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Title: ENVIRONMENTAL ASSESSMENT FOR THE MANUFACTURE AND SHIPMENT OF NUCLEAR REACTOR FUEL FROM THE UNITED STATES TO CANADA

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Los Alamos
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ENVIRONMENTAL ASSESSMENT FOR THE MANUFACTURE AND SHIPMENT OF NUCLEAR REACTOR FUEL FROM THE UNITED STATES TO CANADA

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ABSTRACT: The U.S. Department of Energy (DOE) has declared 41.9 tons (38 metric tons) of weapons-usable plutonium surplus to the United States' defense needs. A DOE Programmatic Environmental Impact Statement analyzed strategies for plutonium storage and dispositioning. In one alternative, plutonium as a mixed oxide (MOX) fuel would be irradiated (burned) in a reengineered heavy-water-moderated reactor, such as the Canadian CANDU design. In an Environmental Assessment (EA), DOE proposes to fabricate and transport to Canada a limited amount of MOX fuel as part of the Parallex (parallel experiment) Project. MOX fuel from the U.S. and Russia would be used by Canada to conduct performance tests at Chalk River Laboratories. MOX fuel would be fabricated at Los Alamos National Laboratory and transported in approved container(s) to a Canadian port(s) of entry on one to three approved routes. The EA analyzes the environmental and human health effects from MOX fuel fabrication and transportation. Under the Proposed Action, MOX fuel fabrication would not result in adverse effects to the involved workers or public. Analysis showed that the shipment(s) of MOX fuel would not adversely affect the public, truck crew, and environment along the transportation routes.

1.0 INTRODUCTION

The National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.), requires all federal agencies, including the Department of Energy (DOE), to consider the environmental consequences of proposed actions before decisions are made. In complying with NEPA, DOE follows the Council on Environmental Quality regulations (40 CFR 1500-1508) and DOE's own NEPA implementing regulations (10 CFR 1021). An Environmental Assessment (EA) was prepared to provide sufficient information so that DOE may determine whether a Finding of No Significant Impact is warranted for the Proposed Action of shipping nuclear reactor fuel to Canada or whether an Environmental Impact Statement (EIS) must be prepared.

1.1 Background

The end of the Cold War has created a legacy of surplus weapons-usable fissile materials both in the United States and the former Soviet Union. The global stockpiles of weapons-usable fissile materials pose a danger to national and international security in the form of potential proliferation of nuclear weapons and the potential for environmental, safety, and health consequences if the materials are not properly safeguarded and managed. Both the United States and Russia have issued policy statements on nonproliferation and export control of these materials. In 1995, President Clinton announced that about 224 tons (203 metric tons) of U.S.-origin weapons-usable fissile materials, of which 165 metric tons are highly enriched uranium and 41.9 tons (38 metric tons) are weapons-usable plutonium, had been declared surplus to the United States' defense needs.

DOE implemented a program to provide for safe and secure storage of weapons-usable fissile materials and a strategy for the disposition of surplus weapons-usable plutonium, as specified in the Record of Decision (ROD) for the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (S&D PEIS) (DOE 1996a). The S&D PEIS examined alternatives to implement the DOE strategy for disposition of surplus plutonium. One approach is the burning of surplus plutonium as mixed oxide fuel (MOX) in existing nuclear reactors. The reactors used for burning and irradiation could be both existing domestic commercial light-water reactors and reengineered heavy-water-moderated reactors, such as Canadian Deuterium Uranium (CANDU) reactors.

1.2 Purpose of DOE Action

As part of its mission to evaluate the disposition of surplus weapons-grade fissile materials, DOE must first test and demonstrate the feasibility of burning MOX fuel in CANDU reactors. The final S&D PEIS ROD issued January 14, 1997, established the dual-track strategy that would immobilize some (and potentially all) of the surplus plutonium in glass or ceramic formulations and allow the burning of some of the surplus plutonium as MOX fuel in existing reactors. The ability to successfully re-engineer and operate heavy-water-moderated CANDU reactors with MOX fuel cycles has never been demonstrated on any industrial scale. The possible use of MOX fuel in CANDU reactors needs to be first successfully demonstrated in the event various governments agree to use this method to dispose of surplus plutonium. DOE has therefore fabricated and may, in the future, fabricate a limited amount of MOX fuel. It now needs to provide a limited amount of MOX fuel to Canada to facilitate the testing and demonstration of MOX fuel in CANDU reactors. This testing will verify equipment design and resolve related performance issues for full-scale operation.

2.0 DESCRIPTION OF THE PROPOSED ACTION

To meet the purpose and need for Agency action, DOE proposed to fabricate and transport up to 59.2 lb (26.8 kg) of MOX fuel as part of the Parallex Project. This test and demonstration project has been named Parallex (parallel experiment) because of the roles of the United States and Russia in supplying the test material. As originally envisioned, the Parallex Project would be a joint agreement between Russia, Canada, and the U.S. to demonstrate the irradiation of U.S. and Russian MOX fuel in parallel in the Atomic Energy of Canada, Limited (AECL)-owned National Research Universal (NRU) reactor. This international project would use MOX fuel made in the U.S. (specifically LANL) and Russia from excess weapons-grade plutonium of both countries' nuclear stockpile.

LANL has research and development experience making MOX fuels for experiments and research reactors. However, these various MOX fuel forms were not made with weapons-grade plutonium. In contrast, the MOX fuel fabrication for the Parallex Project would use weapons-grade plutonium (in unclassified form) obtained from decommissioned nuclear weapons.

The environmental review presented in the EA focused on the fabrication and transportation of MOX fuel from LANL to the Canadian border. The MOX fuel would be fabricated at LANL, and transported to a Canadian port(s) of entry. At the Canadian border the AECL, per prior agreement, would then take possession of the fuel and complete the shipment to the reactor site. At Chalk River, Ontario, the MOX fuel would be delivered to CRL for testing in the NRU reactor. Fueling the NRU reactor with MOX fuel would be part of a feasibility test to determine MOX fuel performance in a converted CANDU reactor setup. The NRU test reactor is the only available reactor specifically redesigned to test MOX fuel performance. Positive test results could support subsequent decisions on the dispositioning of surplus weapons-grade plutonium in CANDU reactors.

2.1 Manufacture of MOX Fuel

Four types of MOX fuel varying in plutonium concentrations and homogeneity would be fabricated at LANL's plutonium facility (PF-4) for this project.

The first step in the process is the receipt of plutonium dioxide powder from dismantled nuclear weapons at the DOE Pantex Plant near Amarillo, Texas. The plutonium dioxide goes though a thermal treatment process to remove impurities. The treated plutonium dioxide is then combined with uranium dioxide to make a master blend.

After the master blend is made, additional uranium dioxide can be added in order to achieve the proper plutonium concentrations as needed in the final blends. The remainder of the fabrication process is as follows: pressing MOX fuel into pellets, sintering the pellets, grinding pellets into final dimensions, and cleaning the pellets. As part of the bench-scale research and development work already conducted at LANL, three batches of test MOX fuel were produced.

Acceptable pellets would be loaded into zircaloy tubes (also known as rods), and natural uranium dioxide end pellets added to obtain the proper stack length. Endcaps would then be welded onto the loaded rods to create sealed fuel rods. The fuel rods would then be leak checked, surveyed for possible contamination, and then stored in PF-4 prior to shipment to CRL.

The MOX fuel fabrication has been and would likely, in the future, be conducted by about a 12-person trained staff within PF-4. All of the handling and work with the plutonium and uranium would be done inside a series of gloveboxes. The gloveboxes are sealed and have a self-contained negative pressure ventilation system that is high-efficiency particulate air (HEPA) filtered. Radiation monitors are located in the gloveboxes. In addition to the glovebox built-in safety measures, PF-4 is sealed to the outside and is also maintained with a negative air pressure to prevent the escape of airborne contamination. The PF-4 area has its own air ventilation system equipped with radiation monitors, alarms, and HEPA filtration to prevent the escape of contamination into the outside atmosphere.

On average, the 12 workers directly involved with the plutonium and uranium handling would receive a radiological dose of approximately 355 millirem (mrem) per year, assuming a year-round routine operation. The anticipated time required to complete the fabrication fuel rods is be about six months. A limited amount (approximately 170 ft^3 [4.8 m^3]) of low-level radioactive dry and solid waste (LLW), such as rags and gloves, would be produced from the fabrication process. A small amount, 22 ft^3 (0.62 m^3), of solid transuranic (TRU) waste such as gloves and plastic bags would be produced inside the gloveboxes. Ethanol would be used in the glovebox to clean the MOX fuel pellets before loading into the rods. The ethanol would be applied with a small cloth. No ethanol liquid waste would be produced due to evaporation.

2.2 Shipping Package Description

Packages used by DOE for radioactive and hazardous materials shipments are either certified to meet specific performance requirements or built to specifications described in the Department of Transportation (DOT) hazardous materials regulations (49 CFR 100-199). For relatively low-level radioactive materials, DOT Specification Type A packages are used. For the Parallex Project described in the EA, a Type B shipping package on a commercial truck would be used to transport the LANL MOX fuel to Canada. Type B packages are designed to retain their contents under both normal conditions of transportation as well as under hypothetical accident conditions. Type B packages are far more robust than Type A packages.

Certified Type B packages would be used in the shipment(s). The Type B shipping package proposed for use is known as the Model 4H Enriched Fuel Bundle Shipping Package, and was designed and manufactured by Canada. The model 4H package has a Certificate of Compliance from the Canadian Atomic Energy Control Board showing that it meets the International Atomic Energy Agency Safety Series 6 requirements. This package also meets DOT Type B specifications. The Model 4H Package can be generally described as a 55-gal. (208-L) metal drum with a sealable lid, and storage spaces surrounded by packing material.

2.3 Transportation of MOX Fuel

MOX fuel in up to two Model 4H Packages would be transported from LANL to Canada by commercial carrier. The loading and shipping of radioactive materials would be carried out in accordance with DOT regulations and existing LANL Safe Operating Procedures (SOPs).

The amount of LANL MOX fuel needed to test in the Parallex Project could be fabricated and transported as one shipment. However, this scenario is unlikely due to evolving programmatic decisions, developments, and schedules. Therefore, up to three different shipments were estimated for transporting all of the MOX fuel to Canada. For purposes of analysis here, three possible shipment scenarios were developed based on the above uncertainties. In Scenario 1, all of the MOX material would be transported in a single shipment. This would include the 11.7 lb (5.3 kg) of lead test fuel, plus the entire test matrix quantities. In Scenario 2, the lead test fuel [11.7 lb (5.3 kg)] would be shipped separately, followed by a different shipment of the complete test matrix amounts. Scenario 3 is similar in that the lead test fuel is shipped first, but the test matrix quantities would be further divided into two shipments (one for each plutonium concentration). The three scenarios were developed in order to provide bounding cases for transportation effect analyses.

2.4 Transportation Routes

Pursuant to DOT and Nuclear Regulatory Commission (NRC) requirements, the Parallex Project transportation route would principally use interstate highways, minimize bridge crossings, not pass through tunnels, bypass high population areas (where possible), minimize distance and time, minimize public effects, and generally be safe. A commercial truck would be used to transport the MOX fuel because of the Model 4H Package safety features and low radioactivity levels per shipment. The shipment(s) would be transported along interstate highways, whenever possible. Shipment over specific routes, i.e., using interstate bypasses around cities and using the most direct interstate highways, is required for shipments identified by the DOT as Highway Route Control Quantity (HRCQ). A HRCQ designation is given to radioactive materials (within a single package) that have a radioactivity level (curie) specified in 49 CFR 173.403. More than 7 ounces (200 g) of plutonium per shipment would be required for a Parallex Project shipment to be declared HRCQ. As currently envisioned, not all Parallex Project MOX fuel shipments would be categorized as HRCQ. HRCQ shipments are regulated under the DOT transportation regulations (49 CFR 397.101). As an added safety measure, all of the LANL MOX fuel shipments to Canada would follow routes meeting HRCQ requirements. In addition to using interstate highways and bypasses, routing regulations require that the quickest routes must be selected in order to reduce the time the radioactive material is in transit. DOT routing regulations permit appropriate state agencies to designate routes for HRCQ shipments through their state. DOE would also identify the MOX fuel shipments as High Visibility Shipments. A High Visibility Shipment requires, in addition to DOT transportation regulations, a Transportation Plan and a satellite communications relay to a central command center (TRANSCOM). The TRANSCOM system would know the exact location of a truck in real time during a shipment from LANL to the Canadian border. The system is capable of tracking vehicles all the way to Chalk River.

Three routes from LANL to the Canadian border that meet DOT routing requirements were analyzed in the EA to present a bounding case for transportation effects. The three routes each have a separate port of entry into Canada. A computer routing program named HIGHWAY (ORNL 1993) was used to determine the three best routes. The HIGHWAY model, developed by Oak Ridge National Laboratory, predicts highway routes for transporting radioactive materials in the United States. The database of the HIGHWAY model calculates routes, which maximize the use of the Interstate highway system. The computer model is designed to circumvent urban areas by use of highway bypasses. The HIGHWAY code conforms to the DOT transportation routing regulations.

The three analyzed routes are listed in Table 2-1 and are identified by the name of the city closest to the actual international border crossing. All three routes meet DOT transportation routing regulations and, therefore, are all acceptable for transporting the MOX fuel to the Canadian border from Los Alamos. The three routes vary in distance. Within the U.S., the Pembina, North Dakota route is the shortest to reach the Canadian border, whereas the Watertown, New York route is the longest within the U.S. to reach the border. In comparison, the Port Huron, Michigan route is the shortest route overall between Los Alamos and Chalk River. Despite these differences, all three routes are acceptable for transporting MOX fuel.

2.5 No Action Alternative and Other Alternatives

The EA described a No Action alternative where no MOX fuel would be shipped to Canada. Other alternatives, such a transport by air and rail, were considered but dismissed from further consideration.

3.0 AFFECTED ENVIRONMENT

For the EA, the affected environment included the analysis of the transportation route, MOX fuel fabrication, and MOX fuel transportation.

3.1 Three Analyzed Routes

Three routes to the Canadian border were analyzed for potential environmental and human impacts. The all would use available interstate highways and bypasses to go around city areas. The first route would be from Los Alamos, New Mexico north to the Canadian border at North Dakota. The Canadian border crossing for this route would be near Pembina, North Dakota. The second route would be from Los Alamos north to Canada by way of Michigan. The Canadian border crossing for this route would be near Port Huron, Michigan. The third route would be from Los Alamos northeast to the New York-Canada border. The Canadian border crossing for this route would be near Watertown, New York. All three transportation routes are shown in Figure 1.

3.2 MOX Fuel Fabrication

Although most plutonium and uranium isotopes are alpha-particle emitters, the nature of the working environment, i.e. hot cells, gloveboxes, other protective enclosures, ventilation systems, and personnel protective measures, prevents internal exposure to workers from alpha particles. These radiation protective measures would be in place for the MOX fuel fabrication workers. The predominant source of personnel radiation exposure in these facilities is external radiation, such as X-rays, gamma rays, or neutrons that accompany the alpha or beta particles emitted by the plutonium and uranium isotopes. External radiation exposure is also "penetrating radiation" because, unlike alpha or beta particles, this radiation penetrates clothing and skin and reaches the internal organs. Shielding barriers between penetrating radiation sources and MOX fuel fabrication workers is used to reduce the dose. Appropriate SOPs and applicable regulatory limits for radiation and environmental protection would be followed to protect the workers, public, and environment.

Exposure to penetrating radiation, routinely measured by personal dosimetry badges, is reported as the effective dose equivalent (EDE) in units of rems for the period during which the dosimeter was worn. Penetrating exposure was used in the EA's Proposed Action as the unit of comparison for human effects of routine and accident events.

A small quantity of test MOX fuel has been fabricated at LANL. During production, the involved workers were protected from direct plutonium and uranium contact by gloveboxes and personal protective clothing. The average involved worker dose from the test MOX fuel was 355 mrem per year. This is well below the DOE as low as reasonable achievable (ALARA) guidelines for LANL workers of 2,000 mrem (2 rem) per year.

3.3 MOX Fuel Transportation

Commercial carriers are required to transport radioactive materials in accordance with DOT regulations (49 CFR 179), NRC regulations (10 CFR 71), and all applicable DOE Orders. For shipments that require real-time tracking for security purposes, a

TRANSCOM (transportation computerized satellite tracking system) linked truck is used that involves a tamper-proof satellite relay system located within the vehicle. A transportation plan detailing the shipment material(s) and associated requirements would be developed and written by DOE. The commercial carrier contracted for radioactive TRANSCOM shipments is required to follow the DOE transportation plan. For overland transport, in conformity with DOT routing regulations for HRCQ shipments of radioactive material, interstate highways and interstate bypasses are the required method of travel whenever possible (49 CFR 397.101). Responsibility for each shipment would transfer from the U.S. to the Canadian Government at the international border.

In the U.S., more than 42,700 miles of interstate highways are open to traffic. The network of interstate highways serves virtually all of the nation's large urban areas and all states but Alaska. Fatality and injury rates are much lower for interstate travel than for travel on other highways or by rail.

Most commercial transportation routes between major U.S. cities are along interstate highways. For the EA transportation analysis, the routes are divided by the transportation computer model known as RADTRAN into route-segments according to population density. In general, three population density zones are defined by the HIGHWAY routing code. The zones correspond to mean population densities for rural, suburban, and urban areas and are expressed as persons per square mile or square kilometer. Rural is defined as 0 to 66 people per square kilometer, suburban is defined as 67 to 1,670 people per square kilometer, and urban is defined as greater than 1,670 people per square kilometer.

DOE's hazardous material (radioactive and nonradioactive) shipments are small compared to the large shipment volume from non-DOE hazardous material transport activities. DOT estimates that approximately 4 billion tons of regulated hazardous materials are transported each year and that approximately 500,000 movements of hazardous materials occur each day. There are also approximately 2 million annual shipments of radioactive materials involving about 2.8 million packages, which represents about two percent of the annual hazardous materials shipments (DOE 1995a).

In comparison, DOE ships about 6,200 radioactive packages (commercial and classified) annually among its sites. DOE's annual shipments of radioactive packages represent less than 0.3 percent of all radioactive shipments in the United States, and less than 0.006 percent of all hazardous material shipments. DOE's unclassified radioactive and other hazardous materials are transported by commercial carrier (truck, rail, or air carriers) while abiding by all applicable DOE and federal transportation regulations (DOE 1995a).

In addition, there are nonradiological risks of highway travel. These risks are caused by air pollution or by highway accidents and do not involve a radiological release. Millions of miles are driven by cars and trucks on the U.S. highways every year. The risk of a highway accident increases with the number of highway miles traveled by a vehicle. In 1993, for example, 10,636 freight trucks traveled 593,262,000 mi (954,770,000 km). For the same year, there were 4.64 truck accidents per 1,000,000 vehicle miles (NSC 1994).

4.0 ENVIRONMENTAL CONSEQUENCES

The EA evaluated the potential effects of the Proposed Action to the workers, public, and environment. The environmental effects, if any, are discussed.

4.1 Human Health

The effect on human health from MOX fuel fabrication would come from the penetrating radiation environment within PF-4. Noninvolved workers, those performing other jobs as well as the usual PF-4 building personnel, would not be expected to receive a dose from the proposed operation. MOX fuel fabrication is not expected to measurably increase the airborne radioactive material emissions from PF-4 associated with routine operations, therefore, no effects to the public are expected. The shipment(s) of MOX fuel to the Canadian border in specially designed and shielded package containers in a commercial truck is not expected to increase the penetrating radiation dose to the public above background levels. No effects to the public are expected from the transportation.

4.2 MOX Fuel Fabrication

No excess fatal cancers would be expected from penetrating radiation exposures associated with MOX fuel production used in the Parallex Project at LANL. The 12 involved workers exposed to penetrating radiation during total MOX fuel fabrication for the Parallex Project are estimated to receive a maximum dose of 661 mrem (0.661 rem) per year. The assumed dose used in this analysis, 661 mrem, is a "conservative" estimate meaning that it leads to an overestimate of ultimate health risk. The MOX fuel fabrication required to complete the test matrix would not be a year-long process, and the assumed total dose was derived as 95 percent of the maximum dose average for two workers in operations that are known to be similar to the Proposed Action. This calculates to the probability of an individual worker developing a fatal cancer from MOX fuel fabrication as being slightly above one chance in ten thousand. For comparison, the 661 mrem estimated dose is well below the DOE ALARA guideline for LANL workers of 2,000 mrem (2 rem) per year. The DOE regulatory annual dose limit for workers if 5,000 mrem (5 rem) per year (DOE 1996b), which corresponds to an individual annual risk of LCF of 2 in 1,000 (2.0×10^{-3}).

If all 12 involved workers were exposed to 661 mrem, it would result in a collective dose of 7.9 person-rem per year. The calculated risk of annual excess fatalities for the worker population is less than the probability at which no additional cancer deaths are expected. Therefore, no excess cancer deaths of workers are expected from radiation exposures associated with routine operations of MOX fuel fabrication at LANL at a full-production rate. Operations would be analyzed, planned, and managed to ensure that worker exposures are kept as low as reasonably achievable.

4.3 MOX Fuel Transportation

No changes to the existing highway infrastructure would be required to allow passage of the MOX fuel shipment(s), nor would the roads need to be closed. The normal traffic flow along the three analyzed MOX fuel transportation routes would not be expected to change with the added presence of one to three commercial truck(s).

A transportation analysis of the proposed shipment(s) of MOX fuel was performed using the RADTRAN 4 computer model developed and maintained by Sandia National Laboratories in Albuquerque, New Mexico. The analysis considered the following elements: mode of transportation, curies of material, proximity dose rates (transport index), type of packaging, accident severity category, and potentially affected populations. Transportation health risks were estimated for accident radiological dose rates, normal (incident-free) transportation radiological dose rates, and nonradiological accident effects (i.e., highway collision fatalities).

The shipment(s) of MOX fuel by commercial truck from LANL to the Canadian border would not be expected to adversely affect the health of the public along the proposed routes. The incident-free dose is the radiological exposure received by the public while the shipment(s) are transported along the routes. Assuming, as an upper bound, all of the MOX fuel is transported in a single shipment, the incident-free doses to the public from each proposed route would be 4.1×10^{-9} person-rem for the Pembina route, 4.7×10^{-9} person-rem for the Port Huron route, and 5.7×10^{-9} person-rem for the Watertown route. The shipment(s) of the MOX fuel along the three routes would result in a negligible radiological dose to the public.

Similarly, the shipment(s) of MOX fuel by commercial truck from LANL to the Canadian border along the proposed routes would not be expected to adversely affect the health of the truck crew. The incident-free dose is the radiological exposure received by the truck crew, if all the MOX fuel is transported in a single shipment, would be 6.3×10^{-10} person-rem for the Pembina route, 7.3×10^{-10} person-rem for the Port Huron route, and 8.8×10^{-10} person-rem for the Watertown route. The truck crew would receive a negligible radiological dose from the shipment(s) of the MOX fuel along the three routes.

By using the single MOX fuel shipment as an upper bound, the risk of excess LCFs can be estimated for the total combined radiological dose to the public and truck crew for each proposed transportation route. The estimated number of LCFs would be very small (much less than 1.0). Therefore, no adverse health effects to the public and truck crew would be expected from any scenario involving the shipment of MOX fuel across the U.S.

4.4 Air Quality

Air emission from the fabrication of MOX fuel pellets and rods for the Parallex Project would be a very small percentage of the overall LANL annual air emissions. The MOX fuel pellets and rods would be made inside sealed gloveboxes that have negative pressure and a primary air system fitted with HEPA filtration. In the event of a glovebox failure or accident, any airborne particles would also be captured by the PF-4 HEPA filters. No MOX fuel powder particles would be expected to be released from PF-4 into the environment. No change to the air quality along the route(s) to Canada would be expected since the MOX fuel would be sealed in rods and package container(s) during transportation. No measurable radioactive particles would be released into the air. A commercial truck carrying MOX fuel would be one out of thousands of trucks on the road at any one time. The overall contribution of nonradiological air pollutants from a single vehicle to the air quality within a given airshed would be small to the point of being immeasurable.

4.5 Waste Management

LANL has established processes to manage radioactive liquid and solid wastes. Only solid waste would be generated from the MOX fuel fabrication. The LLW and TRU waste produced from the MOX fuel process would be within the LANL normal values of waste production. The LLW and TRU waste would be characterized by the generators before packaging and disposal or storage. LLW would be packaged in specially designed cardboard boxes. The TRU waste would be stored in special 55-gal. drums. The LLW and TRU waste would consist of gloves, tape, plastic bags, booties, metal pieces, and rags. No radioactive waste would be generated during the shipment of MOX fuel to the Canadian border.

5.0 SUMMARY

The Proposed Action would result in the fabrication of MOX test fuel at LANL and its delivery to the AECL NRU test reactor in Canada. A successful MOX fuel test could lead to the disposition of surplus weapons-grade plutonium from the U.S. and Russia by irradiation in CANDU reactors in Canada. The parallel disposition of weapons-grade plutonium would support the American and Russian goals of nuclear materials nonproliferation. The fabrication of the MOX fuel at LANL would generate small amounts of low-level and transuranic radioactive waste, and very small radioactive air emissions. The MOX fuel fabrication would not result in adverse health effects in the involved workers or public. The shipment(s) of MOX fuel would not adversely affect the environment at LANL or along the transportation routes. During the shipment(s), the truck crew and public would not be adversely affected by the low amount of penetrating radiation from the MOX fuel in the package container(s).

Under the No Action Alternative, no MOX fuel would be fabricated at LANL and no MOX fuel would be shipped to Canada. The existing MOX fuel already made would continue to be stored at LANL until a decision on its use or disposition is made. The AECL would have no source of U.S. MOX fuel and, therefore, would have to delay its testing program at the NRU reactor in parallel with Russian MOX fuel, or if Russian fuel were available, operate the testing program in the absence of U.S. supplied MOX fuel.

Two hypothetical MOX fuel fabrication and transportation accident scenarios were analyzed that evaluated a potential radiation release to the involved workers and public. Another transportation accident scenario not involving a radioactive release was also analyzed. The three accident scenarios did not result in potentially serious health effects to the involved workers or public during MOX fuel fabrication and transportation.

It is expected that activities associated with the Proposed Action would not amplify cumulative effects, because the contributions to adverse effects from the Proposed Action would be extremely small.

6.0 REFERENCES

DOE 1996a: U.S. Department of Energy, "Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement," U.S. Department of Energy report DOE/EIS-0229.

DOE 1996b: U.S. Department of Energy, "Occupational Radiation Protection," 10CFR835 (December 1996).

DOE 1995: U.S. Department of Energy, "Environmental Assessment for the Disposition of Highly Enriched Uranium from the Republic of Kazakhstan," U.S. Department of Energy report DOE-EA-1063.

NSC 1994: National Safety Council, Accident Facts, 1994 Edition, National Safety Council.

ORNL 1993: Oak Ridge National Laboratory, *Highway 3.1, An Enhanced Highway Routing Model: Program Description, Methodology, and Revised User's Manual*, ORNL report ORNL/TM-12124.

Table 2-1. Transportation Routes

Origin	Port of Entry	Destination	Distance to Canadian Border, mi (km)	Total Distance mi (km)
Los Alamos, NM	Pembina, ND	Chalk River, ON	1,530 (2,462)	2,822 (4,542)
Los Alamos, NM	Port Huron, MI	Chalk River, ON	1,755 (2,824)	2,252 (3,624)
Los Alamos, NM	Watertown, NY	Chalk River, ON	2,126 (3,422)	2,325 (3,742)

Figure. 1 Transportation routes from Los Alamos to Chalk River.