PF-4. Therefore, there would not be any new construction that could affect floodplains, wetlands, biological resources, or cultural resources. The following descriptions are focused on providing sufficient information on the resources that could be affected during operation of the demonstration or in the event of an accident. LANL is not listed on the U.S. Environmental Protection Agency's (EPA) National Priorities List (LANL 1997b:22).

5.3.1 Water Quality

LANL is required to meet effluent limitations under the National Pollutant Discharge Elimination System (NPDES) permit program. These permits establish specific chemical, physical, and biological criteria that an effluent must meet before it can be discharged. Overall compliance for the sanitary and industrial waste discharges during 1996 was 98.8 percent and 97.9 percent respectively. Based on a performance audit inspection conducted by EPA on September 16-17, 1996, the overall NPDES compliance program was rated superior (LANL 1997b:26, 30-31).

In 1996, LANL had 15 NPDES permits: one covering the effluent discharges at LANL, one covering the Hot Dry Rock Geothermal Facility (located 30 miles west of Los Alamos), and 13 covering storm water discharges. In January 1996, LANL's NPDES outfall permit included two sanitary wastewater treatment facilities and 95 industrial outfalls. By the end of 1996, LANL had eliminated nine permitted industrial outfalls in the NPDES permit. The University of California and DOE are co-permittees of the NPDES permits for LANL operations (LANL 1997b:26).

The Utility Building is the only permitted industrial outfall in TA-55. Liquid waste from TA-55 processing buildings is transferred to TA-50 where it is treated. Building 1, the Radioactive Liquid Waste Treatment Facility, in TA-50 also has a permitted industrial outfall. Both the TA-50 and TA-55 outfalls discharge into the Mortandad Canyon (DOE 1998a:4-54).

Under LANL's existing NPDES permits, samples are collected for analysis on a weekly basis and reported to EPA and the New Mexico Environment Department, as required. During 1996, effluent limits were exceeded two times in 165 samples collected from the sanitary wastewater facilities. Effluent limits were exceeded 32 times in the 1,559 samples collected from the industrial outfalls. There were no exceedances for the TA-55 outfall. For the TA-50 outfall, on two occasions the daily chemical oxygen demand concentrations exceeded the permit limit. A chemical oxygen demand sampling program was implemented for this outfall (LANL 1997b:27).

5.3.2 Air Quality

Baseline concentrations at LANL for hazardous and toxic air pollutants are in compliance with concentration limits and guidelines approved by the New Mexico Environmental Improvement Board. Nonradiological criteria pollutants were monitored for several years at LANL without any detectable increases above typical regional background levels, so ambient monitoring was discontinued (LANL 1996a:95). Over 90 percent of all LANL's nonradiological air pollutant emissions are associated with industrial sources, such as power plants and the asphalt plant (LANL 1997b:69). These plants would continue to operate whether or not the Pit Disassembly and Conversion Demonstration is conducted at LANL, and therefore, are not evaluated as part of this EA. EPA limits the effective dose equivalent to any member of the public from radioactive airborne releases from DOE facilities to 10 millirem (mrem) per year. In 1996, the effective dose equivalent from LANL operations to the maximally exposed members of the public was estimated to be 1.93 mrem (LANL 1997b:23).

In 1991 and 1992, LANL received two Notices of Noncompliance from EPA for not meeting all provisions of the Code of Federal Regulations (CFR) "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" (EPA 1997). Specific findings included deficiencies in LANL's identification and evaluation of release sources, noncompliant stack monitoring equipment on all point release sources, using a shielding factor without previous EPA approval, and exceeding the 10 mrem per year standard. DOE negotiated a National Emission Standards for Hazardous Air Pollutants (NESHAP) Federal Facility Compliance Agreement (FFCA) with EPA Region 6, which was signed in June 1996. LANL is meeting the terms of this FFCA and achieved full compliance in June 1996 with the radionuclide NESHAP, as defined in the FFCA (LANL 1997b:42).

5.3.3 Radiation Exposure

LANL has an extensive air monitoring program in place on the site and in regional locations surrounding the site to detect radiological air releases. Because some of LANL's research involves radioactive materials that may enter the atmosphere through a stack, many of the stacks on the site are continually monitored in accordance with 40 CFR 61, Subpart H– National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities (EPA, 1997).

Due to ongoing work at LANL, very small amounts of radioactive elements, such as plutonium (Pu), tritium, americium (Am), and uranium (U), are released to the atmosphere. As shown in Table 5–1, LANL's emission of these radioactive isotopes, as measured on a regional basis, is significantly lower than EPA Public Dose Limits.

Table 5–1. Mean Annual Concentrations of Radioactivity Measured by LANL

Elements	Units	Annual Regional Mean[a]	Highest for Any Monitoring Location[a]	EPA Public Dose Limit[b]	Highest Mean as a Percentage of EPA Limit
^{238}Pu	aCi/m^3	0.1	19.8	2,100	0.9
^{239}Pu	aCi/m^3	0.7	706.6	2,000	35.3
Tritium	pCi/m^3	0.3	400.3	1,500	26.7
^{241}Am	aCi/m^3	2.1	478.2	1,900	25.2
^{234}U	aCi/m^3	35.6	64.5	7,700	0.8
^{235}U	aCi/m^3	2.2	3.7	7,100	<0.1
^{238}U	aCi/m^3	24.7	50.6	8,300	0.6

[a]LANL 1997b:Tables 4-4 – 4-10, 80–93.

[b]Each EPA limit equals the amount of radioactivity that would have to be released into the atmosphere to cause the general public to receive an effective dose equivalent of 10 millirem per year (LANL 1997b:Table 4-1, 75).

5.3.3.1 Perimeter Monitoring

^{238}Pu. In 1996, the mean annual concentration of ^{238}Pu recorded at perimeter locations, including numerous stations in Los Alamos and White Rock, was 0.2 aCi/m^3, which is equivalent to an effective dose equivalent of less than 0.001 mrem per year. At the monitoring station recording the highest offsite concentration, Royal Crest Trailer Court, the mean annual concentration was 1.0 aCi/m^3, which is equivalent to an effective dose equivalent of less than 0.01 mrem per year (LANL 1997b:Table 4–5, 82).

^{239}Pu. In 1996, the mean annual concentration of ^{239}Pu recorded at perimeter locations was 1.0 aCi/m^3, which is equivalent to an effective dose equivalent of less than 0.01 mrem per year. At the monitoring station recording the highest offsite concentration, the Los Alamos Airport, the mean annual concentration was 2.9 aCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.01 mrem per year (LANL 1997b:Table 4–6, 84).

Tritium. Tritium is released by LANL in curie amounts. In addition, tritium is present in the environment as a result of aboveground nuclear weapons tests and is also produced naturally. In 1996, the mean annual concentration recorded at perimeter locations was 1.3 pCi/m^3, which is equivalent to an effective dose equivalent of less than 0.01 mrem per year. At the monitoring stations recording the highest offsite concentrations, the McDonald's Restaurant in Los Alamos and the White Rock Church of the Nazarene, the mean annual concentration was 2.2 pCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.01 mrem per year (LANL 1997b:Table 4–4, 80). Recently, it has been discovered by LANL that the reporting associated with tritium releases from the laboratory (set forth above) may be underestimating actual tritium levels by a factor of two to three times. In the worst case, the level of tritium released could be as high as five times greater than reported (Eberhart, 1998). At the point of highest offsite concentration, the estimated mean annual concentration would be 11 pCi/m^3 (i.e., 2.2×5). This would be equivalent to an effective dose of approximately 0.07 mrem per year.

^{241}Am. Americium is released from LANL in microcurie amounts. In 1996, the mean annual concentration of ^{241}Am recorded at perimeter locations was 1.8 aCi/m^3, which is less than an effective dose equivalent of approximately 0.01 mrem per year. At the monitoring station recording the highest offsite concentration, Santa Fe, the mean annual concentration was 2.5 aCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.01 mrem per year (LANL 1997b:Table 4–7, 86).

^{234}U. All of the isotopes of uranium are released from LANL in microcurie amounts and occur naturally in rocks and soils. In 1996, the mean annual concentration of ^{234}U recorded at perimeter locations was 10.2 aCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.01 mrem per year. At the monitoring station recording the highest offsite concentration, Española, the mean annual concentration was 49.1 aCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.06 mrem per year (LANL 1997b:Table 4–8, 88).

^{235}U. In 1996, the mean annual concentration of ^{235}U recorded at perimeter locations was 0.9 aCi/m^3, which is equivalent to an effective dose equivalent of less than 0.01 mrem per year. At the monitoring station recording the highest offsite concentrations, Española, the mean annual concentration was 3.1 aCi/m^3, which is equivalent to an effective dose equivalent of less than 0.01 mrem per year (LANL 1997b:Table 4–9, 90).

^{238}U. In 1996, the mean annual concentration of ^{238}U recorded at perimeter locations was 10.5 aCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.01 mrem per year. At the monitoring station recording the highest offsite concentration, Jemez Pueblo-Riverside, the mean annual concentration was 38.3 aCi/m^3, which is equivalent to an effective dose equivalent of approximately 0.05 mrem per year (LANL 1997b:Table 4–10, 92).

In all cases, the maximum individual effective dose equivalents attributable to exposure from airborne LANL emissions were below the EPA limits. Measurements of LANL stack emissions during 1996 totaled 13,790 Ci. Of this total, tritium emissions comprised 680 Ci and air activation products[9] contributed 13,110 Ci. Combined airborne emissions of radioactive materials such as plutonium, uranium, and americium were less than 0.5 Ci (LANL 1997b:64).

In 1996, emissions of radionuclides from TA-55 were as presented in Table 5–2. Exposure to these releases was estimated by the CAP88, EPA's dose assessment model, to result in an effective dose equivalent of 0.000364 mrem to the offsite maximally exposed individual (MEI) (Jacobson 1997:6, 20).

Table 5–2. Releases of Radionuclides from TA-55 in 1996

Radionuclide	Sampled Release (Ci)
Americium 241	3.1×10^{-8}
Plutonium 238	2.5×10^{-9}
Plutonium 239	8.6×10^{-8}
Uranium 234	2.6×10^{-8}
Uranium 238	2.9×10^{-8}
Thorium 234	2.9×10^{-8}
Protactinium 234	2.9×10^{-8}
Tritium	$3.1 \times 10^{+1}$

Source: Jacobson 1997:14.

Individuals are constantly exposed to radiation as a result of cosmic radiation from space and natural radiation from radionuclides in the environment (mainly radon). In addition, as people inhale or absorb radionuclides from natural sources they are collected within the body and produce radiation as they decay.

[9] Nuclear reactions with air cause the formation of air activation products. These include radioisotopes of carbon, nitrogen, and oxygen that have a half-life of seconds up to 20 minutes. The major source of these products at LANL has been as a result of airborne emissions from the Los Alamos Neutron Science Center (LANL 1997b:67).

Table 5–3 shows the effective dose equivalent for people living in Los Alamos and White Rock as a result of existing sources of radiation.

Table 5–3. Estimated Background Dose from Natural and Man-Made Sources of Radiation (mrem/year)

	Los Alamos	White Rock
Radon	200	200
Cosmic (corrected for shielding)	120	100
Self-irradiation	40	40
Total effective background dose	360	340

Source: LANL 1997b:50.

To estimate the dose above background levels received by the public as a result of penetrating radiation from LANL activities, a network of thermoluminescent dosimeters has been installed around LANL and surrounding areas. During 1996 the maximum dose, or the ninety-fifth percentile value, was equivalent to 13.3 mrem. This dose was 13.3 percent of DOE's public dose limit of 100 mrem effective dose equivalent from all pathways. The median value (fiftieth percentile) for this dose is 4.3 mrem; this dose is approximately one percent of the total annual dose received by persons living around LANL from all sources of radiation as shown in Table 5–2 (LANL 1997b:51). Based on the population living within 80 kilometers (50 miles) of LANL, it is estimated that the total dose to the public in 1996 was 1.2 person-rem. (LANL 1997b:54).

Workers in TA-55 would be expected to receive an additional dose above that received by the general public as a result of their work with nuclear materials. Exposure pathways to LANL workers during normal operations may include inhaling the workplace atmosphere, drinking potable water that could somehow become contaminated, and possibly other contacts with hazardous materials associated with their work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Although the Federal exposure limit for radiation workers is 5 rem per year (DOE 1997d:sec. 835.202), DOE's Administrative Control Level is 2 rem per year (DOE 1994c:2-3). All facilities at LANL are operating in accordance with the As Low As Reasonably Achievable (ALARA) program to limit worker doses to the extent possible. The average dose that badged workers (radiation workers) in TA-55 received in 1997 was 175 mrem per worker or 3.5 percent of the Federal exposure limit (Graf 1998).

5.3.4 Worker and Public Safety

LANL workers are protected by adherence to Occupational Safety and Health Administration and EPA occupational health standards that limit workplace concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. The LANL Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency on the health and safety of employees and the public.

5.3.5 Waste Management

LANL routinely produces waste in the following categories: TRU waste, LLW, MLLW, and hazardous waste, that could be impacted by the proposed Pit Disassembly and Conversion Demonstration.

5.3.5.1 Transuranic Waste

TRU waste is generally characterized as waste that is contaminated with alpha-emitting transuranic isotopes with atomic numbers greater than 92 and half-lives greater than 20 years, in concentrations greater than 100 nCi/g at the time of assay. TRU waste generated at TA-55 is taken to TA-54, placed in drums, certified, and stored for ultimate disposal at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. Most of LANL's TRU waste is currently stored on asphalt pads. In 1996, LANL generated about 81 cubic meters of TRU waste (LANL 1997i:4).

5.3.5.2 Low-Level Waste

LLW contains some radioactivity but not enough to be classified as high-level waste (HLW), TRU waste, or spent nuclear fuel. After being generated at TA-55, liquid LLW is transferred by a stainless steel pipeline to the Radioactive Liquid Waste Treatment Facility at TA-50 for treatment. The waste water is treated by lime/sulfate precipitation. The treated water is discharged under LANL's NPDES permit. The remaining sludge is dewatered and sent to TA-54 for disposal as LLW. Approximately 521 cubic meters of solid LLW and 11cubic meters of solid LLW that resulted from treating liquid LLW was generated by LANL in 1996 (LANL 1997i:4). This waste is buried in TA-54, Area G, in pits and shafts designed specifically for this purpose.

5.3.5.3 Mixed Low-Level Waste

MLLW contains both hazardous (as defined and regulated by the Resource Conservation and Recovery Act (RCRA)) and low-level radioactive components.[10] MLLW generated at TA-55 is placed in interim storage at TA-55 and collected by LANL waste management personnel. It is then stored at TA-54, Areas L and G, pending the availability of offsite commercial treatment. About 7 cubic meters of MLLW was generated by LANL in 1996 (LANL 1997i:4).

5.3.5.4 Hazardous Waste

Hazardous wastes are listed as such in RCRA regulations or defined as hazardous wastes because they exhibit at least one of the following characteristics: (1) ignitability, (2) corrosivity, (3) reactivity, or (4) toxicity. No disposal facility for hazardous waste exists at LANL. Hazardous wastes are shipped off the site for further treatment and disposal at designated facilities in accordance with RCRA. In 1996, LANL generated approximately 90,000 kilograms of hazardous waste from routine operations (LANL 1997i:4).

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[10] In accordance with the Federal Facility Compliance Act, LANL has developed a Site Treatment Plan that covers management of all mixed waste at LANL. The State of New Mexico Environment Department issued a compliance order in the Site Treatment Plan for Mixed Waste in October 1995. The compliance order addresses land disposal restricted mixed waste. For mixed waste with identified treatment technologies, the plan provides a schedule for submitting permit applications, entering into contracts, initiating construction, conducting system testing, starting operations, and processing mixed waste. For mixed waste without an identified treatment technology, the plan includes a schedule for identifying and developing technologies, identifying the funding requirements for R&D, submitting treatability study notifications, and submitting R&D permit applications.

5.3.6 Socioeconomics

Approximately 10,000 people are employed at LANL in permanent special programs and contractor activities. Eighty-eight percent of all LANL employees reside in a three-county area (Los Alamos, Arriba, and Santa Fe), and more than half of the Los Alamos County employees reside in the unincorporated communities of Los Alamos and White Rock. This three-county area has been designated the region of influence (ROI) for the regional economic area (REA) in which LANL is located. The unemployment rate in the REA was 6.2 percent, which was about the same as the overall unemployment rate in New Mexico of 6.3 percent (LANL 1997a:1; DOE 1996a: 3-326).

LANL has a cumulative economic impact on the ROI of more than $3.5 billion annually, making it the dominant economic force in northern New Mexico. The region's per capita income of $17,689 in 1993 was approximately 8.2 percent higher than New Mexico's per capita income of $16,346 (LANL 1997a:1; DOE 1996a: 3-326).

In 1994, the ROI population totaled 166,788. From 1980 to 1994, the ROI population increased by 36.6 percent, compared to 26.9 percent in New Mexico, with Santa Fe County experiencing the largest growth at 48.6 percent. In 1994, seven schools provided public education in the LANL ROI. City, county, and state law enforcement agencies provided police protection to the ROI residents. Fire protection services were provided by 800 paid and volunteer firefighters in 1995. Four hospitals served the ROI in 1994 (DOE 1996a: 3-326, 3-332).

Regional transportation routes provide access to LANL with vehicular access provided by New Mexico Route 502 to the east and Route 4 to the west. There are no planned road improvement projects within one to two years that would affect LANL. While there is no public bus service to LANL, there is non-profit bus service between White Rock, Los Alamos and LANL (DOE 1996a:3-332).

5.3.7 Environmental Justice

The 1990 minority population, residing within 80 kilometers (50 miles) of LANL, was estimated to be 53.9 percent of the total population. Population data for 1990 was extracted from data published by the U.S. Bureau of the Census for the 1990 census (DOC 1992:Tables P–12, P–121). Minority populations are projected to make up 55.6 percent of the total population in 2001. Projected populations for the year 2001 were obtained from the Bureau of the Census state population projects (Campbell 1997:4-24). It was assumed that minority and majority populations residing within 80 kilometers of LANL would increase at the same rates as projected increases for the statewide minority and majority populations.

Estimates of low-income persons residing in the potentially affected area is shown in Table 5–4 (DOC 1992:Table P–121). In this table, the low-income population is comprised of persons residing within 80 kilometers (50 miles) of the site whose income is less than the poverty threshold (CEQ 1996:app. A, 16). The percentage of the population with income below the poverty threshold exceeds the 13.3 national average.

Table 5–4. Low-Income Persons Residing Within 80 Kilometers of LANL

Site	Total Population (Thousands)	Low-Income Population (Thousands)	Percent Low-Income Population
LANL	214.3	31.5	14.7

6.0 POTENTIAL ENVIRONMENTAL IMPACTS

6.1 Impacts Related to the Proposed Action

6.1.1 Water Quality Impacts

Under the proposed action, noncontact water would be used to cool processing equipment. Wastewater discharges would be into the industrial waste lines at PF-4. It is estimated that less than 189 liters (50 gallons) of noncontact water would be discharged from PF-4 as a result of the proposed demonstration. Additionally, a small amount of process water would be used as part of the decontamination module. This process water, less than 100 liters (26 gallons) per year, would be handled in accordance with LANL's procedures for the treatment and disposal of liquid LLW. The overall compliance for sanitary and industrial discharges during 1996 was 98.8 percent and 97.9 percent, respectively (LANL 1997b:26). The proposed action is not expected to affect these compliance rates because the amount of water that would be used in the process is so small. No increased release of radionuclides is expected by liquid pathways as a result of the proposed demonstration.

6.1.2 Air Quality Impacts

As a part of this demonstration, it is projected that small amounts of plutonium and americium would be released into the atmosphere, as shown in Table 6–1. It is also projected that small amounts of tritium would be released from SRL operations on the plutonium that is subsequently transferred to the demonstration; these tritium releases, while not a part of the demonstration activities, are also shown in Table 6–1 to capture the total cumulative impact of the demonstration activities, support activities, and precursor activities at LANL. The MEI is estimated to receive an effective dose equivalent of 0.043 mrem per year from the demonstration and a total dose from all site operations of 4.3 mrem per year.

Table 6–1. Estimated Annual Radionuclide Releases Under the Proposed Demonstration

Radionuclide	Estimated Annual Releases from Demonstration (in curies)	Annual Releases at LANL in 1996[a] (in curies)	Estimated Releases as a Percent of Annual Releases at LANL
Total plutonium	1.0×10^{-7}	2.3×10^{-5}	<1
Americium 241	2.3×10^{-8}	1.3×10^{-6}	<2
Tritium[b]	69	6.8×10^{2}	10
Total uranium	None	3.9×10^{-5}	NA

[a]LANL 1997b:102-103; Jacobson, 1998.
[b]Estimated release as part of SRL operations.
Note: NA, not applicable.

The pit disassembly and conversion process proposed to be demonstrated does not require the use of hazardous chemicals or other potentially hazardous compounds that could be released into the atmosphere in the course of normal operations. There is not expected to be any airborne releases of beryllium as a result of the demonstration. Any hazardous compounds released would be very small quantities related to routine, cleaning operations connected with the demonstration.

6.1.3 Radiological Impacts

The radiological impacts of normal operations associated with the proposed action were calculated using Version 1.485 of the Hanford Environmental Dosimetry System (GENII)[11] computer code (PNL 1988). Site-specific and technology-specific input data were used, including location, meteorology, population, food production and consumption, and source terms. Dose assessments were performed for members of the general public surrounding LANL and for workers who would be involved with the proposed operations.

To calculate the doses, the projected releases were extrapolated based on the data developed for the SPD Draft EIS (LANL 1997d:62). As shown in that report, the dominant radioactive emission from pit disassembly and conversion activities is tritium. Using this information, it was estimated that approximately 69 curies of tritium would be released annually as a result of SRL operations that are not a part of the demonstration project. A similar method was used to estimate the radioactive emissions from the demonstration although they are all relatively small in comparison to tritium (see Table 6–1).

Dose assessments for members of the public were performed for three different types of receptors considered in this EA: the offsite MEI, the offsite average exposed individual, and the general population living within 80 kilometers (50 miles). The MEI was assumed to be located at a position that would yield the highest impacts during normal operations. In the case of the pit demonstration, this would be an individual in the Royal Crest Trailer Court in Los Alamos, which is located at the northern perimeter of LANL above TA-55. For total LANL site operations, this would be an individual near LANL's East Gate. To bound the analyses, the doses to both MEIs were added to provide a hypothetical worst case dose.

The annual average individual worker dose directly associated with the proposed action was estimated at 750 mrem per year.[12] Subsequent health risks (i.e., latent cancer fatalities) were calculated for the aforementioned groups by using risk estimators established in the National Academy of Sciences and National Research Council's 1990 *Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V* Report.

The pit disassembly and conversion process involves the use of hydrogen, oxygen, and nitrogen, and inert gases such as argon and helium. All of these gases would be fed into the gloveboxes under controlled conditions. Gases exiting the gloveboxes would be filtered through a series of HEPA filters to capture the majority of the radionuclides released during the demonstration. However, a small amount of radionuclides would be expected to enter the atmosphere, if the proposed action were undertaken. As shown in Table 6–1, these releases are estimated to be a small fraction of the radionuclides released by LANL in any given year.

The largest releases are estimated to be approximately 69 curies of tritium each year from SRL operations which are not part of this demonstration. This amount represents about 10 percent of the total expected

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[11] The GENII computer code was developed under a stringent Quality Assurance plan based on the American National Standard Institute standard for National Quality Assurance-1, as implemented in the Pacific Northwest Laboratory Quality Assurance Manual PNL-MA-70. All steps of the code development have been documented and tested. An external peer review of the entire code package was conducted in 1988. The use of GENII has been approved by EPA.

[12] This estimated radiation worker dose was developed based on several factors. Because the proposed pit disassembly and conversion demonstration has never been performed before, the worker dose could not be based on actual or historical worker doses. Therefore, the worker dose had to be estimated based on a review of worker doses from similar operations, process knowledge regarding amounts of materials and potential for worker exposure, and consideration of planned operational features designed to reduce worker exposure. As shown in Table 6-4, similar pit disassembly activities have resulted in average worker doses of 456 mrem/year. Although improvements planned for this demonstration are expected to result in reductions in average worker doses, in order to provide a conservative estimate, a radiation worker dose of 750 mrem/year was used.

tritium releases for LANL.[13] It is expected that total releases would continue to be lower than either the EPA limit or past releases from LANL. Even at the 1995 levels, the resulting maximum concentration measured at any of LANL's numerous offsite monitoring stations was less than one percent of the EPA limit (LANL 1996a:84).

Table 6.2 shows that the proposed demonstration should not affect LANL's ability to continue to meet the guidelines included in 40 CFR 61.93(b)(5)(iv) Subpart H–National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities (EPA 1997). In the case of the proposed demonstration at LANL, the MEI would be located in the Royal Crest Trailer Court. The 1996 maximum offsite concentrations at this site were used as a conservative baseline for making the comparison with 40 CFR 61. Although it is highly unlikely that the maximum would be seen over the course of a full year it was used as the base to project what the affect of the demonstration would be even if the levels were as high as the maximum. Based on this projection, it is estimated that the cumulative total for all radionuclides, with the proposed demonstration included, would be less than two percent of the EPA guidelines.

Table 6–2. Projected Releases of Radionuclides Versus EPA Concentration Levels in 40 CFR 61

Radionuclide	1996 Maximum Offsite Concentration at Location of MEI[a]	Projected Maximum Offsite Concentration with Demonstration	EPA Concentration Levels[b]	Projection/ EPA Levels
Tritium (pCi/m^3)	15.0	16.52	2100	0.0079
^{238}Pu (aCi/m^3)	2.8	2.81	2000	0.0014
^{239}Pu (aCi/m^3)	2.3	2.31	1500	0.0015
^{241}Am (aCi/m^3)	3.3	3.36	1900	0.0018
^{234}U (aCi/m^3)	14.4	14.4	7700	0.0019
^{235}U (aCi/m^3)	1.90	1.90	7100	0.0003
^{238}U (aCi/m^3)	16.6	16.6	8300	0.0020
Cumulative Total				0.0168

[a] LANL 1997b: Tables 4-4 – 4-10, 80–93.
[b] EPA 1997: App E, Table 2.

Radiological impacts on the average and maximally exposed members of the public resulting from normal operations of the proposed action are presented in Table 6–3. Also included in the table are the dose to the population within 80 kilometers (50 miles) in 2000 (mid-year of projected operations for the proposed demonstration), and the projected annual number of latent cancer fatalities in this population. To put operational doses into perspective, comparisons with doses from natural background radiation are also included.

The dose to the maximally exposed member of the public from annual operation of the proposed action would be 0.043 mrem. The corresponding annual risk of latent fatal cancer to this individual would be 2.2×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with the demonstration is less than three in 100 million. The impacts on the average individual would be less.

[13] In 1996, LANL released 680 curies of tritium into the atmosphere during site operations (LANL 1997b: 61).

Table 6–3. Potential Radiological Impacts to the Public at LANL

Receptor[a]	Pit Disassembly Demonstration	Total Site Without Pit Disassembly Demonstration	Total Site With Pit Disassembly Demonstration
Maximally exposed individual member of the public			
Annual dose (mrem)	0.043	4.30	4.34
Percent of natural background[b]	0.0123	1.23	1.24
Annual latent cancer fatalities	2.2×10^{-8}	2.15×10^{-6}	2.17×10^{-6}
Population within 80 kilometers for Year 2000			
Annual dose (person-rem)	0.016	1.20	1.22
Percent of natural background[b]	1.8×10^{-5}	1.32×10^{-3}	1.34×10^{-3}
Annual latent cancer fatalities	8.0×10^{-6}	6.00×10^{-4}	6.08×10^{-4}
Average individual within 80 kilometers[c]			
Annual dose (mrem)	6.1×10^{-5}	4.61×10^{-3}	4.67×10^{-3}
Annual latent cancer fatalities	3.1×10^{-11}	2.30×10^{-9}	2.33×10^{-9}

[a]Presented impacts to these receptors are associated with releases to the air. There would be no liquid releases associated with the pit disassembly demonstration.
[b]The annual natural background radiation level at LANL is 349 mrem for the average individual; the population within 80 kilometers in 2000 would receive 90,900 person-rem.
[c]Obtained by dividing the population dose by the number of people projected to live within 80 kilometers of LANL (260,360) in 2000.
Source: LANL 1997b: GENII model results (Version 1.485).

As a result of annual facility operations, the total population dose would be 0.016 person-rem. The corresponding annual number of latent cancer fatalities in this population would be 8.0×10^{-6}. The *Environmental Surveillance and Compliance at Los Alamos during 1996* report (LANL 1997b:51, 54) states that an annual dose of 4.3 mrem to a MEI and a collective dose of 1.2 person-rem to the surrounding population within 80 kilometers (50 miles) resulted from all 1996 LANL operations. Assuming a similar total site operational status in 2000, radiological impacts associated with the proposed action would increase LANL total site impacts by a small percentage (1.0 percent for the MEI, 1.3 percent for the surrounding population, and 1.3 percent for the average individual).

Doses to involved workers from normal operations, including receiving and staging of the pits, are presented in Table 6–4; involved workers are defined as those directly associated with pit disassembly activities. Under the proposed action, the estimated annual average dose to pit disassembly workers would be 750 mrem.

Table 6–4. Potential Radiological Impacts to Plutonium Workers at LANL

Receptor	Pit Disassembly	Other Pit Disassembly Activities
Involved workers[a]		
Average worker dose (mrem/yr)	750	456
Annual risk of latent cancer fatalities	3.0×10^{-4}	1.8×10^{-4}
Total dose (person-rem/yr)	90	55
Total annual latent cancer fatalities	0.036	0.022

[a]One hundred and twenty badged workers would be required for pit disassembly and conversion facility operations. The radiological limit for an individual worker is 5,000 mrem/year. However, the maximum dose to a worker involved with operations would be kept below the DOE Administrative Control Level of 2,000 mrem per year. An effective ALARA program would ensure that doses would be reduced to levels that are as low as is reasonably achievable.

The annual dose received by the plutonium workers who would perform these activities would increase by 35 person-rem to 90 person-rem. The annual risk of latent cancer fatalities to involved workers as a result of the doses received from the demonstration would be 3.0×10^{-4} or 3 chances in 10,000. Doses to individual workers would be kept to minimal levels by current administrative policies, exposure monitoring, and the ALARA program.

6.1.4 Accident Impacts

The pit disassembly and conversion process proposed to be demonstrated would consist of a number of distinct, sequential processes: bisection and disassembly, oxidation, gallium removal, canning, electrolytic decontamination, and nondestructive assay, each performed in separate gloveboxes. Another glovebox would contain the conveyor system that would transfer the plutonium between the gloveboxes. LANL Process Hazard Analyses serve as the basis for evaluating the potential accidents associated with the proposed action. These Hazard Analyses, intended to provide a screen to identify safety-class equipment requirements, are significantly conservative; they may not take credit for all process or control barriers to an abnormal event or its potential consequences in evaluating consequence likelihoods. For this reason, they form a conservative basis for evaluating accident impacts for this EA. Considering the low-magnitude of the predicted impacts, no effort was taken to further refine the risk evaluations for this EA.

The spectrum of plausible accidents and abnormal events associated with the proposed action were evaluated to identify those with the highest radiological impacts. Because of the physical separation of the various modules in the process, the potential accidents and abnormal events for each step were evaluated independently. It is important to note that both the type and frequency of plausible accidents for the proposed action depend on the specific process involved; for example, processes involving both hydrogen and oxygen along with plutonium would have significantly different risks than would processes involving handling or machining of plutonium components in an inert atmosphere.

The modules associated with the pit disassembly and conversion process at TA-55 have been the subject of Process Hazard Analysis (PrHA) (LANL 1998; LANL 1997c; LANL 1997e; LANL 1997f; LANL 1997g; LANL 1997h). For these PrHAs, the dose to the public was calculated using the Gaussian dispersion model MACCS2.[14] Weather sampling was based on 95th percentile data.

Each hazard was evaluated as to the severity of the consequences and qualitatively assigned a severity category. The severity categories used in the evaluation of accidents and abnormal events are presented in Table 6–5.

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[14] The MELCOR Accident Consequence Code System 2 (MACCS2) computer code (SNL 1997, Chanin 1997) was used for the Process Hazard Analyses referenced in this EA because it is a superior dose consequence analysis code. The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared a series of reports to advise the Federal government on the health consequences of radiation exposures. The latest of these reports, *Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V*, published in 1990, provides the most current estimates for excess mortality from leukemia and cancers other than leukemia expected to result from exposure to ionizing radiation (NAS/NRC 1990). The BEIR V models were developed for application to the U.S. population and are implemented in the radiological consequence model (MACCS2) used in the accident analyses. MACCS2 employs methodology that allows the user to account for the source term contribution of short-term resuspension of deposited material, uses an entire year's worth of actual LANL weather and reports the mean value and the distribution of values accounts for the integrated population exposure (and the resulting latent cancer fatality risk) from the LANL workforce population, and uses actual LANL meteorology. In addition to *ad hoc* verification efforts of beta-test user groups, the University of New Mexico has completed a formal independent verification study of the MACCS2 code package. The results of this verification study will be published in a forthcoming report.

Table 6–5. Consequences Severity Categories

Category	Public	Worker	Environment
A	Immediate health effects	Loss of life	Significant offsite contamination requiring cleanup
B	Long-term health effects	Severe injury or disability Radiation uptake or dose causing temporary radiation worker restriction	Moderate-to-significant onsite contamination Minor offsite contamination
C	Irritation or discomfort but no permanent health effects	Lost-time injury but no disability Radiation uptake or dose causing temporary radiation worker restriction	Significant contamination of originating facility Minor onsite contamination No offsite contamination
D	No significant offsite impact	Minor or no injury and no disability	Minor or no contamination of originating facility No onsite contamination No offsite contamination

Source: LANL 1997c:17.

In assessing the significance of an accident or abnormal event, the frequency of the event must be considered as well as the consequences. Table 6–6 presents the Consequence Likelihood Categories used for the evaluation of hazards associated with the proposed Pit Disassembly and Conversion Demonstration.

Table 6–6. Consequence Likelihood Categories

Frequency	Definition
I (1 to 0.1)	Normal Operations: frequency between once per year and 1 in 10 operating-years or at least once in 10 similar facilities operated for 1 year
II (0.1 to .01)	Anticipated Events: frequency between 1 in 10 years and 1 in 100 operating-years or at least once in 100 similar facilities operated for 1 year
III (10^{-2} to 10^{-4})	Unlikely: frequency between 1 in 100 years and 1 in 10,000 operating-years or at least once in 10,000 similar facilities operated for 1 year
IV (10^{-4} to 10^{-6})	Very Unlikely: frequency between 1 in 10,000 years and once in 1 million years or at least once in a million similar facilities operated for 1 year
V ($<10^{-6}$)	Improbable: frequency of less than once in 1 million years

Source: LANL 1997c:18

Due to design requirements based on reducing the impacts of potential accidents, as the consequences of an event increase, the likelihood of that event occurring decreases. As a result, a Severity Category "A" event would normally be expected to have a frequency of IV or V. Risk, which is the product of consequence and frequency, is one way to evaluate an accident or abnormal event. Table 6–7 shows the way risk is ranked for the evaluation of accidents and abnormal events.

Table 6–7. Risk Ranking Matrix

Severity of Consequence	Likelihood of Consequence				
	I	II	III	IV	V
A	1	1	2	3	3
B	1	2	2[a]	3	4
C	1	3	3	4	4
D	3	4	4	4	4

[a]Assign risk rank of 3 if severity category rank of B is based on worker injury and offsite consequences severity is less than B.
Source: LANL 1997c:18.

6.1.4.1 Pit Bisection and Disassembly

After a pit arrives at the pit bisector and disassembly module, it is weighed; tube appendages are cut off; it is re-weighed; and then it is bisected. The bisection is accomplished using a pit bisector (a rotary shearing assembly much like a tube cutter) or a parting lathe. Using the pit bisector, a beveled-edge parting wheel is placed around the waist of the pit and driven inward toward the center of the pit by a servo-driven lead screw while the pit is slowly rotated. A parting lathe, similar to a standard machine shop lathe, may also be used to cut pits. After bisection is complete, the two hemispheres are separated and weighed. Use of the rotary shearing process minimizes cutting waste while the parting lathe results in a small amount of metal shavings.

The principal hazard associated with this module, is the starting of the rotary table before the vacuum hoist is removed, causing the hoist to hit the glovebox window, the loss of glovebox integrity, and a release of contamination to the room. This hazard is a Severity Category "D" to the public, frequency II, (anticipated), risk-ranked 4 event (LANL 1997c:14-18). The pit is in metallic form during this accident, hence the only room contamination could come from contamination on the surface of the pit, which is small. The PrHA for this module indicates that the accidents associated with this module have less significant consequences than those of other modules.

6.1.4.2 Oxidation

This module converts plutonium from metal to an oxide. In the hydride-oxidation (HYDOX) process, the subassembly is first placed in a vacuum chamber inside the module glovebox. After evacuating the chamber, the subassembly is exposed to hydrogen gas at low pressure and temperature, which converts plutonium to plutonium hydride. Small plutonium hydride particles spall from the surface, falling from the subassembly into a heated crucible. Once the hydride reaction has been established, nitrogen is introduced. Nitrogen readily replaces the hydrogen in the plutonium hydride, creating plutonium nitride and giving off hydrogen gas. The released hydrogen gas then reacts with the remaining plutonium metal in the subassembly, continuing the cycle. Once all the plutonium has been converted to plutonium nitride, the hydrogen gas is removed from the reactor, the reactor is flushed with nitrogen, and the chamber is evacuated. Next, oxygen is introduced to convert the plutonium nitride to plutonium dioxide. Finally, the chamber is purged with argon and cooled. The plutonium dioxide is transferred to a can by a dustless powder transfer system. The can is then moved to the canning module.

Alternatives to the HYDOX process are hydride/dehydride, which converts hydride powder to a plutonium metal ingot, and direct oxidation that converts plutonium metal to an oxide directly. PrHAs for these

processes were conducted, however, they are not discussed here because the consequences of the HYDOX accidents are more severe and therefore envelope process accident consequences.

Two types of hazards exist for the HYDOX module: those that breach the glovebox barrier and criticality. The glovebox barrier could be breached by a fire that burns the gloves, or a hydrogen deflagration or explosion. A number of vessel and glovebox explosion, deflagration, and fire scenarios were evaluated by the PrHA. The deflagration in the reactor vessel was identified as having the highest potential consequences to the public.

In this scenario (a Severity Category "C" for the public, frequency III unlikely, risk-ranked 3 event), the pump-down step following the hydride/nitride recycle sequence is bypassed and oxygen is introduced into the vessel. A deflagration occurs when the hydrogen concentration is reduced to the upper flammable limit. This could only occur with a failure of the system vacuum interlock. The material at risk is 2,500 grams of plutonium nitride. To be conservative, the deflagration was assumed to violate the glovebox integrity and it was also assumed the exhaust HEPA filters on the glovebox were ineffective, though no specific physical cause would be expected to result in this condition.

Using airborne release and the respirable clarifying fractions according to the DOE Handbook, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE 1994a), the 2,500 grams of plutonium nitride would result in a maximum source term from the deflagration of 3.75 grams plutonium in plutonium nitride form. A mitigated accident, where credit is taken for the building's ventilation system including HEPA filters and other features, would result in a source term of 1.4×10^{-8} grams of plutonium and a MEI dose at the site boundary, near the Royal Crest Trailer Park, of 2.8×10^{-8} rem (LANL 1998:52).

Workers in the room at the time of the deflagration may be injured by flying glass and other missiles depending on their proximity to the deflagration. The radiological dose that a worker would receive from an accident cannot be accurately estimated because of several factors, such as the workers proximity to the accident and the shielding that might be in place. If the worker was close to or in contact with the radioactive material involved in the accident, the dose received would be much greater than if the worker were at the other side of the room. Likewise the shielding (i.e., walls, gloveboxes) between the worker and the accident greatly impact the dose received. However, workers in the immediate vicinity may be subject to injury or fatalities as a result of such an accident.

Criticality was considered in the PrHA as a possibility from two risk-ranked 3 events, but was not analyzed in detail because the consequences to the public are bounded by the deflagration accident.

6.1.4.3 Gallium Removal

In this module, plutonium dioxide is thermally treated in a furnace that operates with a reducing gas to volatilize gallium and other impurities that may be present. The impurities are then captured in a vacuum trap and the plutonium dioxide is sent on to the canning module. Possible accidents in this module include fire, a deflagration, or explosion. However, because there would not be any flammable materials present in this module, none of these accidents were considered plausible. Therefore, the consequences of these accidents were not evaluated separately and are considered to be enveloped by the HYDOX accident discussed in Section 6.1.4.2.

6.1.4.4 Canning

In this module, plutonium metal or plutonium dioxide is received in a can that is placed inside a stainless steel inner can, the lid is welded in place with a full penetration weld, the weld is visually inspected, and the

can is leak tested with helium. The inner can is then sent to the decontamination module, where it is decontaminated and placed in an outer can. The outer can is then placed inside a bell chamber that is filled with the inert gas, helium. The outer can is welded with a full penetration weld, the weld is visually inspected, and the can is leak tested. Upon successful testing, the cans are sent to the nondestructive assay module.

Based on rigorous drop and crush tests performed on these cans, there are no accidents associated with this module that are expected to generate significant offsite consequences, that is, all of the accidents are a Consequence Severity Category "D" for the public and all are frequency III or IV, and risk-ranking of 3 or lower. (LANL 1997f:19).

6.1.4.5 Electrolytic Decontamination

This module removes radioactive contamination from the outside of a sealed can by rinsing the can with a sodium sulfate solution and establishing an electric potential across the fluid and can. This electrolytic process removes a small amount of the can material (stainless steel) as well as the contamination. After flushing and drying, the can is monitored for alpha contamination, weighed and, if contamination-free, would be released from the glovebox line so it can undergo nondestructive assay in the next module.

The principal hazard of this module is deflagration of hydrogen from the disassociation of water during electrolytic decontamination. The hydrogen deflagration accident, ignited by a spark from the direct current power, was analyzed for the glovebox, the electrolyte tank, and the decontamination chamber, all risk-ranked 3, frequency level III and consequence C. The hydrogen detection system is assumed to fail although the process control system does shut down the system. The deflagration in the electrolyte tank and the decontamination chamber is inconsequential due to the small space available for hydrogen accumulation. In the glovebox, the lower flammable limit (4 percent hydrogen) could be reached in approximately 2.5 hours if the compressed air and ventilation system were off. A hydrogen deflagration of this amount of hydrogen would injure workers with broken glass and could rupture ear drums, but fatalities are not considered likely. Consequences to the public from such an accident are enveloped by the deflagration accident discussed in Section 6.1.4.2 (LANL 1997h:22).

6.1.4.6 Nondestructive Assay

This module uses a calorimeter, a gamma ray isotopic system, a segmented gamma scanner, and an active/passive neutron multiplicity counter to assay the contents of the cans that come out of the decontamination module. The calorimeter measures the heat output of the sample, while the gamma ray isotopic measuring system determines the plutonium isotopic distribution, americium fraction, uranium/plutonium ratio, and neptunium/plutonium ratio. This information would be combined with the calorimetry data (or the neutron counting data) to yield the mass of plutonium. The neutron counter data would be used primarily when the masses of the sample material are low. Cans are hand carried to the nondestructive assay module and moved within the module by robot.

Because these cans have passed rigorous drop and crush tests, there are no accidents associated with this module that are expected to generate significant offsite consequences, that is, all of the accidents are a Consequence Severity Category "D" for the public and all are frequency IV, and risk-ranking of 3 or lower (LANL 1997g:19).

6.1.4.7 Preliminary Integrated Process Hazard Analysis

An integrated PrHA dealing with the potential for an integrated accident associated with the Pit Disassembly and Conversion Demonstration is in preparation. Based on a preliminary analysis by LANL, no additional scenarios have been identified that could potentially impact multiple modules resulting in the release of radioactive materials from more than one module (Ladino 1998).

6.1.5 Waste Management Impacts

As discussed in Section 5.3.5, the proposed Pit Disassembly and Conversion Demonstration would generate wastes in the following categories: TRU waste, MLLW, LLW, and hazardous waste. The volume of waste generated by the demonstration would be very small as discussed below. Therefore, the projected increase in the total waste volume for each category would be expected to have little or no impact on current LANL waste management processes and procedures (see Table 6–8). Handling of these wastes would be in accordance with established procedures at LANL, which are compliant with all applicable Federal, and state statutory and regulatory requirements; permits; and DOE orders. Impacts of waste management at LANL are evaluated in the *Draft LANL Site-Wide EIS* (DOE, 1998a).

6.1.5.1 Transuranic Waste

Crucibles used to contain plutonium during processing and non-fissile pit parts removed during pit disassembly may be sufficiently contaminated to become solid TRU waste. In addition, gloves and glovebox windows and seals would need to be replaced periodically and would be considered TRU waste. Approximately 2 cubic meters of TRU waste would be expected annually from operation of the demonstration. This is appropriately 2.5 percent of the annual TRU waste expected to be generated by all operations at LANL. This TRU waste is packed in drums and the contents recorded at TA-55. The drums are shipped to TA-54, certified, and stored for ultimate disposal at WIPP. The small quantities of TRU waste generated by the proposed action would be expected to have minimal impact on storage capacity at LANL.

6.1.5.2 Mixed Low-Level Waste

Cutting the pit cladding may produce some fines and turnings that would be classified as solid MLLW, depending on the cladding materials. However, the estimated quantity of these materials is less than 150 grams per year and would be considered negligible in comparison to the approximately 7 cubic meters of MLLW generated annually at LANL. MLLW is collected by LANL waste management personnel and stored at TA-54, Areas L and G, pending disposal in accordance with the Site Treatment Plan prepared pursuant to the Federal Facility Compliance Act. Future management of MLLW would also be consistent with any applicable ROD issued pursuant to the WM PEIS.

6.1.5.3 Low-Level Waste

The proposed demonstration would be expected to generate less than 100 liters per year of electrolytic decontamination solutions containing traces of plutonium. These solutions would be transferred to the Radioactive Liquid Waste Treatment Facility at TA-50 for treatment where the waste would be treated by lime/sulfate precipitation. The resulting solid waste would be handled with the other solid LLW generated by the demonstration. Other solid LLW expected to be generated by the demonstration would include protective clothing, metal shavings, gloves, solid beryllium, stainless steel, depleted uranium, and aluminum. It is estimated that approximately 3 cubic meters of solid LLW would be generated annually by the demonstration and buried on the site in pits and shafts designed specifically for this purpose in TA-54, Area G. This is approximately 0.6 percent of the LLW expected to be generated annually by all operations

Table 6–8. Comparison of Waste Expected to be Generated by the Pit Disassembly and Conversion Demonstration With Current Waste Management Practices at LANL

Waste Category	Examples of Waste Generated During Demonstration	Expected Annual Waste Generated from Demonstration	Current Annual Waste Generated at LANL	Percent of Current Waste Generation (%)	Treatment Capacity	Disposal Method
TRU	Gloves; glovebox components, crucibles, HEPA filters	$2m^3$	$81m^3$[a]	2.5	1,080 m^3/yr[b]	Treated and stored onsite awaiting shipment to WIPP
MLLW	Solidified solutions, cladding shavings	Negligible[c]	$7m^3$[a]	NA	Under development per Site Treatment Plan	Shipped offsite for treatment and disposal
LLW	Protective clothing, gloves, metal, solidified decontamination solutions	$3m^3$	$521m^3$[a]	0.6	Treatment (and therefore, capacity) varies with waste stream	Buried onsite in pits and shafts designed and engineered for this purpose
Hazardous	Laboratory solutions, cleaning solvents, hydraulic fluid	<38kgs	90,000kg[a]	<0.1	Treatment (and therefore, capacity) varies with waste stream	Shipped offsite for treatment and disposal

[a] LANL 1997i: 4.
[b] DOE 1996a:3-338, 3-339.
[c] Less than 150 grams of MLLW is expected to be generated annually during the demonstration.

at LANL. LLW waste generated by the demonstration would be managed according to the current site practices unless those practices are modified by decisions made pursuant to the WM PEIS.

6.1.5.4 Hazardous Waste

The demonstration would generate a very small amount of liquid hazardous waste including laboratory solutions, cleaning solvents, and hydraulic fluids. It is estimated that approximately 38 kilograms would be generated annually as a result of the demonstration or less than 0.1 percent of the hazardous waste routinely generated by LANL. No disposal facility for hazardous waste exists at LANL. Hazardous wastes are shipped off the site for further treatment and disposal at RCRA permitted commercial facilities in accordance with the ROD for hazardous waste issued pursuant to the WM PEIS (DOE 1998c).

6.1.6 Transportation Impacts

The Pit Disassembly and Conversion Demonstration could require transportation of pits from DOE's Pantex Plant or RFETS, and metal from INEEL, SRS, or LLNL. Additionally, HEU removed from disassembled pits would be shipped from LANL to ORR. All shipments would be packaged in Department of Transportation-approved Type-B containers and use safe secure trailers (SSTs).

6.1.6.1 Transportation Impacts Analysis Methodology

Representative overland truck routes have been analyzed for the shipments to LANL and ORR. The routes were selected for analysis consistent with current routing practices and all applicable routing regulations and guidelines. However, the routes were determined for risk assessment purposes. They do not necessarily represent the actual routes that would be used to transport plutonium and HEU in the future. For safety and security reasons, specific routes cannot be publicly identified in advance.

The HIGHWAY (Johnson, et al, 1993) computer code was used for selecting representative highway routes and could be used to help select the actual routes. The HIGHWAY database is a computerized road atlas that currently describes about 386,400 kilometers (240,000 miles) of roads. The Interstate System and all United States-designated highways are included in the database. In addition, most of the principal state highways and many local and community roads are also identified. The code is updated periodically to reflect current road conditions and has been benchmarked against reported mileages and observations of commercial trucking firms. Features in the HIGHWAY code allow the user to select routes that conform to the Department of Transportation regulations. Additionally, the HIGHWAY code contains data on the population densities along the routes. The distances and populations from the HIGHWAY code are part of the information used for the transportation impact analysis.

Since DOE established the Transportation Safeguards Division in 1975, it has accumulated over 110 million kilometers (70 million miles) of experience with no accidents or release of radioactive material (DOE 1996a:G-27). However, there are risks associated with such shipments and in order to quantify the potential risks to the public, DOE-developed RADTRAN (Neuhauser and Kanipe 1993). RADTRAN 4 was developed by Sandia National Laboratories to calculate population risk associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge. This computer code is used for incident-free and accident risk assessments to estimate the impacts on collective populations. RADTRAN 4 population risk calculations take into account both the consequences and probabilities of potential exposure events. The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternatives being considered. As such, the collective population risk is used as the primary means of comparing the various alternatives.

The transportation accident model assigns accident probabilities to a set of accident categories. Eight accident-severity categories defined in NRC's *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NRC 1977) were used. The least severe categories (Category I and II) represent low magnitudes of crush force, accident-impact velocity, fire duration, and/or puncture-impact speed. The most severe category (Category VIII) represents a large crush force, high accident-impact velocity, long fire duration, and a high puncture-impact speed. The fraction of material released and material aerosolized, and the fraction of that material that is respirable (particles smaller than 10 microns) was assigned based on the accident categories. The analytic approach is consistent with the approach used in the *Storage and Disposition Final PEIS.*

The nonradiological risk factors are also taken from the *Storage and Disposition Final PEIS.* Risk factors are provided for fatalities resulting from hydrocarbon emissions (known to contain carcinogens) and transportation accidents (nonradiological fatalities resulting from impact). The risk of transportation accidents involving escort vehicles are included in the estimates. The risk from hydrocarbon emissions for the escort vehicles is much smaller than those from the trucks.

6.1.6.2 Transportation Risks Associated with the Proposed Action

Under the proposed action, plutonium in the form of pits might be shipped to LANL from RFETS or Pantex and in the form of metal from INEEL, SRS, or LLNL. HEU recovered from these pits as they are disassembled would be shipped to ORR. As shown in Table 6–9, the greatest risk to the public from these proposed shipments would be from a traffic accident involving the SST or one of its escort vehicles and not from radiological exposure. In terms of the total risk to the public as a result of implementing the proposed action, it is estimated that the proposed action would result in a risk to the public (either as result of a latent cancer or a traffic accident) of less than 0.005 or 5 chances in 1,000 of a fatality.

Based on the results of the transportation risk analysis, it is unlikely that shipping plutonium, in the form of pits or metal, or HEU would result in a fatality. Therefore, no adverse health effects to the public and truck crews would be expected from any scenario involved in the proposed demonstration.

Table 6–9. Overland Transportation Risks for All Materials Under the Proposed Action[a]

	Routine				Accidental
	Radiological		Nonradiological		
Route	Crew[b]	Public	Emissions	Traffic	Radiological
Plutonium shipments from Pantex Plant to LANL	0.0001	0.0007	0.0001	0.001	$3x10^{-6}$
Plutonium shipments from RFETS to LANL	$3x10^{-5}$	0.0002	$5x10^{-5}$	0.0003	$1x10^{-6}$
Plutonium shipments from INEEL to LANL[c]	$7x10^{-6}$	$5x10^{-5}$	$5x10^{-6}$	$7x10^{-5}$	$3x10^{-7}$
Plutonium shipments from SRS to LANL[c]	$1x10^{-5}$	$7x10^{-5}$	$1x10^{-5}$	0.0001	$7x10^{-7}$
Plutonium shipments from LLNL to LANL[c]	$5x10^{-6}$	$3x10^{-5}$	$8x10^{-6}$	$5x10^{-5}$	$2x10^{-7}$
Highly enriched uranium shipments from LANL to ORR	$3x10^{-6}$	$2x10^{-5}$	$9x10^{-5}$	0.0009	$3x10^{-10}$

[a] All risks are expressed in latent cancer fatalities during the implementation of the proposed action, except for the Accidental-Traffic column, which is a number of nonradiological fatalities.
[b] The two individuals in the vehicle.
[c] Includes risks associated with a single SST shipment from this site should the need arise.

6.1.7 Socioeconomic Impacts

The proposed demonstration would not affect employment at LANL because no additional personnel are anticipated to be required to support the demonstration. The demonstration would be similar to many other research efforts normally conducted at LANL. It is standard practice for workers at LANL to move from one project to another without any impact on the overall employment level. The demonstration, if undertaken, would be staffed in this manner. Therefore, no significant socioeconomic effects would be expected to result from the proposed action.

6.1.8 Environmental Justice Impacts

As discussed above, implementation of the proposed action would pose no significant risk to the general population including minority and low-income populations. Therefore, no disproportionately high and adverse impacts on minority and low-income populations would likely result from implementation of the proposed action.

6.1.9 Cumulative Impacts

The *Draft LANL Site-Wide EIS*, which is incorporated by reference, discusses the cumulative impacts of the proposed demonstration, on-going LANL operations, potential expanded LANL operations, and other activities in the LANL region. As explained in the *Draft LANL Site-Wide EIS*, expanded operations at LANL including the proposed demonstration and other activities, would result in an additional latent cancer fatality risk of about 0.0002 over the lifetime of the maximally exposed individual.

6.2 No Action Alternative Impacts

Under the No Action Alternative, an integrated pit disassembly and conversion line would not be demonstrated at LANL. Research related to these activities would continue to be collected through a series of individual gloveboxes because potential data developed as a result of the demonstration would not be available. There would be no change in the current environmental or health effects associated with work done in PF-4 and TA-55, and these facilities would continue to operate as they do currently.

6.2.1 Transportation Risks Associated with the No Action Alternative

Under the No Action Alternative, pits would not be shipped to LANL from RFETS or Pantex, and plutonium metal would not be shipped from INEEL, SRS, or LLNL. Since there would not be any HEU recovered from these pits, there would be no shipments of HEU to ORR. However, DOE has committed to consolidate its inventory of weapons-grade plutonium, so the pits at RFETS would continue to be shipped to Pantex where they would be stored pending a decision on their ultimate disposition in accordance with the ROD that will be issued after the SPD Final EIS is completed. As shown in Table 6–10, the greatest risk to the public from this alternative would continue to be from a traffic accident involving the SST or one of its escort vehicles and not from radiological exposure. In terms of the total risk to the public as a result of implementing the No Action Alternative, it is estimated that this alternative would result in a risk to the public (either as result of a latent cancer or a traffic accident) of less than 0.001 or 1 chance in 1,000 of a fatality.

Based on the results of the transportation risk analysis, it is unlikely that shipping plutonium to Pantex from RFETS under the No Action Alternative would result in a fatality.

Table 6–10. Overland Transportation Risks for All Materials Under the No Action Alternative[a]

	Routine				Accidental
	Radiological		Nonradiological		
Route	Crew[b]	Public	Emissions	Traffic	Radiological
Plutonium shipments from RFETS to Pantex Plant	0.00005	0.0003	0.00007	0.0005	0.00008

[a] All risks are expressed in latent cancer fatalities during the implementation of the policy, except for the Accidental-Traffic column, which is a number of fatalities.
[b] The two individuals in the vehicle.

6.3 Future Utilization of Pit Disassembly and Conversion Demonstration Equipment

After completion of the demonstration, the equipment would be placed in a standby mode and later used for training purposes (i.e, operators, supervisors) for the production pit disassembly and conversion facility, should it be built. The modules for which there is no further mission would be decontaminated and decommissioned. The ultimate disposition of the modules has not yet been determined. However, when DOE decides what action to propose regarding the modules, an appropriate NEPA review would be conducted.

7.0 RESEARCH AND DEVELOPMENT ACTIVITIES

In the ROD for the *Storage and Disposition Final PEIS*, DOE decided to pursue a strategy for plutonium disposition that allows for the implementation of two different approaches for disposition of the United States' surplus plutonium: one would involve the immobilization of some and potentially all surplus weapons plutonium in a glass or ceramic form surrounded by HLW; the other would involve the use of some of the surplus plutonium as MOX fuel in existing commercial light water reactors. The ROD acknowledged that further research, development, and demonstration is needed to provide data for decisions concerning process development, waste characterization, plant design and engineering (for potential disposition-related facilities), and other support activities.

These R&D activities cover each major area of the surplus plutonium disposition program (pit disassembly and conversion, immobilization, and MOX fuel fabrication) and consist of a number of small-scale projects which in turn consist of a number of individual experiments. As stated before, all of the R&D activities are ongoing, having been started before 1997, with none of the projects currently being complete. However, some individual experiments have been completed and new ones started. Experiments would be phased over about 3 years and therefore, work on R&D activities would continue after the issuance of the SPD EIS ROD. Depending on the decisions made in that ROD, individual experiments as well as some of the projects they support may be canceled.

In the interest of furthering the purposes of NEPA and providing full disclosure to the public, a brief description of each R&D project and the amount and type of nuclear materials involved is being provided in this EA. Some of the project descriptions contain information about individual experiments to provide a better understanding of the work being done and its purpose in the overall surplus plutonium disposition program.

The on-going R&D projects and experiments described in this section (DOE 1998b; DOE 1997b) have already been reviewed for NEPA compliance by DOE. At five of the sites (Argonne National Laboratory-East (ANL-E), Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory (PNNL), INEEL, and SRS), these efforts have been categorically excluded from the need for further NEPA review under Category B3.6[15], because they consist of indoor bench-scale research or demonstration work (Dunigan 1998, Elmore 1998, Grainger 1998, Green 1998, Irving 1998). For the most part, the R&D activities described in this section are being conducted without the need for construction or modification of existing facilities. In the few activities where construction or modification of facilities was required, all of the changes were within already developed areas. No adverse impacts, including cumulative impacts, are expected during these experiments because of the small quantities of materials being used in these bench-scale R&D projects and because applicable safety and health procedures are in place in these buildings (e.g. HEPA filters, gloveboxes). The R&D activities at these five sites are using plutonium in amounts well below the administrative limits for the facility in which the work is being performed. At the remaining two sites, LANL and LLNL, the R&D projects are covered by sitewide EISs which also discuss potential cumulative impacts (DOE 1998a, DOE 1992). The total amount of plutonium used at these two sites would range from 15 to 100 kilograms over the duration of these activities. The amounts used in individual experiments would be well below facility administrative limits. Unless otherwise noted, onsite plutonium is being used for R&D activities, no offsite shipments are required.

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[15] As defined in DOE's NEPA Implementing Procedures, Categorical Exclusion B3.6 is applicable to the siting, construction (or modification), operation, and decommissioning of facilities for indoor bench-scale research projects and conventional laboratory operations (e.g., preparation of chemical standards and sample analysis); small-scale research and development projects; and small-scale pilot projects (generally less than two years) conducted to verify a concept before demonstration actions. Construction (or modification) would be within or contiguous to an already developed area (where active utilities and currently used roads are readily accessible) (DOE 1996c:36241).

7.1 Immobilization Research and Development

The *Storage and Disposition Final PEIS* analyzed the ability of various immobilization technologies to achieve the Spent Fuel Standard for proliferation resistance. The Notice of Intent for the SPD EIS and the SPD Draft EIS stated that the preferred alternative for immobilization is the ceramic can-in-canister technology, using the existing HLW processing operations at the Defense Waste Processing Facility (DWPF) at SRS. The ROD for the SPD EIS will make the final decision on the immobilization technology to be used for disposition, if it is decided to immobilize some or all of the surplus plutonium.

The proposed can-in-canister demonstration has two stages. The first stage is to immobilize the plutonium in a small can using either a glass or ceramic form. The next step is to place the immobilized cans of plutonium in a rack which is placed in an empty DWPF canister. In the second stage of immobilization, the canister is filled with HLW at DWPF, which adds the radiation barrier necessary to meet the Spent Fuel Standard. The same approach is being evaluated for the Hanford Site in Richland, Washington, which is building a vitrification plant similar to DWPF.

Before DOE can make a decision on the technology to be used to immobilize surplus plutonium, immobilization R&D is needed to:

- identify a material formulation that satisfies process and long-term performance requirements;
- develop processing equipment, material flow and process controls, operational strategies, and material accountability procedures that minimize impacts on workers and the environment, and the ability to maintain an acceptable implementation schedule;
- demonstrate that individual operations or processing steps fit together seamlessly; and
- demonstrate that the specific immobilized forms meet the Spent Fuel Standard for proliferation resistance (DOE 1996b:3).

On-going work is needed to develop data to: determine which immobilized form, glass or ceramic, performs best[16]; develop material forms compatible with processing (including determining effects of impurities and long-term performance requirements); develop immobilization processes for reliably producing these forms; demonstrate these processes using radioactive materials; and enhance overall proliferation resistance. LLNL is serving as the lead laboratory and host for most of the immobilization R&D, and is being supported by efforts at SRS, ANL-E, and PNNL. Table 7–1 shows the immobilization R&D projects that are taking place at specific DOE sites, all of the buildings being utilized for the listed R&D projects at these sites, and the cumulative total plutonium estimated to be used for all the listed projects at each site.

7.1.1 Development of Data to Support Selection of Preferred Immobilized Form

To determine the best immobilization form, R&D is being conducted to judge the glass and ceramic forms against established criteria on a consistent basis. These R&D activities are being conducted at LLNL to compare can-in-canister and homogeneous approaches, and the final immobilized form, glass or ceramic. Efforts are focusing on resistance to theft and diversion and retrieval or extraction; technical viability; environmental, safety, and health concerns; timeliness; and cost effectiveness.

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[16] Based on a technical down-selection process, DOE's current research and development efforts are focused on ceramic formulations.

Table 7–1. Summary of Immobilization R&D Activities

Immobilization R&D Projects	Building Number (Administrative Limit)[a]	Quantity of Plutonium Estimated to be Used in These Projects[b]
ANL-E		
Glass Formulation Development, Ceramic Formulation Development, Waste Form Characterization, Proliferation Resistance Tests	Building 205 (400 g)	< 300 g
LLNL		
Glass Formulation Development, Glass Process Development, Ceramic Formulation Development, Ceramic Process Development, Waste Form Characterization, Proliferation Resistance Tests, Can-in-Canister Technology Demonstrations	Superblock[c] (700 kg)	FY 97–2 kg[d] FY 98–8 kg[d]
PNNL		
Glass Formulation Development, Glass Process Development, Waste Form Characterization, Proliferation Resistance Tests	Building 325 (2,759 g) Building 326 (18 g) Building 3720 (18 g)	70 g mg quantities 3-5 g
SRS		
Glass Formulation Development, Glass Process Development, Ceramic Formulation Development, Ceramic Process Development, Waste Form Characterization, Proliferation Resistance Tests, Can-in-Canister Technology Demonstrations	Building 773-A (2,000 g)	< 200 g

[a] The limit on the amount of plutonium allowed in a building at any one time is based on the site-specific safety analysis report; shown are the buildings that would be used for these R&D projects at a specific site.

[b] Amounts listed are cumulative totals for the listed R&D projects at a specific site. The quantities in the building at any one time would be less than the administrative limit.

[c] The Superblock is comprised of Buildings 331, 332, 334, and 335. MD plutonium activities are limited to Buildings 332 and 334. The safety analysis report for Building 334 further restricts the plutonium limit to 12 kg.

[d] These amounts are a subset of the quantity of plutonium being processed through pit disassembly and conversion R&D experiments at LLNL (see Table 7-3).

Source: Pearson 1997; Peko 1998a; Vienna 1997.

7.1.2 Formulation Development

The choice of the first stage immobilization form would affect the design of an immobilization facility, because the immobilization processes differ for each. This choice would also influence the extent of characterization necessary for the product, the waste coming from this facility, potential licensing requirements, and the implementation schedule. For example, the maximum allowable plutonium loading (i.e., the percentage of plutonium that can be encapsulated in the glass or ceramic form) for each immobilized form needs to be determined through R&D related to process safety and the long-term performance of the immobilized form. Similarly, the loading factor would affect the size and throughput of the processing facility. Formulas for glass or ceramic materials to be used for immobilization and the measurement of various physical and chemical properties of the immobilized material need to be refined to aid the selection

of the immobilized form, to determine the production processing parameters, and to develop the qualification for placement of the immobilized form into a potential Nuclear Waste Policy Act repository.

LLNL is performing ceramic formulation experiments with support from SRS and ANL–E; while SRS and ANL–E are performing glass formulation experiments; and PNNL is providing testing support. The formulation development project at these laboratories include experiments using the glass concept to determine acceptable impurity concentrations: experiments of the solubility of plutonium, uranium and neutron absorbers as a function of particle size and thermal treatment history of the plutonium feed; experiments in static, manually stirred and control agitation melts; and experiments to establish the devitrification properties as well as key physical properties (e.g., viscosity and thermal conductivity).

7.1.3 Waste Form Characterization

The main concern about the performance of the immobilized form in a geologic repository is the potential for separation of the fissionable isotopes of plutonium and uranium from neutron absorbers, inside the waste package, in the environment, or both. The concern is that a separation could result in enough of this material coming together to form a critical mass. DOE experiments are being conducted to characterize waste form degradation and radionuclide release in an environment replicating the presumed repository environment.

7.1.4 Proliferation Resistance Tests

The goal of the plutonium disposition program is to place the United States' surplus plutonium into a form from which it can not be easily recovered and used again in nuclear weapons. Proliferation resistance tests are being conducted to ensure that the final glass or ceramic form chosen for immobilization will prevent the return of these materials to a form where they can be used in nuclear weapons. Tests are also being conducted to determine the relative difficulty of recovering plutonium from the glass and ceramic forms. Extraction tests are assessing the degree of difficulty and the cost and time requirements for attempted diversion. These experiments include leaching of the plutonium-bearing forms in sub-boiling solutions (e.g., nitric acid, sulfuric acid) and measurements of the quantity of plutonium released as a function of time.

7.1.5 Process Development

Process experiments involve the development and demonstration of prototypical systems for a full-scale plutonium immobilization facility. Development of prototypical glass and ceramic formulation equipment, using kilogram quantities of plutonium, provide needed information, such as shielding requirements and glovebox spacing, for the full-scale design.

The glass process requires the development of a suitable melter system which includes both prototype feeders and product loadout systems contained in a glovebox enclosure for safer operation. Using the tilt-pour melter, DOE is evaluating the characteristics associated with fabricating and pouring multi-kilogram quantities of glass containing plutonium, uranium, and a range of impurities that would be similar to those expected to enter the full-scale facility.

The ceramic process also requires the development of a prototypical feed preparation and cold-pressing system coupled to an appropriate heat cycle to sinter the ceramic pellets. Ceramic samples are prepared to determine the extent to which the precursor or binder materials and the plutonium dioxide feedstock react to produce stable ceramic forms. The ability of the ceramic formulation to incorporate the expected range of impurities in the plutonium feedstocks is being evaluated and preliminary impurity concentration limits established.

7.1.6 Can-in-Canister Technology Demonstrations

Small-scale demonstrations of the various can-in-canister technologies are facilitating the design of a potential full-scale immobilization facility. Fabrication of glass and ceramic forms is being demonstrated in a tilt-pour melter that can produce materials that are prototypical of a full-scale melter and experimental plutonium ceramic process line at LLNL. Several cans of plutonium forms may be produced to validate formulation and plant processes.

7.2 Reactor-Based and Nuclear Fuels Research and Development

The second disposition approach being pursued by DOE is the use of weapons-usable plutonium in the fabrication of MOX nuclear fuel for use in commercial light water reactors. R&D is needed to resolve technical issues associated with applying the large experience base (existing mainly in Europe) of making MOX fuel with recycled reactor-grade plutonium to the fabrication of MOX fuel using weapons-usable plutonium and to develop the data needed for the MOX alternative for the disposition of surplus weapons-usable plutonium.

The compatibility of commercial reactor-grade MOX fuel with commercial light water reactor technologies is well established. However, several differences exist between reactor-grade and weapons-usable plutonium that create technical issues that must be resolved. These differences include: variation in powder characteristics because the weapons material is expected to be converted primarily using a dry pyrochemical process as opposed to the chemical dissolution and precipitation process currently used in Europe; the presence of gallium or other potential impurities in the weapons material; and the variation in plutonium isotopics between reactor-grade and weapons-usable material. R&D activities fall into two main categories: MOX fuel fabrication and gallium removal. Table 7–2 shows the reactor-based and nuclear fuels R&D projects that are taking place at specific DOE sites, all of the buildings being utilized for the listed R&D projects at these sites, and the cumulative total plutonium estimated to be used for all the listed projects at each site.

The potential disposition of plutonium as MOX fuel would involve a mixture of weapons-usable plutonium dioxide and uranium oxide. Any variation in the fabrication process, including the feed materials, will lead to variations in the final fuel product. It is important to quantify the effect these variations would have on the quality of the MOX fuel. Definition and development of the processes, equipment, and specifications for producing plutonium dioxide and uranium oxide feed is essential for qualifying a fuel fabrication process since the proposed MOX fuel fabrication facility may be licensed by the NRC. On-going research is required to determine the range of fabrication parameters that would lead to an acceptable fuel product, that is, one compatible with use in a commercial reactor.

7.2.1 Light Water Reactor In-Pile Testing

ORNL is directing in-pile testing experiments to examine the effects of gallium on prototypic but generic, light water reactor MOX fuel. The in-pile testing complements out-of-pile experiments by providing generic irradiation data to supplement the out-of-pile results. Fuel for these experiments, a small number of fuel pellets, are being fabricated at LANL and shipped to INEEL, where the fuel is irradiated in the Advanced Test Reactor (ATR). One or two shipments of fuel pins are being shipped to INEEL in DOT-approved commercial trucks. No significant impacts are expected to result from the transportation of the fuel or its irradiation at ATR.

Table 7–2. Summary of MOX Fuel R&D Activities

MOX Fuel R&D Projects	Building Number (Administrative Limit)[a]	Quantity of Plutonium Estimated to be Used in These Projects[b]
INEEL		
Light Water Reactor In-Pile Testing	Advanced Test Reactor (ATR)-Test Reactor Area (TRA) 670 (none)	41 g
	ATR-C (180 g)	49 g
	Canal (365 g)	41 g
	Hot Cells-TRA 632 (450 g)	49 g
	Test Train Assembly Facility (TTAF)-TRA 603 (15 g)	49 g
	Radiography-TRA 635 (15 g)	41 g
	Chemical Processing Plant (CPP)-695 (15 g)	41 g
LANL		
Feed Qualification, Fuel Fabrication Development, Gallium Research, Gallium Removal, Light Water Reactor In-Pile Testing	TA-55/PF-4 [c] CMR (2 kg)	15 kg at PF-4 Gram size samples at CMR
ORNL		
Light Water Reactor In-Pile Testing	Hot Cells-Building 3525 (320 kg)	15 g
	Shipping-Building 3036 (250 g)	15 g
	Storage-Building 7827 (151 kg)	15 g
Gallium-Clad Interaction	Hot Cells-Building 3525 (320 kg)	<5 g
	Shipping-Building 3036 (250 g)	<5 g
	Storage-Building 7827 (151 kg)	<5 g

[a] The limit on the amount of radioactive material allowed in a building at any one time is based on the site-specific safety analysis report; shown are the buildings that would be used for these R&D projects at a specific site.

[b] Amounts listed are cumulative totals for the listed R&D projects at a specific site. The quantities in the building at any one time would be less than the administrative limit.

[c] There are plutonium limits on a large number of individual operations at PF-4. These limits can change depending upon a number of criteria. The amount of plutonium used in the MOX fuel R&D projects is limited by the same criteria used to control other plutonium operations currently conducted at PF-4.

Source: Hodge 1997.

7.2.2 Feed Qualification

For the potential disposition of surplus plutonium as MOX fuel[17], pits could be converted to plutonium dioxide by hydride-oxidation (HYDOX) of plutonium metal. Characterization of previous batches of plutonium dioxide produced by the HYDOX process has shown that the particle structure is quite different from the particles produced by the conventional aqueous conversion processes. Experimentation is required to demonstrate that the variation in structure as a result of the HYDOX process is acceptable for producing quality fuel. Experiments are being conducted at LANL to: fully characterize the production of plutonium dioxide using the HYDOX process; identify modifications to the process and hardware to enable the production of feed that would meet expected specifications for MOX fuel fabrication; and produce plutonium dioxide feed for MOX fuel development activities.

7.2.3 Fuel Fabrication Development

Variations in the MOX fuel fabrication process, including the feed materials, would lead to variations in the final fuel product. On-going experiments are required to determine the range of fabrication parameters that would lead to an acceptable fuel product, that is one compatible with use in a commercial reactor. Fuel fabrication development is also needed to enhance the current techniques available for measurement of fuel characteristics. Analytical capability for measuring properties of weapons-usable MOX fuel is being developed at LANL. Demonstrations being conducted are the implementation of contemporary stoichiometry measurement capabilities, the validation of trace analysis capability, and a sintering study to evaluate the effect that different sintering times and temperatures have on final pellet density.

7.2.4 Gallium Research

To fabricate MOX fuel, plutonium dioxide and uranium oxide are blended with a ceramic powder and pressed into pellets. The pellets are then placed in a sintering furnace to cause the ceramic powder to bond with the plutonium and uranium. The presence of gallium in weapons material is a key difference between weapons-usable and reactor-usable plutonium which could affect the MOX fuel fabrication process. DOE experiments have shown that gallium oxide could volatilize under MOX fuel sintering conditions, resulting in problems because gallium is corrosive and would deposit on the furnace surfaces. In addition, gallium could affect the MOX fuel ceramic, causing significant operational difficulties if frequent adjustments to operational parameters (i.e., time and temperature) are required. This characteristic could also cause large pellet rejection rates following sintering. On-going development is needed to characterize the problems associated with gallium and to develop methods by which gallium can be efficiently removed from plutonium.

7.2.5 Gallium Removal

Evaluations of the phase relations in the complex gallium oxides (e.g., Ga_20_3-PuO_2, PuO_2-UO_2, UO_2-PuO_2-Ga_2O_3) are being conducted at LANL. These phase diagrams are assessed by collecting and critically evaluating all available thermodynamic data. The resulting information is used to assist in the development and optimization of the Thermally-Induced Gallium Removal (TIGR) process, and would be provided to the potential fuel fabricators to assist them in determining the impact of gallium on process

[17] DOE is also evaluating the disposition of surplus plutonium in a immobilized form. In which case, the pits would also need to be converted to an oxide.

parameters for the fabrication of MOX fuel. The TIGR process would allow the gallium to be collected in a vacuum trap, effectively eliminating gallium from the plutonium.[18]

7.2.6 Gallium-Clad Interaction

A series of tests are being conducted at ORNL to determine the effects of gallium on prototypic fuel cladding materials in out-of-pile experiments. These tests involve: heating MOX fuel rods either in a 400°C lead-bismuth bath or a high-flow recirculating water jacket in cells in Building 3525 at ORNL, examining and segmenting the fuel-containing rods as well as the substitute fuel rods (i.e., containing no plutonium) and irradiated fuel rods from INEEL, conducting metallographic/ceramographic examination of the fuel rods, and performing an elemental analysis of the fuel and cladding for gallium and other materials of interest.

7.3 Pit Disassembly and Conversion Research and Development

An integral part of implementing either plutonium disposition technology (immobilization or MOX fuel) is the disassembly of pits from surplus nuclear weapons and the recovery of the plutonium. To develop this capability, DOE must test and demonstrate an integrated method for dismantling pits. Once it has been successfully demonstrated, deployment of this process in a potential production facility would allow the resulting plutonium dioxide to be further processed for immobilization or to be mixed with uranium oxide to form MOX fuel. The proposed demonstration of an integrated process for pit disassembly and conversion is discussed earlier in this EA. However, R&D activities to develop various glovebox modules of the integrated process, system development to support production mode operations, direct oxidation of bulk plutonium, and a HYDOX program for MOX fuel fabrication are ongoing under the current prototype system project at LANL and LLNL. Both LANL and LLNL are performing this R&D, with LANL as the lead laboratory. Table 7–3 shows the on-going pit disassembly and conversion R&D projects at specific DOE sites, all of the buildings being utilized for the listed R&D projects at these sites, and the cumulative total plutonium estimated to be used for all the listed projects at each site.

7.3.1 Electrolytic Decontamination Module

The electrolytic decontamination module consists of a decontamination system mounted in a glovebox that electrolytically decontaminates the outside of the sealed material can. An existing electrolytic decontamination system is being hot-tested (use of plutonium).

7.3.2 Process Development for Unique and Non-Special Nuclear Materials Pit Items

This research at LANL and LLNL is evaluating and developing disposition processes and equipment for unique constituent pit items and developing processes and equipment for the decontamination and declassification of non-special nuclear materials parts resulting from the disassembly of weapons pits.

7.3.3 Pit Disassembly and Conversion Facility Non-Plutonium Product Material and Item Processes

This research at LANL and LLNL involves evaluating options for shipment and processing of non-plutonium product materials and items that result from operation of the pit disassembly and conversion facility that cannot be readily declassified and disposed of through conventional means.

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[18] DOE has also analyzed a polishing step, utilizing a small-scale aqueous process, either as part of the pit conversion facility or the MOX facility. The results of the analysis are presented in Appendix N of the SPD Draft EIS.

Table 7–3. Summary of Pit Disassembly and Conversion R&D Activities

Pit Disassembly and Conversion R&D Projects	Building Number (Administrative Limit)[a]	Quantity of Plutonium Estimated to be Used in These Projects[b]
LANL		
Electrolytic Decontamination Module, Process Development for Unique and Non-Special Nuclear Materials Pit Items, Pit Disassembly and Conversion Facility Non-Plutonium Product Material and Item Processes, Direct Oxidation of Bulk Plutonium, Oxide Characterization	TA-55/PF-4[c]	100 kg
LLNL		
Pit Bisector Module, Hydride-Oxide (HYDOX) Development and Furnace Module, Direct Oxidation of Bulk Plutonium, Oxide Characterization, Pit Dose Studies	Superblock[d] (700 kg)	FY97–20 kg FY98–50 kg

[a] The limit on the amount of radioactive material allowed in a building at any one time is based on the site-specific safety analysis report; shown are the buildings that would be used for these R&D projects at a specific site.
[b] Amounts listed are cumulative totals for the listed R&D projects at a specific site. The quantities in the building at any one time would be less than the administrative limit.
[c] There are plutonium limits on a large number of individual operations at PF-4. These limits can change depending upon a number of criteria. The amount of plutonium used in the pit disassembly and conversion R&D projects is limited by the same criteria used to control other plutonium operations currently conducted at PF-4.
[d] The Superblock is comprised of Buildings 331, 332, 334, and 335. MD plutonium activities are limited to Buildings 332 and 334. The safety analysis report for Building 334 further restricts the plutonium limit to 12 kg.
Source: Peko 1998b.

7.3.4 Direct Oxidation of Bulk Plutonium

Experiments are being conducted at LANL and LLNL to determine if direct oxidation of bulk plutonium is a reasonable backup approach for the conversion of weapons plutonium by determining the throughput and the resultant product quality of this process.

7.3.5 Oxide Characterization

Plutonium from various pit sources is being sampled and analyzed at LANL and LLNL at various stages of the pit disassembly and conversion process to establish a statistically significant database of impurities and to determine the impact of the oxidation process on impurities and oxide particle characteristics. This may involve shipment of samples between LANL and LLNL.

7.3.6 Pit Bisection Module

This module consists of a "simple" pit bisection tool mounted in a glovebox that operates like a tubing cutter, swaging (bending and shaping) rather than sawing through the material to prevent the generation of chip waste. A pit bisector is being hot-tested (using nuclear materials) at LLNL. The existing LLNL bisector module design would be upgraded to add process capability and equipment and procedures would be developed to de-nest shells from bisected pits and remove pit components.

7.3.7 HYDOX Development and Furnace Module

This module consists of the HYDOX furnace mounted in a glovebox, with associated handling accessories for loading hemishells and crucibles and unloading non-plutonium material hemishell parts and oxide after processing. A HYDOX furnace is being hot-tested (use of plutonium) at LLNL.

7.3.8 Pit Dose Studies

The dose characteristics of various pit types are being analyzed by LLNL for intact pits and for pits at various stages of disassembly to characterize the source term to support the design of the potential pit disassembly and conversion facility.

7.4 Site Specific Research and Development Activities

Table 7–4 summarizes the on-going surplus plutonium disposition R&D activities by DOE facility. This summary is a composite by location of the same R&D projects described in Sections 7.1, 7.2, and 7.3.

7.4.1 Argonne National Laboratory-East

All the R&D projects for surplus plutonium disposition being conducted at ANL-E, as shown in Table 7–1, are related to immobilization technologies. The ANL-E is supporting LLNL with ceramic formulations and is performing glass formulations. These projects use Building 205. It is estimated that small amounts of plutonium, less than 300 grams, would be used for these indoor bench-scale R&D projects.

7.4.2 Idaho National Engineering and Environmental Laboratory

The R&D projects for surplus plutonium disposition at INEEL, as shown in Table 7–2, involves light water reactor in-pile testing. The tests take place in one of DOE's research reactors, the ATR, which is located in the Test Reactor Area at INEEL and routinely conducts material irradiation tests for other offices of DOE and the United States Navy. The in-pile testing uses fuel fabricated by LANL. After receiving the fuel from LANL, it is irradiated at the ATR. After irradiation, the fuel is shipped to ORR where it is disassembled and examined. It is estimated that small amounts of plutonium, between 40 and 50 grams, would be used for these R&D projects. As indicated in Section 7.2.1, one or two shipments of fuel pins from LANL to INEEL are anticipated. One shipment of irradiated fuel pins and one shipment of unirradiated fuel pins will be sent to ORR. No significant impacts are expected from these shipments.

7.4.3 Los Alamos National Laboratory

The R&D projects at LANL, as shown in Tables 7–2 and 7–3, involving surplus plutonium disposition are related to the MOX fuel fabrication process and pit disassembly and conversion. MOX fuel fabrication, feed qualification, and gallium research experiments occur within TA-55 at PF-4 where plutonium experiments are routinely conducted. It is estimated that 15 kilograms of plutonium would be used for the MOX R&D projects. In addition, gram size laboratory samples (10 grams or less) are sent to the CMR facility for analytical testing in existing laboratories. For pit disassembly and conversion R&D projects, it is estimated that 100 kilograms of plutonium would be used at PF-4. These R&D projects do not require any upgrade or expansion of the facilities' existing environmental or safety systems.

Table 7–4. Site Summary of Plutonium Disposition-Related R&D Activities

Plutonium Disposition R&D Projects	Building Number (Administrative Limit)[a]	Quantity of Plutonium Estimated to be Used in These Projects[b]
ANL-E		
Immobilization	Building 205 (400 g)	< 300 g
INEEL		
MOX Fuel	ATR-TRA 670 (none)	41 g
	ATR-C (180 g)	49 g
	ATR Canal (365 g)	41 g
	Hot cells-TRA 632 (450 g)	49 g
	TTAF-TRA 603 (15 g)	49 g
	Radiography-TRA 635 (15 g)	41 g
	CPP 695 (15 g)	41 g
LANL		
MOX Fuel	TA-55/PF-4[c]	15 kg at PF-4
	CMR (2 kg)	Gram size samples at CMR
Pit Disassembly and Conversion	TA-55/PF-4[c]	100 kg at PF-4
LLNL		
Immobilization	Superblock[d]	FY97–20 kg
Pit Disassembly and Conversion		FY98–50 kg
ORNL		
MOX Fuel	Hot Cells-Building 3525 (320 kg)	15 g
	Shipping-Building 3036 (250 g)	15 g
	Storage-Building 7827 (151 kg)	15 g
	Hot Cells-Building 3525 (320 kg)	<5 g
	Shipping-Building 3036 (250 g)	<5 g
	Storage-Building 7827 (151 kg)	<5 g
PNNL		
Immobilization	Building 325 (2,759 g)	70 g
	Building 326 (18 g)	mg quantities
	Building 3720 (18 g)	3-5 g
SRS		
Immobilization	Building 773-A (2,000 g)	<200 g

[a] The limit on the amount of radioactive material allowed in a building at any one time is based on the site-specific safety analysis report; shown are the buildings that would be used for these R&D projects at a specific site.

[b] Amounts listed are cumulative totals for the listed R&D projects at a specific site. The quantities in the building at any one time would be less than the administrative limit.
[c] There are plutonium limits on a large number of individual operations at PF-4. These limits can change depending upon a number of criteria. The amount of plutonium used in the MOX fuel and pit disassembly and conversion R&D projects is limited by the same criteria used to control other plutonium operations currently conducted at PF-4.
[d] The Superblock is comprised of Buildings 331, 332, 334, and 335. MD plutonium activities are limited to Buildings 332 and 334. The safety analysis report for Building 334 further restricts the plutonium limit to 12 kg.
Source: Hodge 1997; Pearson 1997; Peko 1998a,b; Vienna 1997.

7.4.4 Lawrence Livermore National Laboratory

The R&D projects at LLNL, as shown in Tables 7–1 and 7–3, are related to immobilization technologies as well as pit disassembly and conversion technology. The R&D projects utilize existing laboratories within Buildings 332 and 334, which are part of the Superblock at LLNL. It is estimated that 20 kilograms and 50 kilograms of plutonium, in Fiscal Years 1997 and 1998 respectively, would be used for these R&D projects. These projects do not require any upgrade or expansion of the facilities' existing environmental or safety systems.

7.4.5 Oak Ridge National Laboratory

The R&D projects for surplus plutonium disposition at ORNL, as shown in Table 7–2, involves characterizing the problems associated with gallium. ORNL conducts evaluations of both irradiated MOX fuel and gallium-clad interactions. Once the material has completed its scheduled irradiation run at INEEL, it is shipped to ORNL where it is examined to determine the effects of gallium on prototypic MOX fuel. This work is accomplished in ORNL's hot cells, where irradiated material samples are routinely disassembled and examined. It is estimated that small amounts of plutonium, less than 5 grams to 15 grams, would be used for these R&D projects.

7.4.6 Pacific Northwest National Laboratory

The R&D projects for surplus plutonium disposition being conducted at PNNL, as shown in Table 7–1, are related to immobilization technologies. These projects occur within Buildings 325, 326 and 3720 where radioactive materials are routinely handled. It is estimated that a small amount of plutonium, between milligrams quantities and 70 grams, would be used for these R&D projects.

7.4.7 Savannah River Site

The R&D projects for surplus plutonium disposition being conducted at SRS, as shown in Table 7–1, are related to immobilization technologies. These projects are housed in Building 773-A. The quantities of plutonium and the types of experimental operations being performed fall within the experience of previous R&D programs conducted in Building 773-A. It is estimated that a small amount of plutonium, less than 200 grams, would be used in these R&D projects.

8.0 AGENCIES AND PERSONS CONSULTED

No outside agencies or persons were consulted during the preparation of this EA.

9.0 REFERENCES

Campbell, P., 1997, *Population Projections: States, 1995-2025*, P25-1131, U.S. Department of Commerce, Bureau of the Census, Washington, DC, May.

CEQ (Council on Environmental Quality), 1996, *Draft Guidance for Addressing Environmental Justice under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, May 24.

Chanin, D. and M. Young, 1997, *Code Manual for MACCS2: Volume 1, User's Guide*, Sandia National Laboratories, REport SAND97-0594, Albuquerque, NM, March.

DOC (U.S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM*, Bureau of the Census, Washington, DC, May.

DOE (U.S. Department of Energy), 1998a, *Draft Site-Wide Environmental Impact Statement on the Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238 Albuquerque Operations Office, Albuquerque, NM, April.

DOE (U.S. Department of Energy), 1998b, *FY98 Annual Operating Plan*, Revision 3, Office of Fissile Materials Disposition , Fissile Materials Disposition Program, Predecisional , Washington, DC, January 10.

DOE (U.S. Department of Energy), 1998c, *Federal Register*, "Record of Decision for the Department of Energy's Waste Management Program and Treatment of Non-waste Water Hazardous Waste," 63 FR 41810, Office of the Federal Register, Washington, DC., August 5.

DOE (U.S. Department of Energy), 1997a, *Federal Register,* "Surplus Plutonium Disposition Environmental Impact Statement," Notice of Intent, 62 FR 28009, Office of the Federal Register, Washington, DC, May 22.

DOE (U.S. Department of Energy), 1997b, *FY97 Annual Operating Plan*, Revision 2, Office of Fissile Materials Disposition, Fissile Materials Disposition Program, Washington, DC, March 1.

DOE (U.S. Department of Energy), 1997c, *Federal Register,* "Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement," 62 FR 3014, Office of the Federal Register, Washington, DC, January 14.

DOE (U.S. Department of Energy), 1997d, *Code of Federal Regulations*, "Occupational Radiation Protection," 10 CFR 835, Office of the Federal Register, Washington, DC, January 1.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *FY 97 R&D Plan for Immobilization Technologies*, Revision 2, Fissile Materials Disposition Program, Washington, DC, December 26.

DOE (U.S. Department of Energy), 1996c, *Federal Register*, "National Environmental Policy Act Implementing Procedures," 61 FR 36222, Office of the Federal Register, Washington, DC, July 9.

DOE (U.S. Department of Energy), 1994a, *DOE Handbook: Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities, Volume 1 - Analysis of Experimental Data, DOE/HDBK-3010 94,* Washington, DC, December.

DOE (U.S. Department of Energy), 1994b, *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee,* DOE/EA-0929, Oak Ridge, Tennessee, September.

DOE (U.S. Department of Energy), 1994c, *Radiological Control Manual*, DOE/EH0256T, Revision 1, Washington, DC, April.

DOE (U.S. Department of Energy), 1992, *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore*, DOE/EIS-0157, August.

Dunigan, P., 1998, DOE Richland Operations Office, Environmental Assurance, Permits and Policy Division, electronic facsimile to B. Nestor, Science Applications International Corporation, Germantown, MD, *NEPA Compliance Approval Form*, No: 22665, Project Title: Plutonium Immobilization Project, March 10.

Eberhard, C., 1998, Los Alamos National Laboratory, ESH-17, telephone communication with J. Eichner and B. Nestor, Science Applications International Corporation, Germantown, MD, *Los Alamos National Laboratory Tritium Release Data,* April 17.

Elmore, J., 1998, Oak Ridge Operations Office, electronic facsimile to B. Nestor, Science Applications International Corporation, Germantown, MD, Two Memoranda: *Contract DE-AC05-96OR22464, National Environmental Policy Act (NEPA) Categorical Exclusion (CX) for Mixed Oxide Fuel Gallium-Clad Interactions (2636X)*, DOE-approved CX March 6, 1998 and *Contract DE-AC05-96OR22464, National Environmental Policy Act (NEPA) Categorical Exclusion (CX) for Gallium-Cladding Compatibility Testing (2559X)*, DOE-approved CX May 19, 1997, March 9.

EPA (U.S. Environmental Protection Agency), 1997, *Code of Federal Regulations*, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," 40 CFR 61, Subpart H, Office of the Federal Register, Washington, DC, September 29.

Graf, J., 1998, Los Alamos National Laboratory, Radiation Protection Office, ESH Division, electronic mail to G. Gonzales, Los Alamos National Laboratory, ESH-20, *Average Worker Dose Technical Area-55*, March 31.

Grainger, D., 1998, DOE Savannah River Operations Office, electronic facsimile to B. Nestor, Science Applications International Corporation, Germantown, MD, *Plutonium Immobilization Research-Savannah River Documentation (for Categorical Exclusions),* February 24.

Green, D., 1998, DOE Chicago Operations Office, Argonne Group, electronic facsimile to B. Nestor, Science Applications International Corporation, Germantown, MD, *Environmental Evaluation Notification Form for Materials Disposition Program Activities at the Argonne National Laboratory-East for Categorical Exclusion under B3.6 (ARG-CX-047)*, February 24.

Hodge, S. Dr., 1997, Oak Ridge National Laboratory, electronic facsimile to J. Eichner, Science Applications International Corporation, Germantown, MD, *Estimated Quantity of Fissile Materials to be Used in MOX R&D Activities January 1997-Fall 1998 and Facility Administrative Limits for Oak Ridge National Laboratory and Idaho National Engineering and Environmental Laboratory,* August 27.

Irving, J., 1998, NEPA/Permitting Department, Lockheed Martin Idaho Technologies, electronic facsimile to B. Nestor, Science Applications International Corporation, Germantown, MD, *NEPA Document Approval Form and Environmental Checklist for the TRA Mixed Oxide (MOX) Fuel Irradiation Test Project for Categorical Exclusion under B3.6*, Project No.: TRA-97-009, February 23.

Jacobson, K., 1998, Los Alamos National Laboratory, electronic mail to J. Jacobson, Science Applications International Corporation, Los Alamos, NM, *1996 Americium 241 Emissions from Monitored Point Sources at LANL*, January 5.

Jacobson, K., 1997, *U.S. Department of Energy Report, 1996 LANL Radionuclide Air Emissions*, LA-13353-ENV, UC-902, Los Alamos National Laboratory, Los Alamos, New Mexico, August.

Johnson, P.E., D.S. Joy, D.B. Clark, and J.M. Jacobi, 1993, *HIGHWAY 3.1, An Enhanced Transportation Routing Model: Program Description, Methodology, and Revised User's Manual*, ORNL/TM-12124, Oak Ridge National Laboratory, Oak Ridge, TN, March.

Ladino, T., 1998, Los Alamos National Laboratory, ESH-20, Ecology Group, letter to D. Peko, DOE Office of Fissile Materials Disposition, MD-3, Washington, DC, *ARIES Interaction of Radioactive Materials from Adjacent Modules*, ESH-20/Ecol-98-0434, March 25.

LANL (Los Alamos National Laboratory), 1998, *Process Hazard Analysis ARIES - HYDOX Module*, LA-CP-98-3, Nuclear Materials Technology -6, Los Alamos, NM, February 9.

LANL (Los Alamos National Laboratory), 1997a, *LANL World Wide Web Site-Welcome*, Los Alamos, NM, October 28.

LANL (Los Alamos National Laboratory), 1997b, *Environmental Surveillance and Compliance at Los Alamos during 1996*, LA-13343-ENV, UC-902, Environment, Safety and Health Division, Los Alamos, NM, September.

LANL (Los Alamos National Laboratory), 1997c, *Process Hazard Analysis - ARIES Bisector Module*, LA-CP-97-243, Facilities Management Group, Nuclear Materials Technology-8, Authorization Basis Team for Advanced Technologies Group, Nuclear Materials Technology-6, Los Alamos, NM, September 30.

LANL (Los Alamos National Laboratory), 1997d, *Pit Disassembly and Conversion Facility Environmental Impact Statement Data Report - Pantex Plant,* Final Draft, LA-UR-97-2909, Los Alamos, NM, September 12.

LANL (Los Alamos National Laboratory), 1997e, *Process Hazard Analysis - ARIES Hydride/Dehydride Module*, Draft, LA-CP-97-244, Facilities Management Group, Nuclear Materials Technology-8, Authorization Basis Team for Advanced Technology, Nuclear Materials Technology-6, Los Alamos, NM, August 15.

LANL (Los Alamos National Laboratory), 1997f, *Process Hazard Analysis - ARIES Canning Module*, LA-CP-97-245, Facilities Management Group, Nuclear Materials Technology-8, Authorization Basis Team for Advanced Technology, Nuclear Materials Technology-6, Los Alamos, NM, July 8.

LANL (Los Alamos National Laboratory), 1997g, *Process Hazard Analysis - ARIES Nondestructive Assay Module*, LA-CP-97-246, Facilities Management Group, Nuclear Materials Technology-8, Authorization Basis Team for Advanced Technology, Nuclear Materials Technology-6, Los Alamos, NM, July 8.

LANL (Los Alamos National Laboratory), 1997h, *Process Hazard Analysis - Integrated Electrolytic Decontamination Demonstration*, LA-CP-97-242, Facilities Management Group, Nuclear Materials Technology-8, Authorization Basis Team for Nuclear Materials Management and Accountability Group, Nuclear Materials Technology-4, Los Alamos, NM, May 6.

LANL (Los Alamos National Laboratory), 1997i, *1996 Annual Report on Waste Generation and Waste Minimization Progress as Required by DOE Order 5400.1*, Los Alamos Environmental Stewardship Office, Los Alamos, NM, July 8.

LANL (Los Alamos National Laboratory), 1996a, *Environmental Surveillance at Los Alamos during 1995*, LA-13210-ENV, Environment, Safety and Health Division, Los Alamos, NM, October.

LANL (Los Alamos National Laboratory), 1996b, *Background Information for Site-wide Environmental Impact Statement Los Alamos National Laboratory, TA-55 Facility Report*, DOE Review Draft No. 2, Los Alamos, NM, Revision Date October 16.

NAS/NRC (National Academy of Sciences and National Research Council), 1990, *Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V*, Committee on the Biological Effects of Ionizing Radiation, Board of Radiation Effects Research, Commission on Life Sciences, Washington, DC .

Neuhauser, K.S., and F.L. Kanipe, 1993, *RADTRAN 4, Volume II: Technical Manual*, SAND89-2370, Sandia National Laboratories, Albuquerque, NM, August.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, NUREG-0170, Volume 1, Washington, DC, December.*

Peko, D. 1998a, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, telephone communication with J. Eichner and B. Nestor, Science Applications International Corporation, Germantown, MD, *Quantity of Plutonium Estimated to be Used in Immobilization R&D Projects at the Lawrence Livermore National Laboratory*, March 20.

Peko, D., 1998b, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, electronic mail to J. Eichner, Science Applications International Corporation, Germantown, MD, *Lawrence Livermore National Laboratory Estimated Fissile Material Use*, March 9.

Person, R., 1997, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, electronic mail to R. Hoffman, Science Applications International Corporation, Germantown, MD, *Immobilization R&D Actinide Use in FY97 and FY98 (for EA)* Regarding Argonne National Laboratory-East, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory, and Savannah River Site, September 25.

PNL (Pacific Northwest Laboratory), 1988, *GENII-The Hanford Environmental Radiation Dosimetry System*, PNL-6584, Richland, WA, December.

SNL (Sandia National Laboratories), 1997, *MACCS2-MELCOR Accident Consequence Code System*, SAND97-0594, Albuquerque, NM, March.

Vienna, J., 1997, Pacific Northwest National Laboratory, personal communication with R. Hoffman, Science Applications International Corporation, Germantown, MD, *Estimated Quantity of Plutonium to be Used in Immobilization R&D Activities January 1997-Fall 1998 and Building Administrative Limits,* October 9.

Sources of Additional Information

Kidinger, J., J. Darby, and D. Stack, 1997, *Technical Risk Assessment for the Department of Energy Pit Disassembly and Conversion Facility Final Report*, LA-UR-97-2236, Los Alamos National Laboratory, Los Alamos, NM, September.

LANL (Los Alamos National Laboratory), 1997, *Design-only Conceptual Design Report for Pit Disassembly and Conversion Facility*, Project No. 99-D-141, Facilities, Security and Safeguard Division, Los Alamos, NM, December 12.

10.0 ACRONYMS

ALARA	as low as reasonably achievable
ARIES	Advanced Recovery and Integrated Extraction System
ANL-E	Argonne National Laboratory-East
ATR	Advanced Test Reactor
CAP88	EPA dose assessment model
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research
CPP	Chemical Processing Plant
DOE	Department of Energy
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESH	Environment, Safety and Health
FFCA	Federal Facility Compliance Agreement
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
GENII	Hanford Environmental Radiation Dosimetry System
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HYDOX	hydride-oxidation process
INEEL	Idaho National Engineering and Environmental Laboratory
LANL	Los Alamos National Laboratory

LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
MACCS2	MELCOR Accident Consequence Code System 2 (computer code)
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MLLW	mixed low-level waste
MOX	mixed oxide
NA	not applicable
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PEIS	Programmatic Environmental Impact Statement
PF	Plutonium Facility
PNNL	Pacific Northwest National Laboratory
PrHA	Process Hazard Analysis
R&D	research and development
RCRA	Resource Conservation and Recovery Act
REA	regional economic area
RFETS	Rocky Flats Environmental Technology Site
ROD	Record of Decision
ROI	region of influence

SPD EIS	Surplus Plutonium Disposition Environmental Impact Statement
SRL	Special Recovery Line
SRS	Savannah River Site
SST	safe secure trailer
STAND	Serious Texans Against Nuclear Dumping of Amarillo
TA	Technical Area
TIGR	Thermally-Induced Gallium Removal
TRA	Test Reactor Area
TRU	transuranic
TTAF	Test Train Assembly Facility
WIPP	Waste Isolation Pilot Plant
WM PEIS	Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

11.0 CHEMICAL AND MEASUREMENT ABBREVIATIONS AND SYMBOLS

aCi	attocurie (one-quintillionth of a curie)
Am	americium
Ci	curie
g	gram
GaO	gallium oxide
HYDOX	hydride-oxidation
kg	kilogram (one-thousandth of a gram)
m^3	cubic meter
mCi	millicurie (one-thousandth of a curie)
mg	milligram (one-thousandth of a gram)
mrem	millirem (one-thousandth of a rem)
nCi	nanocurie (one-billionth of a curie)
pCi	picocurie (one-trillionth of a curie)
Pu	plutonium
PuO_2	plutonium dioxide
U	uranium
UO_2	uranium dioxide

12.0 GLOSSARY

Administrative Limit: The amount of radioactive material that is allowed to be in a DOE building at any one time. This administrative limit is based upon a site-specific safety analysis report.

Alloy: A homogeneous mixture of two or more metals.

Ambient Air: The surrounding atmosphere as it exists around people, plants, and structures.

Americium: Americium 241 is produced by the radioactive decay of plutonium 241. In addition to being an alpha-emitter, it is an emitter of gamma rays. Americium 241 has a half-life of 433 years.

Background Radiation: Ionizing radiation present in the environment from cosmic rays and natural sources in the earth; background radiation varies considerably with location.

Binder Materials: Organic additives used in the ceramic immobilization process to produce a pourable feed that promotes adhesion of the materials when compacted.

Ceramic: Non-metallic materials mixed to form a porcelain-like end-product; can include surplus plutonium.

Characterization: The determination of waste or residue composition and properties, whether by review of process knowledge, nondestructive examination or assay, or sampling and analysis.

Cladding: An external layer of material, in most cases metal, applied directly to nuclear fuel or other material to provide protection from a chemically reactive environment, to provide containment of radioactive products created during the irradiation of the composite, or to provide structural support.

Crew: The two individuals in the vehicle.

Criteria Pollutants: Six air pollutants for which national ambient air quality standards are established by EPA: sulfur dioxide, nitric oxides, carbon monoxide, ozone, particulate matter less than or equal to 10 microns in diameter, and lead.

Criticality: A state in which a self-sustaining nuclear chain reaction is achieved.

Curie: A unit of radioactivity equal to 37 billion disintegrations per second; also a quantity of any nuclide or mixture of nuclides having one curie of radioactivity.

Dose Equivalent: Dose equivalent is expressed in units of rem or sievert, where 1 rem equals 0.01 sievert. The dose equivalent to an organ, tissue, or the whole body would be that received from the direct exposure plus the 50-year committed dose equivalent received from the radionuclides taken into the body during the year.

Dosimeter: A small device or instrument (e.g., film badge or ionization chamber) carried by a radiation worker that measures cumulative radiation dose received during a given period of time.

Effective Dose Equivalent: The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health effects risk of the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides, and the effective dose equivalent due to penetrating radiation from sources external to the body.

Environmental Justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

Feed Materials or Feedstock: Refined uranium or thorium metal or their pure components in a form suitable for use in nuclear reactor fuel elements or as feed to uranium enrichment facilities.

Fissile Material: Any isotope capable of being split by thermal (slow) neutrons; the two primary fissile isotopes are uranium 235 and plutonium 239.

Gamma Rays: High-energy, short-wavelength electromagnetic radiation accompanying fission and emitted from the nucleus of an atom.

Glass: In this instance a borosilicate material in an amorphous mixture formed by melting silica and boric oxide together with the oxides of other elements, such as sodium; can be used to immobilize surplus plutonium.

Glovebox: An airtight box used to work with hazardous materials; vented to a closed filtering system, it includes lead-lined gloves attached inside of the box through which the worker is able to manipulate material and equipment.

Half-life: The time in which half the nuclei of a radioactive substance decay; this varies for specific radioisotopes from millionths of a second to billions of years.

High-Level Waste: The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation.

Highly Enriched Uranium: Uranium enriched in the isotope uranium 235 to 20 percent or above; a level above which uranium is considered fissile.

Homogeneous Approach: In terms of immobilization technologies, the approach that directly mixes the plutonium with the radiation barrier (i.e., HLW), rather than physically separating the plutonium from the HLW as in the can-in-canister approach.

Infrastructure: The basic facilities, services, and installations needed to support a plant or site, such as transportation and communication systems.

In-Pile Testing: Tests conducted in one of DOE's research reactors where test elements are irradiated to determine how materials respond in a nuclear reaction.

Isotope: An atom of an element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons (atomic number) but different numbers of neutrons and, therefore, different atomic masses.

Low-Enriched Uranium: Low-enriched uranium is enriched in the isotopic content of uranium 235, greater than 0.7 percent but less than 20 percent of the total mass, for use as light water reactor fuel.

Maximally Exposed Individual: A hypothetical person who could potentially receive the maximum dose of radiation as a result of normal operations or an accident at the site.

Mixed Oxide: A physical blend of uranium oxide and plutonium dioxide which can be used to fuel light water reactors.

Nuclide: The atomic nucleus and therefore, the number of protons, the number of neutrons, and the energy content.

Outfall: The discharge point of a drain, sewer, or pipe as it empties into a body of water.

Oxide: A binary compound of an element (such as plutonium) with oxygen.

Pathways: The paths or routes by which contaminants are transferred from a source to a receptor.

Person-rem: The sum of the individual doses received by a population segment.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially in a reactor by bombarding uranium with neutrons and can be used in the production of nuclear weapons. Plutonium has 15 isotopes with mass numbers ranging from 232 to 246. Weapons-usable plutonium consists mainly of plutonium 239, which has a radioactive decay half-life of 24,110 years.

Precursor Materials: The initial form of the ceramic feed materials used in the ceramic immobilization process.

Proliferation Resistance Tests: Tests to ensure that the final glass or ceramic matrix chosen for immobilization would assist in preventing the theft or diversion of excess fissile materials and the return of these materials to a form where they can be used in nuclear weapons.

Radionuclide: A radioactive element characterized according to its atomic mass and atomic number which can be man-made or naturally occurring. Radionuclides can have a long life as soil or water pollutants, and potentially mutagenic or carcinogenic effects on the human body.

Reactor-Grade Plutonium: Plutonium which contains greater than 19 percent plutonium 240.

Rem: Roentgen Equivalent Man (rem) is a unit of dose equivalent. Dose equivalent in rem is numerically equal to absorbed dose in radiation multiplied by a quality factor, distribution factor, and any other necessary modifying factor.

Risk: A quantitative or qualitative expression of possible loss that considers both the probability that a hazard would cause harm and the consequences of that event.

Risk Assessment: The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health, the environment, or both by the presence or potential presence and/or use of specific chemical or radiological pollutants.

Safe Secure Trailer: A specially designed semi-trailer which is used for the safe, secure transportation of cargoes containing nuclear weapons or special nuclear material.

Safety Analysis Report: A facility-specific safety document providing a concise but complete description and safety evaluation of a facility, its design, normal and emergency operations, potential accidents, predicted consequences of such accidents, and the means proposed to prevent such accidents or mitigate their consequences.

Sinter: A process whereby ceramic pellets are formed using a combination of heat and pressure. The process does not require the material to be heated to the point of melting the plutonium which may be present.

Spall: To break off chips, scales or slabs.

Stoichiometry: The methodology and technology by which the quantities of reactants and products in chemical reactions are determined.

Thermally-Induced Gallium Removal: A process for removing gallium impurities from plutonium recovered from pits through thermal treatment.

Tritium: A radioactive isotope of the element hydrogen with two neutrons and one proton, ^{3}H; it has a half-life of 12.5 years.

Uranium: A heavy, silvery-white metallic element , atomic number 92, with many radioactive isotopes. Uranium 235 is considered a fissile material. Another isotope, uranium 238, is transformed into fissionable plutonium 239 following its capture of a neutron in a nuclear reactor.

Vitrification: A treatment process that uses glass (e.g., borosilicate glass) to encapsulate or immobilize radioactive wastes or materials.

Weapons-Usable Fissile Material: Plutonium and highly enriched uranium in various forms (e.g., metals and oxides) that can be readily converted for use in nuclear weapons.

APPENDIX A. COMMENT RESPONSE

State of New Mexico
ENVIRONMENT DEPARTMENT
Harold Runnels Building
1190 St. Francis Drive, P.O. Drawer 26110
Santa Fe, New Mexico 87502-0110
(505) 827-2855
Fax: (505) 827-2836

GARY E. JOHNSON
GOVERNOR

MARK E. WEIDLER
SECRETARY

June 9, 1998

Bert Stevenson
U.S. Department of Energy
Office of Fissile Materials Disposition
Post Office Box 23786
Washington, D.C. 20026-3786

Dear Mr. Stevenson:

RE: PIT DISASSEMBLY AND CONVERSION DEMONSTRATION ENVIRONMENTAL ASSESSMENT AND RESEARCH AND DEVELOPMENT ACTIVITIES, PREAPPROVAL REVIEW; OFFICE OF FISSILE MATERIALS DISPOSITION, U.S. DEPARTMENT OF ENERGY; MAY 1998

The following transmits New Mexico Environment Department (NMED) staff comments concerning the above-referenced Environmental Assessment (EA).

The "proposed action" is to conduct a Pit Disassembly and Conversion Demonstration at the Los Alamos National Laboratory (LANL). Plutonium pits will be transported to New Mexico. Waste transport standards should be at least as protective as for other transuranic materials. Small amounts of transuranic waste, mixed low-level waste, and hazardous waste will be produced. Since most of LANL's waste processing capability and waste storage capacity has been committed, impacts at TA-55 and at the Low Level Waste Disposal Facility (TA-54), and the Radioactive Liquid Waste Treatment Facility (TA-50) should be considered. Small amounts of plutonium, americium, and tritium may be released to the atmosphere. Monitoring and control of these emissions should be demonstrated to be adequate and should be maintained. A number of more specific comments follow.

1. **Page 6, 3.0 PROPOSED PIT DISASSEMBLY AND CONVERSION DEMONSTRATION**

The EA mentions that pits would require tritium decontamination. This process, however, was not described at all in the text. What accidents could happen regarding this process? Could they be serious? We strongly recommend that these issues be discussed in, for example, section 6.1.4, and analyzed if they meet the appropriate criteria.

2. **Page 13, 5.3.3 Radiation Exposure**

According to 40 CFR Part 61.93 (b)(5)(iv): "In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2, and the sum of the fractions that result when each measured

A.1 Introduction

In compliance with DOE's NEPA regulations (10 CFR Part 1021), on May 8, 1998, DOE mailed Preapproval Review copies of the Pit Disassembly and Conversion Demonstration Environmental Assessment to the host state and host tribes in New Mexico for comment before DOE made a decision on its proposed action to operate an integrated pit disassembly and conversion demonstration process at LANL. Comments were to be submitted by June 8, 1998.

Following DOE's initiatives to foster stakeholder involvement in the NEPA review process, DOE also made this EA available to the public by posting it on the Office of Fissile Materials Disposition Home Page, available through the World Wide Web on the Internet. In addition, on May 8, 1998, DOE mailed a letter to 33 stakeholders in New Mexico notifying them of the World Wide Web availability of the EA, as well as its availability at DOE's public reading rooms in Albuquerque and Los Alamos, New Mexico. Comments from the public were asked for by June 8, 1998.

DOE received two comment documents (which are presented alongside DOE's response) from Dr. Gedi Cibas, Environmental Impact Review Coordinator for the New Mexico Environment Department (NMED) and Mr. Don Moniak, Program Director for Serious Texans Against Nuclear Dumping (STAND) of Amarillo, Texas.

A.2 DOE's Response to Comments

A.2.1 NMED Comments

Transportation

The commentor noted that as plutonium pits will be transported to New

Bart Stevenson
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concentration value is divided by the value in Table 2 for each radionuclide is less than 1[one]." This part of the regulation should be mentioned in the text and directly demonstrated for compliance.

3. **Page 19, 6.1.3 Radiological Impacts**

Does the second column of Table 6-1 indicate *annual or total* "Estimated Releases from Demonstration"? This should be made clear.

4. **Page 19, 6.1.3 Radiological Impacts**

The code GENII Version 1.485 should be referenced. The EA should indicate whether this code has been peer reviewed, verified and validated. Also, the document should mention whether the code has been approved (or not) for use by the U.S. Environmental Protection Agency (USEPA).

5. **Page 19, 6.1.3 Radiological Impacts**

The radiation worker dose was estimated to be 750 mrem/year. The EA should explain how this estimate was derived; for example, was it done by comparison of doses from similar operations, from calculations, etc.-- this should be stated directly in text or demonstrated.

6. **Page 22, 6.1.4 Accident Impacts**

The code MACCS2 should be referenced and the EA should explain why it was used; it should also indicate whether the code has been peer reviewed, verified and validated.

7. **Air Quality Comments**

The main air quality issue involves radioactive emissions to the air, which are regulated under 40 CFR Part 61 Subpart H. This federal regulation states that radioactive air emissions from the facility can only result in a maximum exposure of 10 millirem (mrem)/year to any member of the public, who is determined by looking at the nearest school, business, or residence to LANL, and is referred to as the Maximally Exposed Individual (MEI). The exposure to this MEI is calculated using the EPA model CAP88 and data gathered by monitoring equipment. As long as the total calculated dose to the MEI from the facility as a whole remains under the 10 mrem/ year cap, the facility is in compliance with the regulation.

Estimates of radioactive air emissions resulting from the demonstration project given in the EA are relatively small and unlikely to cause the facility to exceed its cap. This is consistent with the facts that 1) air from the building goes through a High Efficiency Particulate Air (HEPA) filter before leaving the building, which will trap most radioactive particles, and 2) most, generally over 90%, of the radioactive air emissions from LANL are generated at a different facility which is not involved in this project, the LANSCE facility. Also, if actual radioactive air emissions from this demonstration project exceed the anticipated amount, other activities at LANL can be scaled back so that the facility does not exceed the 10 mrem/year cap. This demonstration project should not cause the facility to violate 40 CFR Part 61 Subpart H regulation.

This EA, of course, applies only to the *demonstration project*, not the entire Surplus Plutonium Disposition Project. A Finding Of No Significant Impact (FONSI) for this EA would be for the

Mexico, waste transport standards should be at least as protective as for other transuranic materials. As stated in the EA, all shipments of plutonium pits and metal to LANL will be packaged in Department of Transportation-approved Type-B containers and transported on SSTs with escort vehicles. Type-B containers are tested to withstand a variety of extremely severe accidents and have been used for years to ship radioactive materials in the United States and around the world. To date, no Type-B container has been punctured or released any of its contents, even in actual highway accidents. With this strong packaging system and DOE's safe record in transporting such material, DOE believes that it can safely transport plutonium pits and metal in Type-B containers to LANL. In addition, a higher level of security results in the use of SSTs and security escort vehicles, all of which increase the level of safety.

Waste Storage Capacity

The commentor noted that small amounts of TRU, MLLW and hazardous waste will be produced by the proposed demonstration. Since most of LANL's waste processing capability and waste storage capacity has been committed, impacts at TA-55, the Low-Level Waste Disposal Facility (TA-54), and the Radioactive Liquid Waste Treatment Facility (TA-50) should be considered.

The expected annual volumes of TRU waste, MLLW, LLW, and hazardous waste that could be generated by the Pit Disassembly and Conversion Demonstration are listed in Table 6–8 of the EA. Table 6–8 also compares these expected annual waste volumes to the current annual waste volumes generated at LANL for the same waste streams and the disposal methods.

The expected annual waste volumes from the proposed demonstration are not anticipated to have any measurable impact on LANL's waste processing capability, storage capacity, or disposal areas. The annual volume of TRU waste ($2m^3$) expected to be generated by the demonstration is equivalent

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demonstration, not the overall project. According to section 1.1 of the EA, a full scale Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS) is currently in preparation and should be available for separate review. Monitoring data gathered on actual radioactive air emissions measured during the demonstration project should be used to revise the estimated releases for the SPD EIS if they become available before the EIS is completed.

We appreciate the opportunity to comment on this document, please let us know if you have any questions on the above.

Sincerely,

Gedi Cibas, Ph.D.
Environmental Impact Review Coordinator

NMED File No. 1172ER

to approximately ten 55-gallon drums or less than one drum of TRU waste a month. This small volume of waste will not pose any problems for the waste handling activities currently conducted at TA-55 and TA-54. This TRU waste would be disposed of at the WIPP facility.

As indicated in Table 6–8, less than 150 grams of MLLW are expected to be generated annually during the demonstration. This small amount of material is much less than one 55-gallon drum and could easily be handled consistent with existing waste handling operations at TA-55 and TA-54. This waste would be stored onsite pending the availability of offsite commercial treatment, and would not be expected to affect the Low-Level Waste Disposal Facility located at TA-54.

The amount of solid LLW anticipated to be generated from the demonstration is projected to be $3m^3$ or about fifteen 55-gallon drums annually. This equates to about a 0.6 percent increase in the current annual volume of LLW generated at LANL. All LLW would be disposed of at the Low-Level Waste Disposal Facility located at TA-54. This small percentage of increase would not adversely affect the disposal area or have a major impact on the amount of space available for LLW disposal. In addition, less than 100 liters (26 gallons) of liquid LLW is expected to be generated as a result of the proposed action, no adverse impacts on the Radioactive Liquid Waste Treatment Facility at TA-50 are anticipated.

The proposed demonstration would increase the current amount of hazardous waste generated at LANL by less than 0.1 percent. All hazardous wastes would be treated and disposed of offsite. The anticipated volume of hazardous waste that would result from the proposed action is not expected to have any impact on LANL's waste processing capability, waste storage capacity, or waste disposal areas.

Air Sampling Network

As small amounts of plutonium, americium, and tritium may be released to the atmosphere, the commentor indicated that the monitoring and control of these emissions should be demonstrated to be adequate and should be maintained. The radiological air sampling network at LANL is designed to measure environmental levels of airborne radionuclides, including plutonium, americium, and tritium, that may be released from LANL operations. During 1996, ambient air sampling for airborne radioactivity was conducted at more than 50 locations on a regional, pueblo, perimeter, or onsite basis. Because maximum concentrations of airborne releases of radionuclides would most likely occur onsite, more than 30 stations are within LANL's boundary. During 1996, air monitoring network data indicated that at all locations, air concentrations were well below applicable limits and guidelines. Within its Air Quality Group, LANL has a Quality Assurance Program which monitors the air sampling system. In addition, the stacks in TA-55 are continually monitored in accordance with 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities."

Tritium Decontamination

The commentor noted that tritium decontamination was mentioned in the EA but not described, and also asked what accidents could happen regarding this process. At LANL, pits that require tritium decontamination are processed in the SRL located at TA-55. The actual removal of the tritium contamination occurs in a glovebox environment so as to recover as much tritium as is reasonably possible and to minimize worker exposures and the release of tritium to the environment.

The impacts from routine operations, as well as accidents, associated with SRL operations have been considered in the *Draft LANL Site-Wide EIS*

(DOE/EIS-0238). As indicated in Section 3.0 of the Final EA, the proposed demonstration would not result in an increase in the number of pits processed through the SRL and therefore would not increase total tritium releases or any other impacts associated with SRL operations. The expected tritium releases are reported in the Final EA, and were considered in the determination of the health effects presented in Section 6.0. The accidents addressed in this EA are considered to be bounding in terms of radiological impacts for all aspects of the demonstration and therefore, specific accidents associated with the tritium decontamination process are not discussed in the EA.

Radiation Exposure

In response to the comment regarding compliance with 40 CFR Part 61.93(b)(5)(iv) for radionuclide emissions from DOE facilities, a new Table 6–2 has been added to the Final EA which demonstrates compliance with this regulation.

Radiation Impacts

Table 6–1 in the Final EA has been revised to clearly reflect that the estimated releases from the demonstration shows annual data.

The GENII (Version 1.485) computer code has been peer reviewed, verified, and validated and approved for use by U.S. EPA. This information has been included in the Final EA.

This estimated radiation worker dose was developed based on several factors. Since the proposed Pit Disassembly and Conversion Demonstration has never been performed before, the worker dose could not be based on actual or historical worker doses. Therefore, the worker dose used in the EA had to be estimated based on a review of worker doses from similar operations, process knowledge regarding amounts of materials and potential

for worker exposure, and consideration of planned operational features designed to reduce worker exposure. As shown in Table 6–4 of the EA, similar pit disassembly activities have resulted in average worker doses of 456 mrem/year. Although improvements planned for this demonstration are expected to result in reductions in average worker doses, in order to provide a conservative estimate, a radiation worker dose of 750 mrem/year was used. This information has been added to the Final EA. As stated in the EA, doses to individual workers would be kept to minimal levels by current administrative policies, exposure monitoring, and the ALARA program.

Accident Impacts

The MELCOR Accident Consequence Code System 2 (MACCS2) computer code was used for the Process Hazard Analyses referenced in this EA because it is a superior dose consequence analysis code. The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared a series of reports to advise the Federal government on the health consequences of radiation exposures. The latest of these reports, *Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V*, published in 1990, provides the most current estimates for excess mortality from leukemia and cancers other than leukemia expected to result from exposure to ionizing radiation (NAS/NRC 1990). The BEIR V models were developed for application to the U.S. population and are implemented in the radiological consequence model (MACCS2) used in the accident analyses. MACCS2 employs methodology that allows the user to account for the source term contribution of short-term resuspension of deposited material, uses an entire year's worth of actual LANL weather and report the mean value and the distribution of values accounts for the integrated population exposure (and the resulting latent cancer fatality risk) from the LANL workforce population, and uses actual LANL meteorology. In addition to *ad hoc* verification efforts of beta-test user groups, the University of New Mexico has completed a formal independent verification study of the MACCS2 code package. The results of

this verification study will be published in a forthcoming report. This information has been included in the Final EA.

Air Quality

Comments on air quality support the analysis provided in the EA.

Author: dm4stand@igc.apc.org_at_internet at x400PO
Date: 6/8/1998 9:59 PM
Priority: Normal
TO: Howard Canter at NS-FOR2
CC: Bert Stevenson at NS-FOR5
Subject: Comments on LANL EA Pgs 1-7, also faxed
X-Sender: dm4stand@pop.igc.org

June 8, 1998

Howard Canter
Acting Director
Office of Fissile Materials Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Mr. Canter:

Following are Serious Texans Against Nuclear Dumping (STAND) of Amarillo's comments on the Department of Energy's (DOE) May 1998 "Pit Disassembly and Conversion Demonstration Environmental Assessment (PDCD-EA) and Research and Development Activities," preapproval review. The PDCD-EA analyzes the effects of a proposed demonstration project at the Los Alamos National Laboratory (LANL) involving the disassembly of 250 surplus plutonium pits and converting the plutonium metal to an unclassified form suitable for long-term disposition and international inspection. DOE also proposes to convert 80 kilograms of "clean" plutonium metal to plutonium oxide using the same processes.

STAND considers the PDCD-EA to be an insufficient NEPA document and expects DOE to analyze all plutonium pit disassembly and conversion alternatives in an Environmental Impact Statement (EIS). STAND believes that the information contained in the PDCD-EA is insufficient for DOE to issue a Finding Of No Significant Impact (FONSI). DOE must either complete a full environmental impact statement (EIS) for this demonstration project or, more preferably, incorporate this proposed action into the Surplus Plutonium Disposition Environmental Impact Statement (SPDEIS) to which the PDCD-EA is currently tiered. STAND requested this latter action during the scoping period for the SPDEIS.

An Environmental Impact Statement is necessary because:

I. DOE is proposing the wrong action. (See Background, Page 2).

II. DOE must Incorporate all available information about plutonium disassembly and conversion processes into its NEPA process and documents. The public should be fully informed as to what is actually being proposed, the actual range of impacts and risks from proposed activities, and the technical uncertainties involved with the proposed plutonium processing technologies.
(See Background, Page 3).

III. There will be significant direct, indirect, and cumulative effects if the proposed action is implemented, and the National Environmental Policy Act (NEPA) requires DOE to conduct an EIS if the proposed action will result in significant effects on the environment. (See Background, Page 4).

IV. DOE has not provided, as required by NEPA, "sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact." (40CFR1508.9.(a).(1)).
(See Background, Page 5)

A. The PDCD-EA does not contain, as required by NEPA, a discussion of the alternatives
that are available to disassemble plutonium pits and convert plutonium metal

A.2.2 STAND Comments

The commentor considers the Pit Disassembly and Conversion Demonstration EA to be an insufficient NEPA document and advocates an approach whereby DOE would analyze all alternatives for disassembling pits and converting plutonium metal in an EIS. The commentor further believes that the information contained in this EA is insufficient for DOE to issue a FONSI.

DOE believes that it has taken the correct NEPA approach with regard to the action proposed in this EA. DOE is proposing a limited scope demonstration to test an integrated pit disassembly and conversion process on a relatively small sample of plutonium pits and metals. In compliance with DOE's NEPA regulations (10 CFR Part 1021), the EA discusses the no-action alternative in addition to the proposed action. DOE also considered other alternatives but determined that they were not reasonable and therefore, did not analyze them further. In response to this comment, Section 4.0 of the EA has been modified to more fully explain the consideration given other alternatives. Based on the analysis in the Final EA, DOE will make a decision whether to issue a FONSI or to prepare an EIS for the proposed demonstration.

STAND Comment I. DOE is proposing the wrong action.

The commentor maintains that DOE has taken the wrong action in proposing to convert plutonium pits to a form suitable for MOX fuel use in the EA, rather than determining the best way to disassemble pits. As stated in the EA, DOE is proposing an integrated demonstration project that would convert plutonium metal to an oxide form and place this material into storage until a decision is made on the ultimate disposition strategy, both MOX fuel and immobilization. The resulting plutonium dioxide will be suitable for use in either immobilization or MOX fuel. Because this material would be stored within classified areas of TA-55, it is not DOE's plan to place this material under international safeguards as part of this demonstration. However,

to a declassified form suitable for both long-term disposition and international inspections and safeguards.

B. The PDCD-EA does not contain a sufficient analysis of the full range of activities actually being proposed at LANL.

V. The PDCD-EA does not meet DOE policy "to follow the letter and spirit of NEPA; comply fully with the CEQ regulations, and apply the NEPA review process early in the planning stages for DOE proposals." (See Background, Page 12)

BACKGROUND

I. DOE is proposing the wrong action

In the PDCD-EA, DOE has proposed the wrong action because it proposes to convert plutonium pits to a form suitable for MOX fuel use, and it proposes to demonstrate a technology when it should propose to solve a problem. DOE should be determining the best way--with the least risks, hazards, and impacts--to disassemble plutonium pits and convert the plutonium metal into a demilitarized form suitable to meet the specifications for:

? Proposed surplus plutonium disposition activities involving a range of alternatives for immobilizing plutonium as a waste form

? Safe, secure plutonium storage that can be put under international inspections prior to disposition or during long-term storage if disposition proves unfeasible.

? Proposed surplus plutonium disposition activities involving reactor options such as MOX fuel fabrication and utilization (although STAND does not support the MOX option)

DOE should conduct this analysis because the PDCD-EA is tiered, under the National Environmental Policy Act (NEPA), to DOE's January, 1997 Record of Decision (ROD) for the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (SD-PEIS), which is the binding NEPA document presently addressing DOE's surplus plutonium disposition program.

DOE considers the plutonium pit disassembly and conversion activities proposed for LANL as necessary "front-end" processes for its surplus plutonium disposition program. DOE is currently analyzing whether to build and operate a full-scale Plutonium pit Disassembly and Conversion Facility (PDCF) at one of four DOE-owned sites as part of its Surplus Plutonium Disposition Environmental Impact Statement (SPDEIS). The resulting experience from the proposed demonstration project at LANL would, according to DOE, "be applied to expedite the design of the production disassembly and conversion facility should it be decided to construct this facility in the SPD EIS ROD."

A full scale PDCF would process--using presently undemonstrated and even untested technologies--up to 12,500 plutonium pits and 31.8 metric tonnes of plutonium over a planned 10-year period. Since the proposed demonstration project is integral to the success of a probable proposed PDCF, which would be a first-of-its-kind facility, the more stringent application of NEPA procedures governing actions without precedent (40CFR1501.4.(e).(2).(ii)) should be applied in this case.

II. DOE must use all available information

DOE must incorporate all available information about plutonium disassembly and conversion processes into its NEPA process and documents. The public should be fully informed as to what is actually being proposed, the actual range of impacts and risks from proposed activities, and the technical uncertainties involved with the proposed plutonium processing technologies. Since the January 1997 decision on the SD-PEIS, DOE has made considerable changes that are not reflected in the Record of Decision, and is obligated to use this opportunity to address these changes and provide a clear picture of

this material would be made available for international safeguards when it arrives at the final disposition site.

The commentor maintains that, "the more stringent application of NEPA procedures governing actions without precedent" should be applied in this case. However, it is DOE's position that this is not the situation with regard to the proposed action in this EA. For a number of years, LANL has had a capability to disassemble pits and convert the plutonium to a form that could be used for a variety of purposes. The equipment needed to accomplish this work was in existence before the start of the plutonium disposition program. LANL in recent years assembled this capability into a system called ARIES using components and equipment that were drawn from several other DOE programs (e.g., pit surveillance). These programs were addressed in the 1979 *LANL Site-Wide EIS* (DOE/EIS-0018). The equipment to be used for the proposed demonstration addressed in this EA would use some parts of the ARIES capability, other existing equipment/capacities, plus new equipment that was developed at other sites.

STAND Comment II. DOE must use all available information.

The commentor makes reference to two documents that he believes should have been included in the EA analysis. Both of these documents were prepared to assist DOE in planning and procurement efforts associated with design, construction, and operation of a full-scale pit disassembly and conversion facility. Neither document was used in preparing the information used in the EA because the information presented in these documents is not specific to the demonstration project as it would be set up within TA-55 at LANL. The information used in preparing the EA was specific to processes anticipated to be used in the demonstration at LANL, most specifically hazards analyses that are unique to TA-55. None of the information presented in the two reports cited contradicts information presented in the EA or would be expected to result in additional impacts to the environment beyond those

its proposed actions and ongoing activities.

A. In an Environmental Impact Statement, DOE must incorporate key documents governing its plutonium disposition program. The analyses in the PDCD-EA and related NEPA documents fail to address the fact that DOE is also presently implementing a procurement process for the design, construction, and possible operation of a full scale plutonium pit disassembly facility. Two documents related to the procurement process that are uncited and not referenced in the PDCD-EA, yet provide considerably more accurate and comprehensive information are:

? Los Alamos National Laboratory and Fluor Daniel, Inc. 1997. Design-Only Conceptual Design Report for the Pit Disassembly and Conversion Facility. Project No. 99-D-141. Prepared for the DOE Office of Fissile Materials Disposition. December 12, 1997. (PDCF Design Report)

? Kidinger, John, ARES Corporation, John Darby and Desmond Stack, Los Alamos National Laboratory. 1997. Technical Risk Assessment for the Department of Energy Pit Disassembly and Conversion Facility Final Report. September, 1997. LA-UR-97-2236. (TRA or Technical Assessment)

B. An EIS should also address the numerous issues and activities discussed during DOE's May 20-21, 1998 MOX Industry Conference in Atlanta, Georgia. The most important is the fact that LANL is prepared to begin an "initial integrated 40-pit demonstration" of the ARIES process to demonstrate throughput and processes on seven pit types. This 40-pit demonstration is reportedly planned to begin in June, 1998. DOE must address whether existing NEPA documentation adequately addresses ongoing plutonium pit disassembly and conversion activities at LANL and Lawrence Livermore National Laboratory.

III. DOE must identify and analyze significant effects

There will be significant direct, indirect, and cumulative effects if the proposed action is implemented, and the National Environmental Policy Act (NEPA) requires DOE to conduct an EIS if the proposed action will result in significant effects on the environment.

A. The most significant direct effects of the proposed action will be airborne releases of radio nuclides will occur at a site with previous violations of the Clean Air Act and where existing compliance with the Clean Air Act is still being determined through an independent audit of the site. According to the PDCD-EA, routine releases of tritium during normal operations are expected to be as high as 69 curies per year. DOE only analyzed these effects in relation to other polluting activities at LANL and in relation to background exposure to other radionuclides.

DOE also failed to report known sources of air pollution that will result from the proposed action. Most importantly, DOE failed to identify and address beryllium air emissions. The PDCF Design Report states that, "the National Emissions Standards for Hazardous Air pollutants (NESHAP's) are applicable to the PDCF, specifically regulating emissions from beryllium and radionuclides to the ambient air, and that "An application for approval of construction or modification of an existing source is mandatory for the owner or operator of a beryllium or radionuclide operations."

In its 1994 Environmental Checklist for ARIES, LANL wrote that, "Beryllium is handled in the PDCF as relatively large pieces. The pit cutting operations will make beryllium chips and turnings, but these are relatively large particles not easily entrained." However, the ARIES EC also contained the statement that, "the expected emissions are within the quantity allowed under the current beryllium permit for TA-55-4."

B. The most significant indirect effect of the proposed action is the probable construction and operation of a Category I plutonium processing facility, the PDCF. The parameters and final processes of the PDCF will be determined by the results of the proposed action. According to demonstration project personnel at LANL, the data from the ARIES demonstration is "needed to support PDCF design." In the PDCD-EA, DOE is actually proposing an action with national implications.

presented in the EA. However, these reports do present additional information that is beyond the scope of this EA, but may be of interest to the public. Therefore, they have been added to the Final EA as sources of additional information.

The commentor also refers to a meeting held in Atlanta, in May 1998, during DOE's 1998 MOX Industry Conference at which LANL personnel referred to a 40-pit demonstration that was planned to begin in June 1998, and the commentor questions whether existing NEPA documentation adequately addresses these activities. Any references to a 40-pit demonstration have been superseded by this EA. The 40-pit demonstration referred to at the Atlanta meeting is now part of the 250-pit demonstration analyzed in this EA. The 250-pit demonstration will not begin until a decision has been made by DOE based on the information presented in this EA.

STAND Comment III. DOE must identify and analyze significant effects.

The commentor states that "There will be significant direct, indirect, and cumulative effects if the proposed action is implemented. . . ." As evidence of this statement, it is stated that the most significant direct effect will be the "airborne release of radio nuclides." The EA presents detailed analysis of all expected airborne releases of radionuclides, including routine releases of tritium, and the potential impacts of these small releases on the population and environment surrounding LANL.

The commentor makes reference to a 1994 analysis performed by LANL which referred to the possibility of airborne releases of beryllium, a hazardous air pollutant. This information was considered in preparing the EA but subsequent analysis from LANL has indicated that there will not be any airborne releases of beryllium. The beryllium in the process will include large pieces and cuttings if a lathe is used to bisect the pits. These cuttings will be large enough that they will not become airborne. No grinding will be done

C. The most significant cumulative effect is the effect on LANL's plutonium stabilization and packaging program. By allocating space and priorities for this project in LANL's plutonium processing facilities (Technical Area 55) DOE will further contribute to delays in LANL's plutonium stabilization and packaging program. According to the Government Accounting Office, "competing priorities for site funding, staff, and equipment have caused delays" at LANL in the Department of Energy's ability to meet milestones in its plutonium stabilization and packaging commitments. LANL's continued failure to meet DOE's commitment to safe long term storage of plutonium that is now being stored below DOE standards would constitute an unnecessary risk.

IV. DOE should sufficiently analyze the proposed action

The plutonium pit disassembly and conversion documents cited in Section II contain numerous references to alternatives not discussed in the PDCD-EA, and to processes not analyzed in the PDCD-EA.

A. The PDCD-EA does not contain, as required by NEPA, a discussion of the alternatives
that are available to disassemble plutonium pits and convert plutonium metal to a declassified form suitable for both long-term disposition and international inspections and safeguards.

In related NEPA documents, DOE has never evaluated the range of options available for disassembling plutonium pits and converting the plutonium in the pits to meet storage and disposition objectives. Instead, DOE chose a plutonium pit disassembly and conversion process (ARIES) that was not originally designed to produce materials suitable for disposition technologies, and which Industry considers a controversial technology. By pursuing this approach to plutonium pit disassembly and conversion, DOE has been in violation of NEPA for failing to conduct an analysis of the full range of alternatives for demilitarizing plutonium pits.

In an Environmental Impact Statement, DOE must:

1. Analyze the full range of technological options that are available to disassemble plutonium pits and convert plutonium metal to a declassified form suitable for both long-term disposition and international inspections and safeguards.

2. Analyze the range of technical options that have been addressed in other DOE and contractor analyses. In its Technical Risk Assessment (TRA) for the PDCF, DOE contractors evaluated three options for plutonium pit disassembly and conversion:

? The Baseline Option which would require processing of whole pits at the PDCF but not pit parts and plutonium not associated with pits; production of both metal and oxide by the PDCF; and the only contaminants of concern for MOX fuel that would be removed is gallium.

? The MOX Grade Oxide Option which would require processing of all plutonium pits and plutonium not associated with pits; production of both metal and oxide; production of plutonium oxide that will be of MOX fuel quality that will involve removing other contaminants such as americium-241; and processing to stabilize and recover materials from classified internal parts. This option appears to most closely resemble the Design-Only Conceptual Design Concept for the PDCF and the presentations made by LANL personnel at the MOX industry conference in Atlanta.

? The Metal-Only Option in which only "nonproblem pits will be processed and the product will be metal only, with no oxide produced." This option has not been identified in the design only design concept or the PDCD-EA.

Both the MOX and Baseline Options involve the use of the HYDOX process, even though the Technical Risk Assessment reported, "significant disagreement among technical persons as to whether HYDOX is required and whether or not HYDOX is the preferred technique when producing plutonium oxide." The report

which could cause small pieces of beryllium to become airborne. The beryllium, in solid form, will be disposed of as low-level or TRU waste and has been included in the waste projections included in the EA. A statement has been added to the Final EA regarding the airborne release of beryllium to ensure that the EA addresses this issue.

As an indirect effect of the proposed action, it is inferred that the decision to proceed with the demonstration will lead to the probable construction and operation of a full-scale pit disassembly and conversion facility. The construction of a full-scale facility is currently being analyzed in the SPD EIS being prepared by DOE. A decision to build a full-scale facility will be made by DOE based on the information presented in the SPD EIS. The information gathered from this demonstration, should the decision be made to go forward, will be used to supplement information developed to support the construction of a full-scale facility if it is decided to build such a facility.

The commentor states a concern about how the proposed action will impact the space and priorities of other work in TA-55. DOE evaluated the impact of the proposed demonstration on TA-55 as part of the EA and concluded that the demonstration would not adversely impact the ability to continue other high priority activities that are ongoing and need to be completed in this facility.

STAND Comment IV. DOE should sufficiently analyze the proposed action.

The commentor maintains that DOE does not discuss all alternatives and processes available to disassemble plutonium pits and convert plutonium metal to a declassified form and calls for the preparation of an EIS for this purpose. By referencing the documents cited in Comment II, the commentor is referring to the full-scale pit disassembly and conversion facility being studied by DOE in the SPD EIS. In compliance with DOE's NEPA

further stated that, "many of the pits, perhaps as many as 80%, can bypass the hydride/dehydride (conversion to metal) module as the plutonium metal can be mechanically separated from the pits."

3. Analyze the various options involved with "aqueous" processing, also known as reprocessing and "chemical purification," that DOE has repeatedly left open as an option to thermal processes. At the May 20-21, 1998 MOX Industry Conference in Atlanta, considerable objections were raised to the proposed plutonium conversion processes by members of consortiums seeking to design, construct, and operate a MOX fuel fabrication facility. DOE has repeatedly cited aqueous processes as an option to produce MOX fuel feedstock if the proposed thermal processes are not demonstrated to be feasible to meet this objective. LANL recently identified "aqueous derived oxide" as another "near future" source of PuO2 at the Atlanta MOX conference.

4. Identify and analyze the range of alternatives for a final product from plutonium pit disassembly and conversion.

DOE should identify and analyze the different requirements-- in terms of activities, hazards, impacts, and risks?-between the various plutonium end-products that could result from plutonium pit disassembly and conversion. For example, the alternative of gallium removal is not discussed in the context of immobilization. The various end products include:

? plutonium oxide suitable for use in Mixed Oxide (MOX) fuel
? plutonium oxide suitable for use in the Ceramification Can-In-Canister variant of immobilization.
? plutonium oxide suitable for both storage and disposition
? plutonium metal and/or oxide suitable for storage
? plutonium metal suitable for storage while awaiting conversion for disposition

B. The PDCD-EA does not contain a sufficient analysis of the full range of activities actually being proposed at LANL.

According to NEPA, DOE is required to provide "high quality" environmental information to "public officials and citizens before decisions are made." (40CFR1500.1.b) and that contains "accurate scientific analysis, expert agency comments, and publics. DOE is required to "wherever feasible, explain technical, scientific, or military terms or measurements using terms familiar to the general public." (10CFR1021.301.(a))

The analysis in the PDCD-EA is in clear violation of NEPA requirements to provide accurate, concise, and comprehensive information to the public, and the complexities of the proposed action would best be addressed in an EIS. DOE's description and analysis of the proposed action is misleading and inaccurate, and is contradicted by other pertinent agency and contractor documentation. Whereas DOE presents the proposed action as an already-integrated process, in reality the plutonium disposition and conversion demonstration process consists of several processes that are at various stages of development, for which there are varying stages of experience and expertise, and for which there are varying levels of technical uncertainty and risk.

In an Environmental Impact Statement, DOE should fully describe the proposed action. DOE fails to provide sufficient details on the processes involved in plutonium pit disassembly and conversion, and presents a misleading description of the demonstration program This insufficiency is epitomized by the fact that key components of the plutonium pit disassembly and conversion process being demonstrated?such as ARIES (Advanced Recovery and Integrated Extraction System)?are never addressed by name in the PDCD-EA, and several processes that would be involved in a full scale PDCF are not discussed or analyzed (Table 1).

regulations (10 CFR Part 1021), the EA discusses the no-action alternative in addition to the proposed action. DOE also considered other alternatives but determined they were not reasonable and therefore, did not analyze them further. Section 4.0 of the Final EA has been revised to present a discussion of the potential options considered by DOE but determined not to be reasonable alternatives for the proposed demonstration.

The commentor identifies (see Table 1 of the comment letter: Plutonium pit disassembly and conversion steps and processes) a number of "processes and activities identified as part of plutonium pit disassembly and conversion program" and indicates whether impacts and risks for these processes and activities are discussed and analyzed by DOE in the EA.

The following areas are considered inadequately covered in the EA by the commentor:

- Packaging Pits for Transportation. Most of the plutonium, in the form of pits or metal, to be used in the demonstration would be taken from storage at LANL. If there is a need to test additional types of pits, they will be shipped from Pantex or RFETS. Additional plutonium in the form of metal would be shipped, if needed, from INEEL, SRS, or LLNL. The movement of plutonium pits from other DOE sites to LANL has already been covered by various NEPA documents to support a number of DOE programs. For example, the *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* and the *Draft LANL Site-Wide EIS* (DOE/EIS-0238) cover the transportation of pits from Pantex to LANL for the purpose of pit surveillance. The level of risk, therefore, is well known and documented.

The processes that are involved in plutonium disassembly and conversion, as they have been described in more accurate and comprehensive publications and forums, and as they should be addressed in an Environmental Impact Statement, are as follows:

1. Transportation of Plutonium Pits between DOE sites, including packaging of pits at DOE sites.

DOE did conduct an assessment of transportation risks in the PDCD-EA but did not analyze or describe the impacts and risks of repackaging plutonium pits at other DOE sites to prepare for shipment to LANL. DOE also did not cite a Process Hazards Analysis for these activities in the PDCD as it did with other processes. In an EIS, DOE should address the following:

a. The effects of transporting plutonium pits on other proposed shipments. At this time, the only containers certified for transporting plutonium pits are "FL" containers. There are presently only about 300 FL containers available to DOE for intersite shipping of plutonium pits. Tritium contaminated FL containers have to be decontaminated before re-use.

Don Moniak
Program Director
STAND of Amarillo
7105 W. 34th Avenue, Suite E
Amarillo, TX 79109
dm4stand@igc.apc.org
806-358-2622
806-355-3837 (FAX)

- Pit Receiving and Staging. This operation is routinely accomplished within TA-55 and is covered in the *Draft LANL Site-Wide EIS*. However, the dose associated with receiving and staging the pits that will be used in the proposed demonstration has been included in the projected dose to involved workers for this EA.

- Special Recovery Line. At LANL, pits that require tritium decontamination are processed in the SRL located at TA-55. The actual removal of the tritium contamination occurs in a glovebox environment so as to recover as much tritium as is reasonably possible and to minimize worker exposures and the release of tritium to the environment. The impacts from routine operations, as well as accidents, associated with SRL operations have been considered in the *Draft LANL Site-Wide EIS*. As indicated in Section 3.0 of the Final EA, the proposed demonstration would not result in an increase in the number of pits processed through the SRL and therefore would not increase total tritium releases or any other impacts associated with SRL operations. The expected tritium releases are reported in the Final EA, and were considered in the determination of the health effects presented in Section 6.0. The accidents addressed in this EA are considered to be bounding in terms of radiological impacts for all aspects of the demonstration and therefore, specific accidents associated with the tritium decontamination process are not discussed in the EA.

- Gallium Removal. The commentor is concerned that this process was analyzed in the EA "strictly in the context of meeting plutonium dioxide specifications for MOX fuel fabrication." As stated in the EA, the plutonium dioxide that will be produced in the demonstration must be able to be used in MOX fuel or in the immobilization process. In order to help ensure this, the gallium removal process is being tested during this demonstration. No testing of the effect

Author: dm4stand@igc.apc.org_at_internet at x400PO
Date: 6/8/1998 9:59 PM
Priority: Normal
TO: Howard Canter at NS-FOR2
CC: Bert Stevenson at NS-FOR5
Subject: EA comments pgs 8-15.
X-Sender: dm4stand@pop.igc.org

b. Unreported hazards and risks associated with the repackaging of plutonium pits from storage containers to shipping containers that were not analyzed in previous NEPA documents.
LANL has written that "older pits have a significant ingrowth of americium-241 which has a higher neutron emission rate than plutonium-239," resulting in higher exposures to workers during pit disassembly. Shipments of plutonium pits from Rocky Flats to Pantex now require extensive "pit leak testing" at Rocky Flats prior to shipping to Pantex.

TABLE 1 : Plutonium pit disassembly and conversion steps and processes
(* = ARIES processes)
Processes and activities identified as part of plutonium pit disassembly and conversion program Impacts and risks discussed and analyzed by DOE in PDCD-EA?
Packaging and Transportation of Plutonium Pits Packaging: NO
Transportation: Yes
Pit Receiving and Staging No
Special Recovery Line No
Pit Bisection and Disassembly* Yes
Conversion to plutonium oxide* Yes
Gallium removal Yes
Primary Canning Module* Yes
Electrolytic Decontamination* Yes
Secondary Canning* Yes
Nondestructive Assay Module* Yes
Storage of Pu oxide No
HEU processing, staging, and shipping No
IAEA accomodation No
Shipping of HEU, No
Declassification processing No
Declassification Furnaces No

2. Receiving and Staging of plutonium pits at LANL.

In the PDCD-EA, DOE failed to analyze or discuss the process and associated impacts and risks of plutonium pit receiving and staging at LANL in the PDCD-EA. DOE also did not cite a Process Hazard Analysis for these operations. Pit receiving at a full scale PDCF, and most likely at the PDCD at LANL, would involve removing FL containers from Safe Secure Transports (SST's), a transfer check and material confirmation on the FL container, moving the FL container to a receiving vault, unpacking the FL container and testing the atmosphere of the inner container for tritium. FL containers containing tritium are moved to storage or the Special Recovery Line. Uncontaminted pits are removed and transferred to the processing line or storage.

3. Special Recovery Line

In the PDCD-EA, DOE only mentioned "decontamination if pits are shown contaminated with tritium," (page 6), but did not discuss or analyze the impacts and risks of these operations. DOE also did not cite a Process Hazard Analysis for these operations.

Decontamination of pits refers to a "Special Recovery Line," which is being planned for a full-scale PDCF, and involves seperating plutonium from HEU and then processing plutonium in a vacuum furnace that drives off tritium and produces a metal ingot. The tritium is captured and packaged as a low level waste." The resulting plutonium ingot is assayed and then reprocessed

of gallium on other materials is being proposed as part of the demonstration.

- Storage of Plutonium. The pits and plutonium metal to be used in the demonstration will be staged in existing special nuclear material storage facilities at LANL. The plutonium metal and dioxide that will be produced during the demonstration will also be staged in existing special nuclear material storage facilities at LANL. No new storage construction will be required and there will be no need to increase the storage limits of the existing facilities. The demonstration will result in a small net increase in the amount of surplus plutonium at LANL. DOE intends to ship LANL's total surplus plutonium to the disposition site or sites that are chosen as a part of the ROD for the SPD EIS which is currently being prepared. DOE expects to make that decision in early 1999. This information has been included in the Final EA.

- HEU Processing, Staging, and Shipping. No processing (except for decontamination) is required of the HEU before it is shipped to Oak Ridge for storage. The doses, wastes, etc. associated with handling this material, preparing it for shipment, and shipping it to Oak Ridge have been included in the EA. A reference to the decontamination was added to Section 3.0.

- Shipping of HEU. The transportation impacts of shipping this material to Oak Ridge is included in the EA and discussed in Section 6.1.6.2.

- IAEA Accommodation. The resulting plutonium dioxide will not be placed under international safeguards as part of this demonstration. It will be made available for international safeguards when the material arrives at the final disposition site.

if it still contains tritium.

4. ARIES

DOE did analyze and describe the hazards, impacts, and risks from the various processes integrated in the Advanced Recovery and Integrated Extraction System (ARIES), but did not fully describe the various processes, did not refer to ARIES by name, and did not provide background on the project.

a. Background on ARIES

ARIES R&D has been approved for development at Los Alamos National Laboratory and Lawrence Livermore National Laboratory since May 31, 1995, when a NEPA Categorical Exclusion following a review of a 1994 Environmental Checklist was issued allowing LANL to move forward on a pilot scale project involving 35-40 plutonium pits to "develop and demonstrate integrated methods by which any pit from a retired nuclear weapon could be disassembled and the constituent materials could not be recovered." At the time of the CE, ARIES did not involve a Special Recovery Line or Gallium removal, tritium emissions were not a concern, and the identified product was a "solid that could be stored for an indefinite interval." .

In early 1996 the scope of the project appeared to change?without any evidence of proper NEPA documentation upgrades?. In the ARIES Program Plan , the stated purpose was to "receive weapon pits, disassemble them, and provide a product.of either a plutonium metal button or plutonium oxide powder appropriately canned to meet all requirements for long term storage." A "hot testing" schedule goal was set for September 30, 1997. Processes that were specifically identified in the 1996 program plan but not in the 1994 environmental checklist included:

? the "hydride-dehydride recycle module" for casting plutonium as a metal ingot
? a "parallel hydride-oxide (HYDOX) module" to produce plutonium oxide powder.

ARIES was also described as "unique because the project uses a matrix management approach with dedicated staff from two national laboratories responsible for the success of the project." This unique arrangement involved ARIES team leaders at both LANL and LLNL. The 1994 Environmental Checklist cited in the 1995 NEPA Categorical Exclusion that was cited as sufficient NEPA coverage in the 1996 ARIES Program Plan did not include activities at LLNL, and the 1996 Program Plan did not identify other NEPA documentation for ARIES activities at LLNL. The Special Recovery Line and Gallium Removal were not identified as part of the ARIES process at this time.

Later in 1996, during preparation of the SD PEIS, DOE and LANL identified, in several documents, as an issue the presence of gallium in plutonium pits.

In January 1997 DOE announced in its Record of Decision for the SD PEIS that failed to consider previous NEPA documents for ARIES. In the Final PEIS, DOE provided information that was contradicted in the LANL NEPA documents. For example, DOE stated that "the cancer risk from hazardous chemicals to the MEI...is zero (because no carcinogens are released from the hazardous chemicals used.)," whereas the 1994 Environmental Checklist identified "potential beryllium emissions" that were expected to be "within the quantity allowed under the current beryllium permit for TA-55-4." Also in the final PEIS, tritium emissions are not cited .

As of May 1998, the scope of ARIES had changed further, with ARIES being defined by ARIES Module Leader Chris James as preparing "weapons plutonium for long-term storage and disposition in a form quantifiably verified by nondestructive assay," with the assay results "can be presented for international inspection and safeguards." James also announced that LANL intends to conduct hot-testing of the ARIES line beginning in June 1998 would lead to the initial integrated 40-pit demonstration, with a total of "~250 pits will be disassembled by 2002. The data from the ARIES

- Declassification Processing and Furnaces. This processing is not required as part of the proposed demonstration. This on-going operation is conducted in accordance with the *Draft LANL Site-Wide EIS*.

STAND Comment V. DOE must meet the spirit and letter of NEPA.

In preparing the EA, DOE has fully complied with its NEPA regulations (10 CFR Part 1021), which state in Part 1021.301 that, "DOE shall notify the host state and host tribe of a DOE determination to prepare an EA or EIS for a DOE proposal, and may notify any other state or American Indian tribe that, in DOE's judgment, may be affected by the proposal." On May 16, 1997, DOE notified the host state and four host tribe officials in New Mexico of its determination to prepare an EA on a proposed integrated pit disassembly and conversion demonstration. Analysis in support of this EA was conducted during the remainder of 1997 and the beginning of 1998.

DOE's NEPA regulations, in 10 CFR Part 102.301 (d), further requires that, "DOE shall provide the host state and host tribe with an opportunity to review and comment on any DOE EA prior to DOE's approval of the EA. DOE may also provide any other state or American Indian tribe with the same opportunity if, in DOE's judgment, the state or tribe may be affected by the proposed action." In compliance with this provision, on May 8, 1998, DOE mailed copies of the EA to the host state and host tribes. Additionally, DOE notified 33 stakeholders in New Mexico of the World Wide Web availability of the EA, as well as its availability at DOE's public reading rooms in Albuquerque and Los Alamos, New Mexico.

The commentor also stated that, "DOE did not provide for adequate or timely review of the proposed action. . . ." DOE's NEPA regulations, in 10 CFR Part 1021.301 (d), state that, "At DOE's discretion, this review period shall be from 14 to 30 days." Adequate time was provided for a timely review of

demonstration was presented as "needed to support PDCF design. It is unclear whether subsequent NEPA documentation has been conducted on the initial 40 pit demonstration. ARIES was presented almost strictly in the context of a MOX fuel fabrication program.

b. ARIES processes.

i. Pit Bisection. In the PDCD, DOE described and analyzed the impacts and risks of in the Pit Bisector Module, where "pit tubes are cut off from the pit and the pit is cut into two hemispheres." DOE did not distinguish the different processes for bonded pits vs. nonbonded pits, which can be disassembled into plutonium, HEU, and non-SNM classified shapes."

ii. Oxidation. In the PDCD, DOE described and analyzed the risks and impacts of converting plutonium metal to plutonium oxide powder using the "three-step hydride-oxidation" (HYDOX) process, which is also identified in the preliminary design-only documents as the only oxidation process. In the three step HYDOX process, plutonium metal are "conveyed to a HYDOX reactor in a HYDOX module. In the reactor plutonium reacts with hydrogen to form a (plutonium) hydride. The hydride is reacted with nitrogen to form a (plutonium) nitride that is then reacted with oxygen to produce the oxide product." IN the three step process, hydrogen and oxygen are never mixed.

This latter fact is important because ARIES originally involved a two-step process that involved a dangerous combination of plutonium, hydrogen, and oxygen in the same environment. However, the three-step process has only been developed and tested at LLNL, not LANL, and "No prototypic metal to oxide conversion process has been defined to date" for MOX fuel fabrication.

iii. Packaging. DOE did analyze the step of packaging plutonium oxide or metals are in a primary container. DOE did not identify and analyze the different requirements between the existing DOE 3013 Standard for plutonium metal and oxide storage and the proposed Disposition Criteria for plutonium oxides.

iv. Electrolytic decontamination. DOE did analyze the step of placing the primary containers in an apparatus where they are "electrochemically cleaned" using a rinse solutions that can lead to a liquid TRU waste stream.

v. Secondary canning. DOE did analyze the step of placing the primary can in a secondary can that is seal welded and leak tested.

vi. Non destructive Assay. DOE did analyze the step of conducting an analysis of the product in the final container.

5. TIGR: Thermally Induced Gallium Removal

DOE did analyze the gallium removal step, but presented an inaccurate and misleading description of the processes involved and the associated technical uncertainties.

Between conversion of plutonium metals to plutonium ingots or oxides and canning of the materials, DOE proposes the additional step of removing gallium and other impurities from the resulting oxides. A gallium removal reactor is used to heat the plutonium oxide and the gallium oxide "is reduced to a volatile form that is collected in a vacuum trap. Gallium oxide will be collected and sent to a TRU waste assay."

This gallium removal process is being analyzed strictly in the context of meeting plutonium oxide specifications for MOX fuel fabrication. Because this issue was not considered in the ARIES development, development of the TIGR process is behind the technically uncertain HYDOX process. At the Atlanta MOX conference, LANL personnel stated that they have only conducted "process development tests incorporating surrogate and prototypic PuO_2," and future efforts include "integration into ARIES/PDCF." The step to "install TIGR into ARIES" is not planned until 1999, so the initial demonstration planned for 1998 would not include gallium removal.

its proposed action as copies of the EA were sent to the host state and host tribes and notification letters were sent to stakeholders on May 8, 1998. A copy of the EA was available on the World Wide Web on May, 11, 1998. The review and comment period for both the host state and host tribes and the public was open through June 8, 1998.

The commentor objected to DOE not including categorical exclusions that have been issued at LANL involving the plutonium pit disassembly and conversion processes and not addressing comments made during the scoping process for the SPD EIS. A categorical exclusion was previously completed by LANL for a smaller demonstration project. When the demonstration was expanded to include 250 pits, DOE decided that a categorical exclusion was not appropriate and the EA was started. This earlier document was reviewed in completing the EA but was not referenced because no information was incorporated from this document into the EA. Comments made within the SPD EIS scoping process were not considered in relation to the EA because these comments were specific to the full-scale pit disassembly and conversion process and will be addressed in the SPD EIS.

The commentor also noted that at the DOE MOX Conference in Atlanta, during May 1998, "LANL personnel presented the Demonstration Project as a final decision." This statement was not accurate. The final decision on the proposed action will be made by DOE as a result of the analyses presented in this EA. No action will be taken until DOE issues a FONSI or a decision is made based on the results of an EIS, should it be determined that a FONSI is not appropriate.

There are also numerous uncertainties associated with gallium removal that are not discussed in the PDCD-EA. The effects of gallium on zircaloy cladding on nuclear fuel rods is still being tested at the Oak Ridge National Laboratory. 6. International Inspections

The objective of plutonium pit conversion is to produce a declassified form of plutonium that will be available for international inspections and verification. DOE is planning for such requirements at a full scale PDCF, but for the Demonstration Project is "not expected that the plutonium products from this demonstration will come under international safeguards."

7. HEU Processing, Staging, and Shipping

In the PDCD-EA, DOE identified but did not analyze the step where highly enriched uranium (HEU) parts "will be electrolytically decontaminated, stored, and shipped to the Y-12 plant." This process will involve decontamination in a tank holding sodium nitrate solution. The solids that build up in the tank will have to be filtered, dried and packaged as waste.

8. Declassification Processing

In the PDCD-EA, DOE did not identify or analyze the process where "non-SNM metals will be crushed and melted in furnaces. These metals include stainless steel, aluminum, beryllium, and depleted uranium."

V. DOE must meet the spirit and letter of NEPA

DOE has already violated NEPA during preparation and release of the PDCD-EA for providing inadequate and timely opportunity for the public to review the PDCD-EA, for failing to implement the NEPA process in a timely manner, for reaching a decision before completing its NEPA review and not incorporating relevant NEPA documents into the PDCD-EA. By conducting a full Environmental Impact Statement, DOE can create another opportunity to follow its legal NEPA requirements.

A. Under NEPA policy, DOE is obligated to reduce delays and "integrate the NEPA process into early planning." (40CFR1500.5.a) and it is "DOE's policy to...apply the NEPA review process early in the planning stages for DOE proposals." (10CFR1021.210.a)

DOE did not release the PDCD-EA until May, 1998, even though it announced its Notice of Intent to conduct the PDCD-EA in May, 1997. There is no evidence that the NEPA review was actually conducted in 1997.

B. DOE is obligated to "provide for adequate and timely NEPA review of DOE proposals." (10CFR1021.200.a).

By releasing the PDCD-EA at a late date, DOE did not provide for adequate or timely review of the proposed action in the PDCD-EA. An effort to extend the comment deadline was denied by DOE.

C. For research, development, demonstration, and testing programs, DOE policy is to "begin its NEPA reviewed as soon as environmental effects can be meaningfully evaluated."

DOE had meaningful data on the proposed action before December, 1997, when it published environmental data for the SPDEIS.

D. DOE is required, under NEPA, to "consider the relevant NEPA documents, public and agency comments (if any) on those documents, and DOE responses to those documents, as part of its consideration of the proposal and shall include such documents, comments, and responses as part of the administrative record."(10CFR1021.210.c)

DOE did not include Categorical Exclusions that have been issued at LANL involving the plutonium pit disassembly and conversion processes.

DOE also did not address the comments made during the scoping process for the SDPEIS.

E. For each proposed action, DOE is required to "complete its NEPA review for each DOE proposal before making a decision on the proposal."

At the Atlanta MOX conference, LANL personnel presented the Demonstration Project as a final decision.

Thank you for this opportunity to comment.

Sincerely:

Don Moniak
Program Director
STAND of Amarillo
Don Moniak
Program Director
STAND of Amarillo
7105 W. 34th Avenue, Suite E
Amarillo, TX 79109
dm4stand@igc.apc.org
806-358-2622
806-355-3837 (FAX)

ENERGY
RESEARCH
FOUNDATION

Frances Close
Board Chairwoman

Theodore K. Harris, Esq.
President

July 3, 1998

Mr. Howard Canter, Acting Director (MD-1)
Office of Fissile Materials Disposition
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re: Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities, Preapproval Review, May 1998, DOE/EA-1207-D

Dear Mr. Canter,

Alternatives analysis, including an openness to review the potential impacts of those alternatives, is at the heart of the process set forth by the National Environmental Policy Act (NEPA). Yet, the Department of Energy (DOE) appears to be approaching its decision on pit disassembly and conversion with a willful determination that it had the answer before the decision-making process had barely begun.

DOE is attempting to use the NEPA process to say: This is what we intend to do, now let's look at where we'll do it. DOE's approach avoids the more important and interesting question of whether its preferred alternative is the best one. After all, if DOE's preference is only compared to a no action alternative, there's at least an even chance DOE will select the option it liked before the NEPA process began. Furthermore, framing the question this way tends to encourage public interest toward competing for federal funds and jobs associated with DOE's proposal rather than a discussion of the merits of the proposal itself. Such an approach is not what is intended by NEPA, but there are several reasons we conclude it is nonetheless the approach DOE is taking.

In its December 1996 *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229), DOE declares the process it intends to use for pit disassembly and conversion: "The surplus Pu would be removed from the pits by separating them in half with a cutting wheel and subjecting each half to a dry chemical process that converts the metal to a hydride powder, then either back to a metal or to an oxide powder." (p. 2-89) The only reference to alternatives in this final EIS is that DOE indicates it will select from among four sites a location for this pit disassembly and conversion

Brian Costner, Director, 537 Harden Street Columbia SC 29205 803/256-7298, fax 803/256-9116
Tim Connor, Associate Director, 5 1016 Buena Vista Drive Spokane, WA 99204, 509/838-4580, fax 509/624-9188

A.3 DOE Response to Comments Received After Close of Comment Period

DOE prepared the *Storage and Disposition Final PEIS* (DOE/EIS-0229) that analyzed among other things, the technical alternatives for surplus plutonium disposition. The preparation of this document was preceded by analyses and studies which narrowed down a broad range of technical alternatives to those that were evaluated in the *Storage and Disposition Final PEIS*. While full aqueous processing was considered for pit conversion, it was eliminated from further consideration because of the relatively large environmental impacts of using that process compared to the dry process. The aqueous process would produce greater waste volumes, require more space, result in larger personnel exposures, and could have greater potential for nuclear criticality events. The dry pit disassembly and conversion process emerged from the studies and analyses as the only reasonable pit conversion alternative. The proposed demonstration discussed in the EA will only involve the dry process, is consistent with the activities described in the PEIS, and is configured to provide information needed for the design of the potential pit disassembly and conversion facility.

The existing equipment and glovebox modifications referenced in the EA and by the commentor were done in part in other research. However, some minor modifications, relating to the installation of new gloveboxes, would be made under this proposed demonstration, as reflected in the Final EA. To further explain, DOE previously conducted pit bisection and related work as part of its weapons maintenance research on various pits at LANL and LLNL. Bench scale research to reduce worker exposure associated with this work proceeded under other NEPA reviews. When DOE decided to propose an integrated pit disassembly and conversion demonstration to test the feasibility of the process for surplus plutonium disposition, it prepared the Pit Disassembly and Conversion Deomonstration EA to assist in determining whether the proposed demonstration would result in significant environmental impacts. DOE has

Mr. Howard Canter, July 3, 1998, page 2

facility. The January 14, 1997, Record of Decision (ROD) for the Storage and Disposition PEIS commits DOE to this preferred alternative and, based on "appropriate NEPA review," to demonstrate its pit disassembly/conversion approach at LANL before constructing a full-scale facility.

The environmental assessment (EA) referenced at the top of this letter is the NEPA review mentioned in the ROD. Much like the PEIS, the EA provides only a single alternative - no action - to DOE's preferred approach of demonstrating an integrated system for pit disassembly and conversion. Moreover, the EA even goes so far as to state: "No new facilities are needed to support this demonstration; however, minor internal modifications *were* made to existing facilities." (pp. 5-6, emphasis added) It appears DOE has both severely limited the scope of the NEPA review and begun implementing its preferred alternative before the review is complete.

DOE's approach to NEPA compliance in regard to this project leaves several questions unanswered - at least within the readily available public literature. Some of the questions can be grouped as follows:

1. Are pits a homogeneous lot? If not, are there differences among pits (e.g., whether they are bonded) which justify use of more than a single process to most efficiently complete the process of disassembly and conversion?

2. What is the end product of the pit disassembly and conversion process? As noted above, the PEIS for storage and disposition indicates the product is either a metal or an oxide powder. The ROD for the PEIS does not specify which of the two. The pit disassembly and conversion EA indicates both will be produced. (p. 1) The Notice of Intent for the Surplus Plutonium Disposition EIS, however, describes a "facility to disassemble and convert pits (a nuclear weapons component) into plutonium oxide suitable for disposition."

   Why is DOE proposing to demonstrate a system which can produce metal or oxide if it only intends to construct a facility to produce plutonium oxide? Will the oxide produced be suitable for immobilization or MOX or both? Are there advantages to changing the pit disassembly and conversion process depending on which disposition option is selected?

3. What are alternatives to the particular set of operations DOE is proposing to demonstrate? What are the cumulative impacts of the work DOE has completed to date and that proposed in the EA? Will the final operation involve a dry chemical process as briefly described in the PEIS? More generally, how does the brief description in the PEIS compare to the proposed demonstration and to the current expectation for the final pit disassembly and conversion facility?

not implemented the proposed pit disassembly and conversion demonstration in advance of a decision on the EA.

The following information is provided in response to specific questions:

1. The demonstration would involve a variety of pit types. One of the results DOE expects to obtain from the demonstration is how various pieces of equipment and process steps perform with different pit types.

2. The planned end product is an oxide. The oxide could be used for immobilization or mixed oxide fuel development programs or stored pending disposition. The oxide will be suitable for disposition using immobilization and suitable for use in mixed oxide fuel. The process can also produce a metal from demilitarized pits for storage.

3. The EA has been modified to explain more clearly why potential options that were considered are not reasonable alternatives. The EA has been modified to explain that there would not be significant cumulative impacts as a result of the proposed pit disassembly and conversion demonstration or with the on-going research and development work. The demonstration would only involve the dry process. The proposed demonstration is consistent with the activities described in the *Storage and Disposition Final PEIS* and would provide information needed for the design of the pit disassembly and conversion facility.

4. Pit components other than plutonium would be declassified and recycled if possible. For example, some stainless steel could be shredded and sold as scrap while other stainless steel would be disposed of as low-level waste. This processing is not required as part of the proposed demonstration. Such activities are part of the on-going operations discussed in the *Draft LANL Site-Wide EIS* (DOE/EIS-0238) which is incorporated by reference in the EA.

4. How will pit components other than plutonium be converted, or will they?

These are the type questions on which DOE should encourage public discussion if it wishes to select the best method for preparing pits for disposition, not merely for deciding, as seems to be DOE's current inclination, whether to do what it currently envisions and where.

We recognize these remarks are submitted after the close of the comment period, but it is before the end of the additional time we and other organizations requested (but you denied) for review of the EA. Addressing the issues raised above is important to ensuring the soundness of DOE's decision-making process and to satisfying the public's right to participate in that process. We hope DOE finds time to thoughtfully consider our comments.

Finally, we request that DOE reissue the EA for additional public comment so that we and others may more thoroughly review this important matter. The discussion above, as other public comments submitted on this EA, makes it apparent that the subject of the EA is thoroughly linked to numerous ongoing decision-making documents. Consequently, an adequate review takes considerable time. Failing additional time to comment on the EA itself, we request that, if DOE is inclined to reach a Finding of No Significant Impact (FONSI), it first issue a proposed FONSI for public review as provided for within DOE's NEPA rule at § 1021.322(d).

Should you or others have any questions, please contact me at 803/790-1158. Thank you.

Sincerely,

Brian Costner
Director

cc: Ms. Carol Borgstrom, Director, Office of NEPA Policy and Assistance