ORNL/MD/LTR-67
Revision 4

OAK RIDGE
NATIONAL
LABORATORY

LOCKHEED MARTIN

Letter Report

United States Transportation Plan for MOX Fuel Shipments Under Project Parallex

September 1999

INTERNAL USE ONLY - LIMITED DISTRIBUTION

S. B. Ludwig
I. G. Harrison

Transportation & Packaging Technologies Team
Fissile Materials Disposition Program

MANAGED AND OPERATED BY
LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL-27 (3-96)

Revision History

Revision Number	Date Issued	Reason for Revision
0	1/29/1997	Initial version, for comment.
1	3/7/1997	Revised version.
2	4/12/1999	Major revision. Number of possible routes analyzed changed from three to seven. Shipment quantity reduced from up to three shipments (~513 g Pu) to a single shipment (~119 g Pu).
3	5/21/1999	Revised draft incorporating comments from planning meeting at LANL on 4/19-20/99. Also includes comments from TRANSCOM control center. Marked “Internal Use Only - Limited Distribution”
4	9/24/1999	Revised to incorporate final comments.

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OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
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U.S. DEPARTMENT OF ENERGY
under contract DE-ACO5-96OR22464

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Revision 4

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S. B. Ludwig
I. G. Harrison

Submitted by: _____ _____
Tammra Horning (ORNL) Date

Concurred by: _____ _____
Stan Zygmunt (LANL) Date

Coordinated with: _____ _____
David Cox (AECL) Date

Approved by: _____ _____
John Baker (DOE/MD-4) Date

Approved by: _____ _____
Laura S. H. Holgate (DOE/MD-1) Date

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Parallex Shipments-Contact List

Organization	Name	Position	Telephone Number
Shipping Organization			
Los Alamos National Laboratory (LANL)	Tom Houston	BUS-4	(505) 665-2781
LANL	Tim Stone	NMT-7 (TA-55)	(505) 665-3585
LANL	Stacey Eaton	TSA-10, Engineer, Parallex Project	(505) 665-0539
LANL	Stan Zygmunt	NMT-15, Manager, International Programs	(505) 667-8978
Receiving Organization			
Atomic Energy of Canada Limited (AECL), Chalk River Laboratories (CRL)	Lloyd Dunn	Supervisor, Storage and Shipping, Radioactive Materials Services	(613) 584-8811 ext. 4335
AECL/CRL	David Cox	Manager, Project Parallex	(613) 584-8811 ext. 3382
Carrier			
Carrier Dispatch	TBD by LANL		TBD by LANL
TRANSCOM			
TRANSCOM Control Center, operated for DOE by SCG	Operator on duty	System Operators	(423) 576-9115
	Gene Carnes	Manager, TCC	(423) 576-0982
Oak Ridge National Laboratory (ORNL)			
ORNL	Tammra Horning	Manager, Project Parallex, FMDP	(423) 574-0316
ORNL	Scott Ludwig	Manager, Transportation & Packaging, FMDP	(423) 974-1979
U.S. Department of Energy (DOE)			
DOE/MD-1	Laura Holgate	Director, Office of Fissile Materials Disposition	(202) 586-2695
DOE/MD-4	John Baker	Manager, International Programs, FMDP	(202) 586-7493
DOE/AL	Marta R. Jones	Traffic Manager, Albuquerque Operations	(505) 845-4398
DOE/NTP	Robert Sanchez	Manager, National Transportation Program	(505) 845-5541
DOE/OR	P. Brady Lester	Traffic Manager, Oak Ridge Operations	(423) 576-8354
EMERGENCY Contacts			
Nearest DOE Regional Coordinating Office	(see Attachment A)		
TRANSCOM CONTROL CENTER	Operator on duty	System Operator	(423) 576-9115
Los Alamos Shipping Organization	24-hour emergency phone number		(505) 667-6211
AECL Material Receiving Org.	24-hour emergency phone number		(613) 584-1682

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ACRONYMS

AECB	Atomic Energy Control Board (Canada)
AECL	Atomic Energy of Canada Limited
CANDU	Canadian Deuterium/Uranium reactor design
CFR	Code of Federal Regulations
CRL	Chalk River Laboratories
CVSA	Commercial Vehicle Safety Alliance
DOE	Department of Energy
DOE-AL	DOE Albuquerque Operations Office
DOE-EM	DOE Office of Environmental Management
DOE-LAAO	DOE Los Alamos Area Office
DOE-MD	DOE Office of Fissile Materials Disposition Program
DOE-NN	DOE Office of Nonproliferation and National Security
DOE-NTP	DOE National Transportation Program
DOE-OAK	DOE Oakland Operations Office
DOE-OR	DOE Oak Ridge Operations Office
DOT	Department of Transportation
EA	Environmental Assessment
EPA	Environmental Protection Agency
HRCQ	Highway Route Controlled Quantity
IAEA	International Atomic Energy Agency
LANL	Los Alamos National Laboratory
MOX	Mixed-Oxide fuel
NEPA	National Environmental Protection Act
NRC	Nuclear Regulatory Commission
NRU	National Research Universal
ORNL	Oak Ridge National Laboratory
PIE	Post-Irradiation Examination
RAP	Radiological Assistance Program
RCO	Regional Coordinating Office
RF	Russian Federation
RQ	Reportable Quantity
SNM	Special Nuclear Material
TRANSCOM	Transportation Tracking and Communications System
TCC	TRANSCOM Control Center

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EXECUTIVE SUMMARY

The PARALLel EXperiment (PARALLEX) Project has the objective of irradiating laboratory-produced quantities of mixed-oxide (MOX) nuclear reactor fuel containing weapons-derived plutonium in the National Research Universal (NRU) test reactor at the Chalk River Laboratories (CRL) in Chalk River, Ontario Canada. The MOX fuel for this test irradiation will be fabricated in the United States (US) and in the Russian Federation (RF). The test will disposition the weapons-derived plutonium and will permanently render the material inaccessible for use in nuclear weapons. The test will also demonstrate many of the steps necessary to conduct a similar undertaking on a larger scale.

Two shipments of MOX fuel to CRL are currently planned for the Parallex Project; one from the Los Alamos National Laboratory (LANL) in New Mexico in the United States and one from the Bochvar Institute in Moscow in the Russian Federation. This Transportation Plan describes details of the planning for the shipment from LANL to CRL. It complements a separate Transportation Plan prepared by Atomic Energy of Canada Ltd. (AECL) to cover the portion of the shipment in Canada.

The material to be shipped consists of nine 50-cm-long nuclear fuel elements, containing a total of 4.7 kg of ceramic MOX fuel pellets inside welded and sealed Zircaloy metal cladding tubes. The MOX material contains a total 119 g of weapons-derived plutonium. It will be shipped in a specially designed and certified package that has been tested to withstand transport accidents, including severe impact, puncture, water immersion, and fire.

Because of the small quantity of MOX fuel involved in this shipment, there is no requirement for any security planning, physical protection or security measures to be implemented, according to US and international regulations on safe transport of nuclear materials. However, because of the importance of the Parallex Project and because of public and policy sensitivity, this shipment has been declared as “high visibility” by the USDOE, which necessitates the preparation of a transportation plan, the use of satellite tracking system on the vehicle, and application of an exclusive-use vehicle.

USDOE conducted an environmental review of seven possible routes from Los Alamos to CRL. The potential environmental impacts were reviewed and a determination was made that none of the routes pose a significant impact to the environment. The transportation containers to be used conform to strict safety standards set by the US Nuclear Regulatory Commission and the Canadian Atomic Energy Control Board. The standards ensure that the container will not break open even in a severe accident and that the public will not receive a radiation dose above regulatory limits during the transport of the fuel elements. Agreement has been reached with the Canadian government that the material will cross into Canada at Sault Saint Marie, Michigan.

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U.S. TRANSPORTATION PLAN FOR MOX FUEL SHIPMENTS

1. INTRODUCTION

The U.S. Department of Energy (DOE) is committed to the safe, efficient, and cost-effective transportation of all materials that support its various programs and activities. DOE strives to ensure that its radioactive and other hazardous materials, hazardous substances, and hazardous and mixed wastes are handled, packaged, and transported in compliance with all applicable international, federal, state, tribal, and local regulations.

This Plan outlines the responsibilities of DOE, DOE-contractors, commercial carriers, and other organizations participating in a shipping campaign of laboratory samples of mixed-oxide (MOX) fuel. The shipment described herein shall be conducted in accordance with applicable regulations of the U.S. Department of Transportation (DOT), U.S. Nuclear Regulatory Commission (NRC), and all applicable DOE Orders.

This Plan has been reviewed by and received concurrence from all major participants in the shipment campaign and approved by the DOE Office of Fissile Materials Disposition (DOE-MD). Refinements shall be made in a controlled revision. The controlled revision shall be distributed to all affected organizations. Any major change in responsibilities or data beyond refinements of dates and quantities of material shall be prepared as a new Plan for review and concurrence/approval from the project participants.

2. BACKGROUND

The United States, Canada, and the Russian Federation (RF) are supporting a demonstration program of irradiation, in the Canadian Chalk River Laboratories (CRL) National Research Universal (NRU) reactor, of laboratory samples of U.S. and RF MOX fuel derived from weapons-grade plutonium. The purpose of the program is to demonstrate many parts of the disposition of weapons-grade material mission including: disassembly of weapons, conversion of the plutonium to oxide, fabrication of MOX fuel, assembly of fuel elements and bundles, shipment to a reactor, irradiation, post-irradiation examination (PIE), and storage of the spent fuel elements awaiting eventual disposition in a geological repository. The objective of the Parallex (for parallel experiment) tests is to simultaneously burn laboratory-produced quantities of U.S. and RF MOX fuel in a test reactor under conditions representative of those expected in the Ontario Hydro Bruce A reactors. Sample fuel will be manufactured in the United States at Los Alamos National Laboratory (LANL) and in the RF at the Bochvar Institute. The US-manufactured fuel phase is supported by a project team that includes DOE, LANL, Oak Ridge National Laboratory (ORNL), and Atomic Energy of Canada Limited (AECL).

A single shipment of fresh (unirradiated) MOX-fuel is planned. Nine Canadian Deuterium/Uranium reactor design (CANDU) MOX fuel pins will be transported from LANL to CRL. The nine MOX fuel pins (eight full pins, plus a ninth partially filled pin containing archived material) contain sintered uranium-plutonium oxide fuel pellets that have been seal-welded in Zircaloy cladding. The sealed fuel pins each contain about 3.1% plutonium oxide mixed with a balance of depleted uranium oxide. The fuel pins are loaded into an AECL Model 4H enriched fuel bundle package for shipment. The Model 4H package design is certified as a Type B(U)F package design under Canadian and IAEA regulations. The DOT has revalidated the Canadian certification.

The major responsibilities for the lead organizations in the U.S. phase of Project Parallex are: (1) ORNL for overall project coordination and planning (including transportation planning) as part of the DOE Fissile Materials Disposition Program's Reactor Project; (2) LANL for the development, manufacture, and shipment of the MOX fuel; and (3) AECL for the receiving, irradiation tests, and PIE of the irradiated MOX fuel. The sample fuel will be shipped from LANL in a package currently certified by both the Canadian and U.S. authorities and will be carried by a qualified nuclear-transport carrier from LANL to CRL. The responsibility (liability) for the shipments will transfer from the DOE to AECL at the U.S.-Canada border as the effective title to the material is transferred from DOE to AECL.[1]

3. PURPOSE

The DOE Order for Transportation Management, DOE O 460.2 (Ref. 1), requires that determination of "high visibility" shipments be made by the Program Office in charge of the shipment program. When such a determination is made, there are several additional requirements that are then placed on the shipment, including:

- preparation of a U.S. Transportation Plan approved by the DOE Program Office,
- use of the DOE satellite Transportation Tracking and Communications system (TRANSCOM), and
- use of an exclusive-use vehicle for the shipment.

In consideration of the sensitivity and importance of Project Parallex to the DOE and also as a demonstration of the many system components, the Program Office (DOE-MD) has declared that Parallex shipment to be "high visibility" in consideration of the Order.

This U.S. Transportation Plan fulfills the Order requirements for preparing a Transportation Plan and identifies the responsibilities, requirements, and shipment details to ensure the successful movement of MOX fuel from LANL to CRL. The Transportation Plan contains information describing material type, planned shipment schedule, estimated number and weight of shipments, mode of transport, potential carrier routes, packaging description, and cargo security arrangements. It also discusses the methodology for meeting the requirements of the Order. DOE-MD will review and approve the U.S. Transportation Plan for compliance with the requirements of DOE O 460.2.

4. ORGANIZATION RESPONSIBILITIES

The complexity of the Parallex Project and the number of supporting organizations mandate that all roles and responsibilities be clearly defined and observed throughout the life of the project. Each phase of the demonstration program has its own planning effort. This Plan addresses only the responsibilities unique to the transportation phase. The responsibilities of the parties are defined below.

1 Title as used herein means the right to own, acquire, receive, possess, and use special nuclear material.

4.1 U.S. DEPARTMENT OF ENERGY

4.1.1 DOE Office of Fissile Materials Disposition

DOE Headquarters Program Offices establish overall policy for transportation of DOE-owned materials, resolve policy questions, issue guidance, and provide information for use in transportation activities.

MD.1 DOE-MD shall seek and arrange funding authority for DOE laboratories and arrange procurement authorization for other parties.

MD.2 DOE-MD shall provide the DOE Los Alamos Area Office (DOE-LAAO) and LANL with guidance on the amount of special nuclear material that will be shipped by DOE as laboratory samples to AECL under provisions of the Atomic Energy Act of 1954 (Ref. 2).

MD.3 DOE-MD shall review and approve the U.S. Transportation Plan. DOE-MD may enlist the DOE Office of Environmental Management (DOE-EM) to (1) assist in coordination of shipment information through their Liaison and Communications program and to provide advance information regarding the MOX shipments to participating organizations, state agencies, and stakeholders, if requested, and (2) facilitate the use of the DOE TRANSCOM satellite tracking system.

MD.4 DOE-MD is responsible for arranging for transfer of funds between DOE-MD and the DOE Oak Ridge Operations Office (DOE-OR) to fund extended use of TRANSCOM and the operation of the TCC beyond the normal 40-hour workweek, should 24-hour shipment coverage be required.

MD.5 DOE-MD shall conduct the required environmental review for the MOX fuel shipment in the United States.

MD.6 DOE-MD in conjunction with the Government of Canada shall specify the Canadian-U.S. border crossing location and a backup crossing point for the shipment and provide this information to LANL.

MD.7 DOE-MD shall determine the most appropriate U.S. route for the shipment and advise LANL of this route.

MD.8 DOE-MD shall specify to LANL a shipping time window during which the shipment will take place.

4.1.2 DOE Office of Nonproliferation and National Security

NN.1 DOE-NN shall notify DOE-MD and LANL in writing when the authority to make the shipment is granted.

4.1.3 DOE Operations Offices

OP.1 If a transportation incident requiring emergency response occurs, DOE Operations Offices shall provide emergency response teams, including personnel with packaging operations, radiological, and transportation management expertise in the unlikely event of a transportation incident while the shipment is in the United States. Headquarters provides such assistance on the request of the state or local emergency response teams through the DOE Regional Coordination Offices. A list of these offices is provided in Attachment A.

4.1.4 DOE Albuquerque Operations Office

The DOE Albuquerque Operations Office (DOE-AL) is responsible for overall program management for the transfer of the MOX shipment from LANL to CRL. Under the authority of DOE-AL, DOE-LAAO is the shipper of record, with LANL acting as agent.

AL.1 LANL and DOE-LAAO shall provide DOE-MD with assistance in preparation of documentation that describes the laboratory samples of special nuclear material that will be shipped by DOE to AECL.

4.1.5 DOE Oak Ridge Operations

The TRANSCOM tracking system is under the program management of DOE-OR.

OR.1 Coordination with the TCC concerning shipment schedules and schedule changes, if any, shall be overseen by the DOE-OR.

OR.2 Any financial arrangements necessary for extended use of TRANSCOM shall be arranged by DOE-MD with DOE-OR.

4.2 OAK RIDGE NATIONAL LABORATORY

ORNL, as the lead laboratory for reactor alternatives for fissile materials disposition, is managing the Parallex Project for DOE-MD. ORNL has the responsibility to plan, coordinate, and oversee the activities of the other parties to assure success of the project and report on progress and schedule to DOE.

ORNL.1 ORNL shall prepare the U.S. Transportation Plan for the MOX fuel shipment.

4.3 LOS ALAMOS NATIONAL LABORATORY

LANL is the DOE-designated shipper for these shipments and shall conduct shipping activities in compliance with applicable international, federal, state, tribal, and local requirements and the conditions of this Transportation Plan. The following are LANL responsibilities.

Before the Shipment

LANL.1 LANL is responsible for registering in writing with the U.S. Competent Authority (DOT) as a user of the AECB approved Model 4H package [CDN/4212/B(U)F]. The U.S. Competent Authority approval, USA/0485/B(U)F, Rev.1, will expire on September 30, 2001.

LANL.2 LANL is responsible for ensuring that the most current versions of the Canadian Certificate of Compliance are available.

LANL.3 LANL is responsible for ensuring that the shipping package is loaded according to the instructions contained in the AECL Procedure No. A-12052-PR-1.

LANL.4 LANL is responsible for ensuring that the shipment complies with applicable sections of the AECB's *Transport Packaging of Radioactive Materials Regulations* (Ref. 4) and applicable sections of SOR/85-77 *Transportation of Dangerous Goods* (Ref. 5).

LANL.5 LANL is responsible for ensuring that the shipment complies with applicable sections of the International Atomic Energy Agency (IAEA) Safety Series No. 6 Regulations (Ref. 6).

LANL.6 LANL shall notify AECL a minimum of three weeks in advance of the dates by which the AECL Model 4H packaging will be needed to adequately allow for the receipt and loading prior to the scheduled shipping date.

LANL.7 All preloading activities, such as preparing and testing the loading equipment, and scheduling of required support personnel, are the responsibility of LANL.

LANL.8 LANL is responsible for selecting the carrier involved in the transport.

- LANL shall verify the carrier's qualifications.
- LANL shall ensure that the motor carrier is in compliance with the Federal Motor Carrier Safety Regulations (49 CFR 350-399).
- The carrier selected shall be evaluated by LANL in accordance with DOE's Motor Carrier Evaluation Program (Ref. 7).
- LANL shall ensure that the carrier is certified to carry Dangerous Goods in Canada (Ref. 5).
- LANL shall ensure that vehicle operators are appropriately licensed and trained to meet Canadian requirements.
- LANL shall ensure that the carrier is capable of interfacing with the TRANSCOM system (i.e., currently has an active QUALCOM unit installed on the transport vehicle).

LANL.9 LANL is responsible for coordinating the schedule for loading and shipment of the material within the shipping window specified by DOE-MD. The actual schedule will be based on such factors as the LANL facility's ability to load and ship materials, the consignee's ability to receive the material, predicted weather conditions, and existing road conditions along the route.

LANL.10 LANL shall contact the DOE National Transportation Program (DOE-NTP) (Bobbie Sanchez) to request the use of TRANSCOM to track the MOX fuel shipment. DOE-NTP will direct DOE-OR to facilitate the use of TRANSCOM.

LANL.11 LANL, as shipper, will be assigned as the designated user (DU) of TRANSCOM and will, in addition to the TRANSCOM Control Center (TCC), be responsible for communicating with the driver while the is en route. LANL will also receive all messages from the driver.

LANL.12 LANL shall direct TCC not to provide advanced notification to states through which the shipment passes, but states through which the shipment passes should be provided access to view the shipment's progress.

LANL.13 LANL shall provide preshipment notification information updates about the shipment schedule to the DOE Prospective Shipment Module. LANL shall also provide this information to participating organizations: DOE-MD, DOE-NTP, ORNL, AECL, TCC, and the carrier.

LANL.14 LANL shall notify AECL at least seven days before the shipment starts. The AECL notice will request authorization to ship on the expected date, and will provide a draft copy of the shipping papers, time of expected arrival, transfer point (border-crossing), name of carrier, and transport identification.

LANL.15 LANL must receive confirmation from AECL prior to commencement of shipment. The confirmation should indicate that AECL is prepared to receive the shipment at the planned time and location.

LANL.16 LANL shall provide the carrier with the DOE-MD approved route and border crossing and alternatives in advance of shipment with concurrence by AECL.

LANL.17 LANL, with the assistance of ORNL, shall coordinate scheduling and routing information with the TCC and arrange for TRANSCOM training of drivers, as needed.

LANL.18 LANL shall ensure that the motor carrier's vehicles are in compliance with Appendix G, "Minimum Periodic Inspection Standards," (Ref. 8) prior to loading, and that the load is properly secured prior to departure.

LANL.19 LANL, in coordination with AECL, shall be responsible for providing the carrier with awareness of Canadian emergency response requirements.

LANL.20 LANL shall ensure that radioactive contamination and radiation levels for the package and vehicle are in compliance with the U.S. and AECB regulations, through surveys performed on loaded packages and vehicles using qualified, trained personnel; calibrated equipment; and approved procedures.

LANL.21 LANL shall meet the physical protection requirements for in-transit safeguards and security of this material in accord with DOE and AECB regulations.

LANL.22 LANL is responsible for preparing the shipping papers, assuring that the marking and labeling are correct, and supplying the proper placards to the carrier. Canadian emergency response information shall be included in the shipping papers. The AECL 24-hour emergency phone number will be included on the shipping papers prepared by LANL.[2]

LANL.23 LANL shall ensure that all required labeling, marking, and placarding complies with 49 CFR requirements, as well as the U.S. Certificate of Competent Authority and the Canadian Package Design Approval Certificate before release of the shipment.

LANL.24 LANL shall provide carrier drivers with an information packet containing copies of the shipping papers, emergency response information, special instructions for the shipment (see Section 4.3.1), and a description of the appropriate routes before the shipment is dispatched from LANL. LANL shall supply the applicable competent authority certificates for the package to the carrier.[3]

LANL.25 LANL must receive written notification from DOE-NN when shipment authorization has been granted before commencement of the shipment.

During the Shipment

LANL.26 LANL shall maintain 24-hour available emergency telephone contact for technical advice and detailed information regarding the shipment.

After Shipment

LANL.27 DOE and LANL shall receive notification from AECL upon arrival of the shipment.

2 The U.S. Transportation Plan includes additional relevant contact numbers.
3 The certificates are required to accompany the packages in Canada, but not in the United States.

4.3.1 Carrier Responsibilities

The carrier, under contract to LANL, is responsible for safely transporting the MOX shipment from LANL to CRL. The carrier's responsibilities include the following items.

Before the Shipment

C.1 In advance of the shipment, the carrier shall arrange for vehicle inspections with the appropriate state vehicle inspection agencies.

C.2 The carrier, under its service contract with LANL, is responsible for obtaining required permits and arranging for vehicle inspections along the transportation route, as may be required.

C.3 The carrier shall ensure that the required drivers' training and licensing requirements are current.

C.4 The carrier shall ensure that the vehicle meets Appendix G (Ref. 8) inspection requirements prior to the vehicle being placed in service.

C.5 The carrier shall ensure that the vehicle satisfies the Commercial Vehicle Safety Alliance (CVSA) Out-of-Service criteria (Ref. 9).

C.6 The carrier shall ensure that all applicable U. S. Federal Motor Carrier Safety, Transport Canada, and Ontario Ministry of Transport regulations are met.

C.7 The carrier shall ensure that the package is properly tied down and they have received the proper shipping documents.

C.8 The carrier must verify proper operation of TRANSCOM prior to departure.

During the Shipment

C.9 The carrier operator selected to transport the material shall inspect the vehicle and security of the load every 2 hours or 100 miles, whichever occurs first, as required by DOT regulations.

C.10 The driver shall maintain communication via TRANSCOM from dispatch at LANL to receipt at CRL. Any deviation in approved shipment routing, expected arrival times, or unplanned stoppages shall be reported to the TRANSCOM designated user (DU)(i.e., LANL) and the TCC. The driver shall also maintain contact with its dispatch office using TRANSCOM.[4] The driver shall communicate with the DU (and TCC) at each vehicle inspection checkpoint (approximately every 2 hours).

4 TRANSCOM has an interface to the QUALCOMM satellite tracking system that is used by the carrier dispatch

C.11 The carrier dispatch center shall implement the back-up communications procedures as specified in the TRANSCOM User Procedures Manual (Ref. 10) in the event of a TRANSCOM system failure.

C.12 The driver is responsible for maintaining the correct status of the vehicle placard.

C.13 The carrier's dispatch shall ensure effective communication with its drivers on all extraordinary events involving the shipment, including external public relations/affairs events that have potential impact on the shipment. The carrier's dispatch shall communicate with LANL for guidance.

If a Transportation Incident Occurs

C.14 The carrier shall notify the both the TRANSCOM DU and TCC and follow DOT emergency response procedures.

Following Completion of the Shipment

C.15 The carrier is responsible to file, within 90 days of completion of the shipment, the postnotification information [49 CFR 397.102(g)] with the Federal Highway Administration.

4.4 ATOMIC ENERGY OF CANADA LIMITED

AECL has the joint responsibility for transportation, safeguards, and security of the shipments with LANL for U.S. fuel. AECL has prepared a Canadian Transportation Plan (Ref. 11) which describes the requirements for the transportation of materials and equipment associated with the Parallex Program. Issues for which AECL is responsible related to the U.S.-fuel MOX shipments to CRL are described below.

Before the Shipment

AECL.1 AECL shall supply the to LANL the AECL Model 4H packaging required for the shipment of fissile materials from LANL to CRL. Drawings, procedures, etc., are available from AECL.

AECL.2 AECL in conjunction with DOE-MD shall determine a Canadian-U.S. border crossing location and alternative for the shipment.

AECL.3 AECL shall determine the most appropriate preferred and alternative Canadian route for the shipment and advise LANL of this route.

center. The carrier dispatch center will use QUALCOMM to communicate with the truck. All communications using QUALCOMM between the carrier and the dispatch center will be accessible to TRANSCOM.

AECL.4 AECL shall coordinate with LANL to provide the carrier with Canadian emergency response information that will be included in the shipping papers.

AECL.5 AECL is responsible for preparing "Emergency Response Form for Road", if needed, for transit in Canada from the Canadian border to CRL, based on review of shipment papers.

AECL.6 For transportation in Canada, AECL shall assure, through communication with LANL, that the shipment is prepared at LANL in accordance with regulations of the AECB (Ref. 4) and Transport Canada (Ref. 5).

AECL.7 AECL shall obtain a required import permit for the shipment entering Canada. This includes, but is not limited to, the Import License and a Canadian Customs Invoice. The governing bodies are the Department of Foreign Affairs and International Trade Canada and the AECB.

AECL.8 Copies of the import permit shall be sent to LANL and become part of the shipping documentation package that accompanies the shipment.

AECL.9 AECL shall assure, through communication with LANL, that the carrier chosen is certified to carry Dangerous Goods in Canada.

AECL.10 AECL shall prepare any required documentation for the transportation segments in Canada. This shall include an Emergency Response Form for Road, if required.

AECL.11 AECL shall confirm to LANL, prior to commencement of shipment, that AECL is prepared to receive the shipment at the planned time and location.

During the Shipment

AECL.12 AECL shall maintain a 24-hour emergency contact number during the shipment.

After the Shipment

AECL.13 AECL shall notify LANL immediately upon receipt of material or if there is delay past the estimated time of arrival or suspected loss of material.

AECL.14 AECL shall notify LANL if there is suspected loss or unaccounted for material in the shipment that is received.

4.5 TRANSCOM CONTROL CENTER

The TCC will have a coordinating role with the shipper, carrier, carrier dispatch center, AECL, and DOE. In this capacity, TCC has the following responsibilities.

TCC.1 TCC shall provide satellite-tracking capability for this shipping campaign.

TCC.2 TCC shall provide a transponder to the carrier, if the carrier's vehicle is not already so equipped.

TCC.3 TCC shall assist LANL and the carrier in ensuring proper operation of communications equipment.

TCC.4 TCC shall provide procedures to the carrier on the proper use of the equipment, how and when to report and log events, what to do in case of a TRANSCOM outage, and all other procedures necessary for proper functioning of the system.

TCC.5 TCC shall provide reports of shipment status to DOE-MD, DOE-Emergency Operations Centers, AECL, ORNL, and LANL approximately twice in each 24-hour period or, in case of emergency or unplanned stoppages, the report will be directed immediately to all parties.

TCC.6 Details of the decisions of the carrier communications center on stopping or diversion of the MOX shipment due to severe weather shall be entered into the communications center's log and to TCC.

TCC.7 TCC shall not provide notification to states through which the shipment will be made. Assess to the designated organization within the state to view the movement of the shipment will be provided through TRANSCOM.

TCC.8 In case of an incident, following the alert of local officials, the driver or TCC shall notify LANL's 24-hour emergency notification number.

TCC.9 If the driver is unable to respond, the carrier communications center or TCC shall notify the state patrol that the driver is not responding.

TCC.10 Information pertaining to the vehicle breakdowns shall be recorded in the TCC shipment log.

5. SHIPMENT SCHEDULE

The shipment schedule will be determined by DOE-MD. The schedule will not be made public.

6. ADVANCE AND POSTNOTIFICATIONS/TRACKING OF SHIPMENTS

Advance notification to the states is not required for this shipment. LANL will provide the notification to AECL before the shipment commences. The notification shall contain the required information as specified in 49 CFR 173.478(b). LANL will provide advance notification of shipment details to AECL, the consignee.

The DOE TRANSCOM system will provide satellite-tracking capability for this shipping campaign. Advance information of projected shipment schedules will be coordinated by LANL with TCC. LANL will notify TCC of the shipment schedule and schedule changes, as appropriate, at the earliest possible date. LANL will supply TRANSCOM with the expected and alternate routes.

The driver will notify TCC of any unscheduled stops in route, including stops for inclement weather. Any deviation from the preferred route will comply with applicable regulations, state, tribal, local, and international direction, and carrier operating procedures.

In the event of TRANSCOM failure, the carrier will comply with the procedures specified in the TRANSCOM Users Procedures Manual (Ref. 10). Program participants may obtain software (Ref. 10, 12) from the DOE-NTP that will permit them to monitor the progress of the shipment from their personal computers.

AECL will notify LANL (1) on receipt of material, (2) if the shipment has not arrived on time (is past due), or (3) if there is suspected loss or unaccounted for material.

The carrier completes the postnotification requirements of the Federal Highway Administration within 90 days of completion of the shipment, if required. These requirements are for all HRCQ shipments (quantities of radioactive material $>3000A_2$ or $>3000A_1$).

7. MATERIAL INFORMATION

Nine (9) MOX fuel elements will be manufactured at LANL. Eight of the fuel elements will be prepared for reactor irradiation; the ninth element will contain archive MOX pellets from different fabrication batches, to be de-canned and characterized at AECL. The 8 reactor fuel elements will each contain natural urania fuel pellets at each end of the fuel stack. The MOX fuel itself is made with depleted urania blended with weapons-derived plutonium dioxide at a concentration of about 3.1 wt %. The fuel cladding material is Zircaloy-4 alloy. Each of the fuel elements is helium leak-tested and decontaminated prior to loading into the shipping container. See Attachment C for detailed analysis of isotopic quantities for the shipment.

The amount of radioactive material in the shipment will determine the shipment's designation as HRCQ shipments. The controlling regulatory requirement is expressed as the A_2 value that may be calculated considering the mixture of radionuclides in the shipment. (The determination of the A_2 value for single radionuclides and for mixtures of radionuclides, including radioactive decay chains, may be found in 10 CFR 71 Appendix A.) For the fabricated fuel in this shipment, it was calculated that an excess of approximately 200 grams of the mixture of Pu-239, -240, -241, -238, and Am-241 in a shipment would classify the shipment as HRCQ. Therefore, the planned shipment will need to be carefully evaluated for HRCQ and the associated additional regulatory requirements.

8. PACKAGING

The shipment classification for the MOX pellets will be Type B(U)F. The shipping Package will be a Type B(U)F, specifically an "Atomic Energy of Canada Limited Model 4H Enriched Fuel Bundle Shipping

Package". This packaging has certificates that are current in both Canada (CDN/4212/B(U)F, Rev 7) and the United States (USA/0485/B(U)F, Revision 1). One of these packages will be supplied to LANL by AECL for use in shipping the MOX fuel elements.

The 4H packaging consists of a 208-L (48 imperial gallon) metal drum with a sealable lid. Four inner containers (2R type) are surrounded by a thermal shield material, a cushioning material, and metal reinforcement retaining structures. Each 2R container houses an individual felt-lined aluminum can. The MOX fuel will be packed in a rigid foam cylinder with holes for each of the nine fuel elements, and loaded into one of the four 2R-type containers – the other 2R-type containers will be empty.

The AECL Model 4H packaging is specifically designed to withstand transport accidents, including severe impact, puncture, water immersion and fire. Prior to certification of the package design, physical testing – such as drop tests, puncture tests, underwater immersion, and fire exposure – was conducted to demonstrate compliance with licensing requirements. The Model 4H packaging has been successfully used for radioactive material shipments in Canada and several other countries around the world for more than 20 years.

As prepared for shipment, each of the 2R containers may contain up to 100 grams hydrogen, and:

> not more than 22.6 kg of oxides of unirradiated uranium (natural or depleted) and plutonium (separated and further described in Ref. 14), (U, Pu) O_2, containing a maximum of 20 kg total of uranium and plutonium with up to 4 wt% PuO_2 in (U+Pu) O_2 sealed in zirconium alloy fuel cladding with Allowable Numbers and Transport Indices as set out in Table 4. CDN/4212/B(U)F, Rev. 7.

Containment for Type B quantities is provided by the closed drum and specification 2R containers with additional containment provided by the leak-tight zircaloy fuel cladding on the elements (required). The maximum gross weight of the package is 250 kg. According to the Operating Procedures and the Canadian Package Design Approval Certificate (and the U.S. Competent Authority Certification):

> Shipment is authorized as Fissile Class II with a minimum transport index as specified (*in Canadian certificate of competent authority CDN/4212/B(U)F, Revision 7)* under Authorized Radioactive Contents, or the highest radiation dose rate, in microsieverts per hour divided by 10, measured at one meter from any accessible external surface of the package, whichever is larger.

The U.S. Certificate contains no additional requirements affecting the shipment other than the registration of the user and the maintenance of the most recent copy of the U.S. Certificate.

9. SHIPMENT PREPARATION

In addition to observation of the proper packaging procedures for the 4H shipping container, LANL is responsible for preparing the shipping papers, assuring that the marking and labeling are correct, and supplying the proper placards to the carrier. The carrier is responsible for attaching the placards as required by DOT and Transport Canada.

An example of the proper shipping description to be used on the shipping papers is:

RQ, Radioactive material, fissile, n.o.s., 7, UN2918
FISSILE MATERIALS
Normal Form
Physical and Chemical Form: Solid, Oxide
Contains: Plutonium-239, Plutonium-240, Americium-241, Plutonium-241[5]
Total Activity:_____TBq (weight in grams is an optional addition)
Type B: CDN/4212/B(U)F, Rev. 7, USA/0485/B(U)F, Rev. 1

Labels Required: RADIOACTIVE YELLOW-III; Transport Index:___
Placards Required: RADIOACTIVE
Weight:_____ (units)
Emergency Response Number:_____
Exclusive Use Shipment

Shippers certification, signature

The marking of each of the packages must include the complete alpha/numerical description of the Canadian and U.S. certificates. The package must display the following marking: "RQ, Radioactive material, fissile, n.o.s., UN2918 (RADIONUCLIDES)." In addition, the gross weight of the shipment must be stenciled on the package, and the marking may include the consignee name and address (optional).

A Radioactive Yellow-III label must be affixed to the package. On the label, in waterproof pen, the following should be inscribed:

Contents: Plutonium-239, plutonium-240, americium-241, plutonium-241
Activity: (insert total activity in TBq; in addition, weight in grams of isotopes may be inserted)
Transport Index: (for 3.1% Pu, this is assigned a value of 10 based on package certificate)

10. PROPOSED ROUTES

The shipment will be by highway. Representative routes from LANL to the Canadian border have been calculated using the HIGHWAY routing model, which was developed by DOE specifically for the purpose of selecting routes for shipment of radioactive materials using criteria set forth in DOT regulations. The representative routes are listed in Table 1 and described in some detail in the Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment, DOE/EA-1216.

[5] The package may also contain other low activity radionuclides that are not required to be explicitly identified in the "Contains" section of the shipping papers.

Table 1.
Summary of Representative Transportation Routes
Between LANL and the U. S. Canadian Border

U.S.-Canadian Border Crossing	Distance from LANL to U.S.-Canadian Border
	(miles)
Pembina, ND	1532
Sault Ste. Marie, MI	1960
Port Huron, MI	1755
Detroit, MI	1715
Buffalo, NY	1896
Niagara Falls, NY	1918
Watertown, NY	2127

11. EMERGENCY PLANNING AND RESPONSE

State, tribal, and local government officials have the responsibility for emergency response to any accident within their jurisdiction. Initial responders administer first aid, isolate the area, attempt to identify the hazard, and notify appropriate state and federal authorities. Federal agencies become involved in responding to an emergency when specifically requested to do so by the state, tribal, or local government officials. DOE is the primary agency for providing radiological monitoring and assessment assistance. DOE's support ranges from giving technical advice over the telephone to sending highly trained personnel and equipment to the accident site to help identify and minimize any radiological hazards. The selected carrier for these shipments is responsible for providing emergency response assistance and recovery/restoration actions, if necessary. The TCC can provide assistance in emergency planning for the shipment, if requested.

11.1 EMERGENCY PREPAREDNESS

As the DOE designated shipper, LANL will provide shipper-related emergency information and maintain a 24-hour available emergency telephone contact for technical advice and detailed information regarding the shipment. This telephone contact number is recorded on the shipping papers accompanying the shipment. AECL will also provide 24-hour emergency contact. This number will be recorded on the shipping papers.

Current plans call for the TCC to be staffed during the 8-hour day shift, but the automated TRANSCOM system will be running 24 hours a day so that authorized users can track the shipment at any time. If there is a requirement for 24-hour a day staffing of the TCC during the shipment, additional funding will need to be allocated for TCC operations.

11.2 NOTIFICATIONS

11.2.1 Carrier Breakdown

The carrier driver will notify the communications center if mechanical problems occur or a driver is incapacitated. If the driver requires assistance and replacement equipment and/or drivers, the carrier communications center will notify LANL. Information pertaining to the vehicle breakdown shall be noted in the carrier communication center's log and input to TRANSCOM. If the vehicle must deviate from the preferred route due to need of vehicle repair, or any condition that makes continued use of the preferred route unsafe, the communications center will notify LANL and TCC stating that the vehicle will be deviating from the preferred route.

11.2.2 Severe Weather

Indication of severe weather can be obtained from numerous sources. Upon indication of severe weather, the carrier communications center shall notify the driver and obtain his/her input (if not initially alerted to the weather conditions by the driver). The communications center will obtain further information from the state police of the affected states and either:

- divert the driver, truck, and cargo to a state-designated safe parking haven until weather improves;
- direct the driver to remain at present location until weather conditions permit safe travel; or
- delay the shipment, if prior to leaving the LANL facility, until weather improves.

Details of the decisions by the carrier communications center on stopping or diversion of the MOX shipment due to severe weather will be entered into the communications center's log and to TRANSCOM.

11.2.3 Incident/Accident In Route

In the event of an incident, the driver will notify the 911 line, the appropriate state patrol, the carrier communications center, and TCC of the event. If the driver is unable to respond, the carrier communications center or TCC will notify the state patrol that the driver is not responding. The state patrol can then locate the truck and establish incident command, if necessary. Following the alert of the local officials, the driver or TCC will notify the LANL 24-hour emergency notification number.

Any state, tribal, local, or private sector organization needing radiological assistance can call the nearest DOE Regional Coordinating Office (RCO) to obtain information, advice, or assistance through the Federal Radiological Monitoring and Assessment Plan. The DOE Regional Coordinator decides what action is needed based upon the request. The DOE RCO also ensures that the appropriate state or tribal personnel are contacted in order to effect the appropriate involvement of state or tribal officials and resources. If the emergency is such that personnel and/or equipment are needed at the accident scene, the RCO coordinates the activation of a DOE

Radiological Assistance Program (RAP) team. The RCO offices and phone numbers are listed in Attachment A.

11.3 EMERGENCY RESPONSE IN THE UNITED STATES

The emergency-related roles and responsibilities that support this Plan are outlined below.

- The carrier driver, if able, will make emergency notifications described above and undertake first aid actions, control the initial incident scene, provide assistance to first responders, and perform other emergency actions as described in the carrier's emergency response plan.
- First responders, local law enforcement, fire fighters, and emergency medical service personnel will be guided in their approach to the incident scene and initial response actions by information contained in *1996 North American Emergency Response Guidebook* (Ref. 15). Guide 165 applies to material transported in these shipments and is attached for reference (Attachment D). The Guidebook shall be in the possession of the driver, and the Guide 165 or other similar information must be attached to the shipping paper documentation.
- Working with the local incident command center, the carrier will follow its emergency response procedures. The carrier will be given first opportunity to dispatch a crew to the affected area. The states maintain specialized state-level hazardous materials and/or radiological response teams that may be activated to provide technical assistance and mitigation during emergencies. State teams are activated by the incident commander. DOE will provide RAP teams from one of its eight regional offices to advise or assist in cleanup operations, if requested.
- All public contact and release of information will be coordinated through the local officials that have established incident command. All information released will be with the concurrence of all parties involved with the transportation and local incident command.

11.4 RECOVERY

The carrier has primary responsibility for package and transporter recovery operations. Recovery will not begin until the emergency phase of any accident is terminated, following a decision that no further radiological or other hazard is present. DOE will assist the carrier in recovery operations, where appropriate. States may wish to exercise their vehicle inspection responsibility before permitting the recovery vehicle to proceed to the nearest DOE facility or to return to LANL.

11.5 CLEANUP AND SITE RESTORATION

The carrier has primary responsibility for cleanup and site restoration following an emergency. Standards for such actions are established by regulation and by authorities in the affected jurisdictions.

After the immediate threat of the accident has passed, the lead federal radiological monitoring and assessment role is transferred from DOE to the Environmental Protection Agency (EPA). It is the

responsibility of the shipper to repackage and dispose of any primary radioactive material spilled, plus any contaminated material.

11.6 EMERGENCY RESPONSE IN CANADA

AECL is responsible for preparing the "Emergency Response Form for Road" for transit in Canada from the Canadian border to CRL.

12. PHYSICAL PROTECTION

Under existing U.S. and Canadian regulations, the proposed shipment of MOX fuel from LANL to CRL does not require any form of special security measures (e.g., security escorts).

LANL, acting on behalf of DOE, is required by DOE to meet the NRC physical protection requirements for "special nuclear material, of low or moderate strategic significance" when offering the material to a carrier for export. The defining limits for these materials are (1) moderate strategic significance is special nuclear material containing more than 500 grams plutonium but less than 2 kilograms and (2) low strategic significance is special nuclear material containing more than 15 grams of plutonium but less than 500 grams. DOE is exempt from these requirements when using a DOE transport system [10 CFR 73.6 (d)]; however, a commercial carrier will be involved, and the requirements of DOE are to comply with the NRC regulations [DOE O 460.1A (Ref. 16) and 460.2].

The physical protection regulations for moderate strategic significance material in transit are found in 10 CFR 73.67 (e)(5) and for low strategic significance material in transit are found in 10 CFR 73.67 (g)(4). The notifications differ somewhat regarding threat or theft of material, but both sections require a response plan or procedures to deal with either threat or theft. LANL shall carefully consider the quantities to be shipped and comply accordingly.

AECL is responsible for providing protection comparable to the recommendations in the current version of IAEA INFCIRC/225 (Ref. 17). The IAEA Categories II or III protection will be applicable. IAEA Category II is the same as the NRC's special nuclear material (SNM) of Moderate Strategic Significance, and IAEA Category III is the same as the NRC's SNM of Low Strategic Significance.

13. INSURANCE/LIABILITY ISSUES

The carrier will maintain necessary insurance and liability coverage for the shipments. DOE will retain title of the material until it passes through the U.S.-Canadian customs and enters Canada. AECL will assume title at that point. AECL will obtain insurance coverage for the material during transportation from the Canadian border to CRL, if any is necessary beyond that normally held by the carrier.

14. REFERENCES

1. U.S. Department of Energy, "Departmental Material Transportation and Packaging Management," DOE O 460.2, Sept. 27, 1995.

2. Title 42 U. S. C. 2011 et seq., the Atomic Energy Act of 1954, as amended. Statutory authority exempting DOE from NRC export licensing regulations for foreign distribution of laboratory samples of special nuclear material is given in 42 U.S.C. 2074(d) and 42 U.S.C. 2155.

3. 10 CFR Part 110, "Export and Import of Nuclear Equipment and Material."

4. Atomic Energy Control Act (Canada), *Transport Packaging of Radioactive Materials Regulations*, SOR/83-740 with amendments.

5. Transport Canada, *Transportation of Dangerous Goods*, SOR/85-77.

6. International Atomic Energy Agency, *Regulations for the Safe Transport of Radioactive Material, 1985 Edition (As Amended 1990)*, Safety Series No. 6, 1990.

7. U.S. Department of Energy, "Motor Carrier Evaluation Program (MCEP)," from the Environmental Management Home Page, September 15, 1995.

8. Federal Highway Administration, U.S. Department of Transportation, Federal Motor Carrier Safety Regulations, Chapter III, Subpart B, Appendix G, *Minimum Periodic Inspection Standards*.

9. Commercial Vehicle Safety Alliance, "North American Uniform Out-of-Service Criteria," Appendix A, Parts I, II, and III, April 1, 1995.

10. U.S. Department of Energy, "TRANSCOM The Transportation Tracking and Communications System for Windows: User Procedures Manual, Rev. 0" April 1998.

11. Atomic Energy of Canada Limited, Chalk River Laboratories, "Transportation Plan for the Parallex Program," 100-37000-TD-002, Rev. 0, March 1996.

12. U.S. Department of Energy, "TRANSCOM The Transportation Tracking and Communications System for Windows: User's Manual, Version 1.0," March 13, 1998.

13. Oak Ridge National Laboratory, *Test Plan for the Parallex CANDU-MOX Irradiation*, ORNL/TM-13302, October 1996.

14. W. R. Taylor, *Fissile Material Packaging 4H Compliance with Canadian Transport Regulations*, Report No. CRNL 1698.

15. Research and Special Programs Administration, U.S. Department of Transportation, *1996 North American Emergency Response Guidebook*, 1996.

16. U.S. Department of Energy, "Packaging and Transportation Safety," DOE O 460.1A, Oct. 2, 1996.

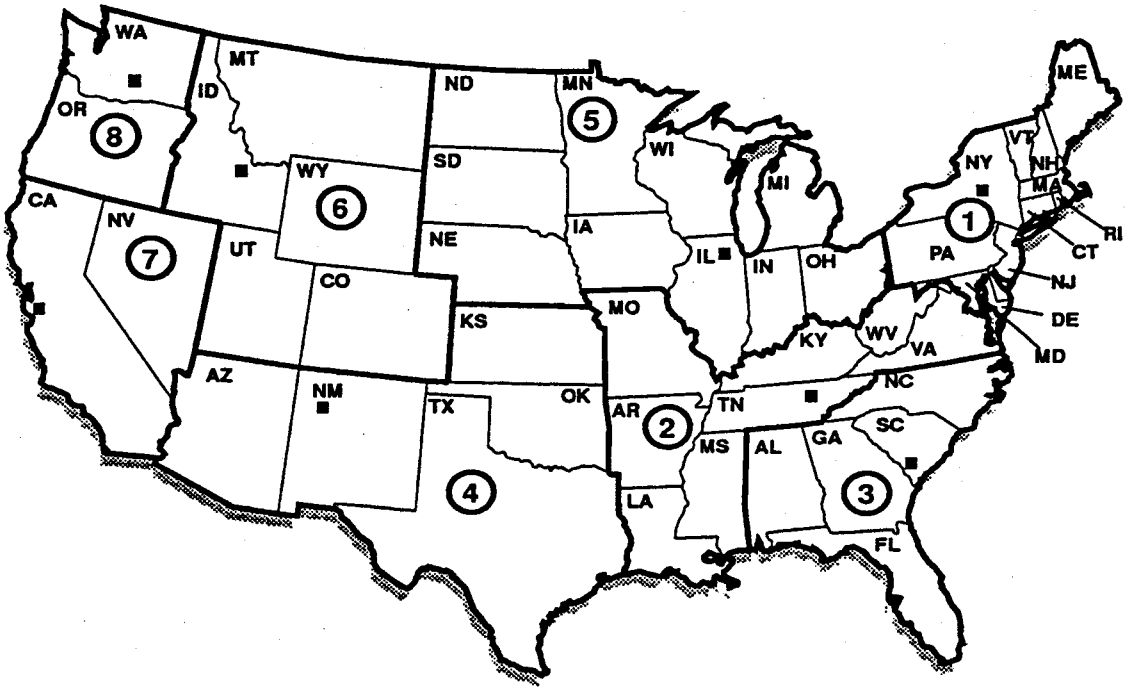
17. International Atomic Energy Agency, *The Physical Protection of Nuclear Material*, INFCIRC/225/Rev.2, December 1989.

ATTACHMENT A

U.S. DEPARTMENT OF ENERGY REGIONAL COORDINATING OFFICES

U.S DEPARTMENT OF ENERGY REGIONAL COORDINATING OFFICES

The name, post office or street address, and telephone number for assistance for the eight RCOs that are located at eight DOE Operations Offices are provided below. The map shows the location of the offices and their geographical areas of responsibility.



1 Brookhaven Area Office
Upton
Long Island, NY 11973
516-282-2200

2 Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831
423-576-1005
423-576-7885

3 Savannah River Operations Office
P.O. Box A
Aiken, SC 29801
803-725-3333

4 Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87115
505-845-4667

5 Chicago Operations Office
9800 S. Cass Avenue
Argonne, IL 60439
708-252-4800 (Duty Hours)
708-252-5731 (Off Hours)

6 Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83401
208-526-1515

7 Oakland Operations Office
1333 Broadway
Oakland, CA 94612
510-273-4237

8 Richland Operations Office
P.O. Box 550
Richland, WA 99352
509-373-3800

ATTACHMENT B

ROUTING ANALYSIS FOR PROJECT PARALLEX SHIPMENTS

Purpose of the Shipments

DOE-MD proposes to ship nine CANDU reactor experimental MOX fuel pins between the DOE's LANL and the AECL's CRL for the purposes of reactor irradiation in the Chalk River NRU Reactor and subsequent PIE. The material will be transferred from DOE to AECL as a laboratory sample, in support of Project Parallex (meaning—Parallel Experiment) being conducted by AECL and funded by DOE. The purpose of Project Parallex is to insert MOX fuel pins manufactured from U.S. and Russian weapons plutonium into a CANDU fuel bundle and then irradiate this fuel bundle in the NRU for a period of 15 to 18 months, followed by PIE of the irradiated fuel. The PIE will determine burnup and other data that will allow AECL and DOE to assess the suitability of burning MOX fuel in CANDU reactors.

Seven U.S. representative routes have been analyzed for their suitability in the upcoming shipment and are described in some detail in the Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment (Ref. B1). Figure B-1 is a map of the representative routes between Los Alamos and the U.S. Canadian border.

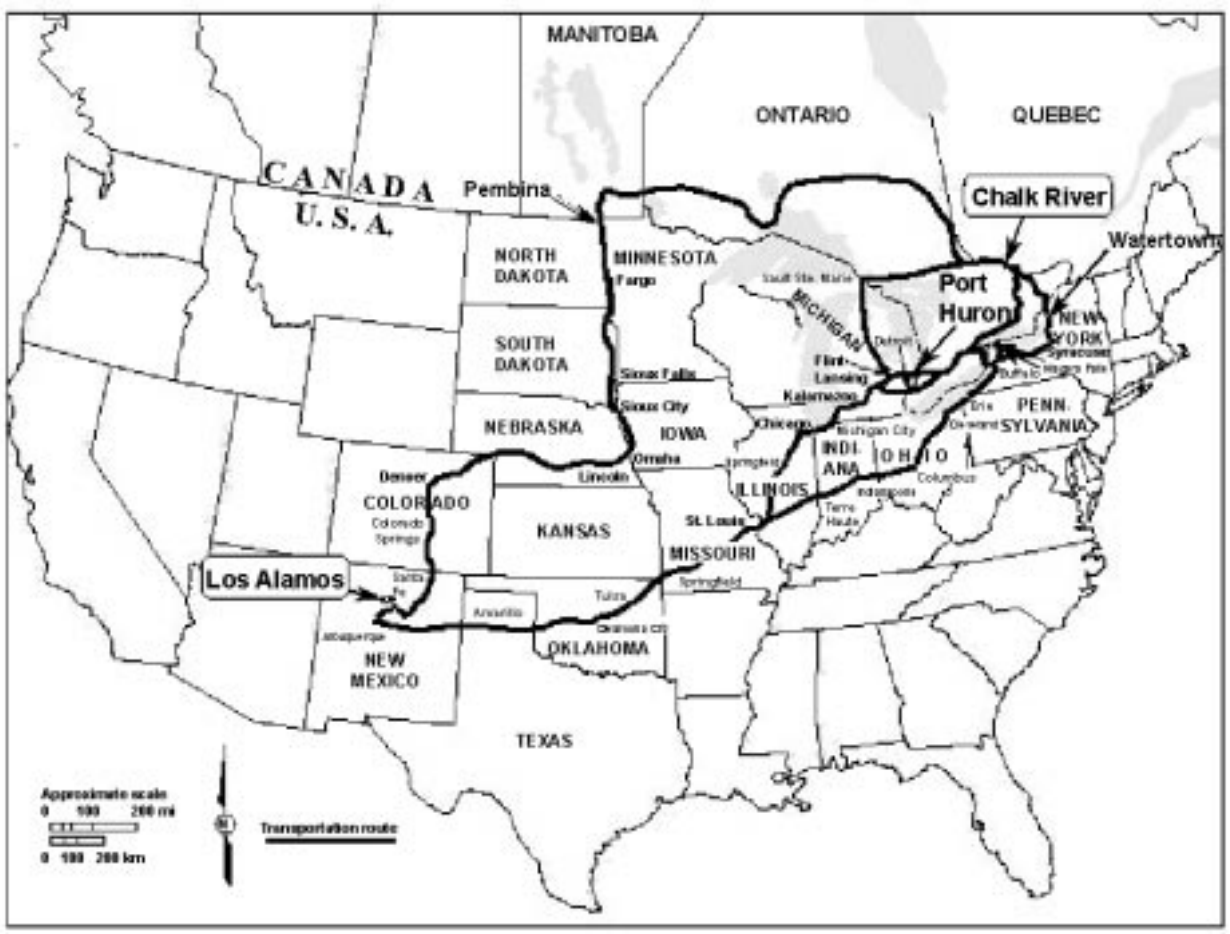


Figure B-1. Map of Representative Routes between LANL and CRL

Shipment Description

The shipment will be conducted using a commercial carrier and will use a Type B(U)F package certified by both the Canadian and U.S. Transportation Authorities. The quantity of material in the shipment is described in Attachment C. The Parallex EA (Ref. B1) provides a bounding estimate of environmental risks associated with this action.

This Transportation Plan considers only the material quantities that are currently expected to be shipped between LANL and CRL. Thus, the planned shipment quantity of plutonium is less than analyzed in the EA. The total quantity of Pu required for the shipment is approximately 0.119 kg.

Routing Analysis

Any shipment of radioactive material within a single package that exceeds 3000 times either the A_1 (for special form radioactive materials) or A_2 (for normal form radioactive materials) value is by definition an HRCQ shipment.[1] Additionally, when isotopic mixtures are involved, all isotopes must be evaluated relative to their unique A_1 or A_2 values to determine if the mixture exceeds a HRCQ.

The 49 CFR 397.101 specifies that HRCQ shipments of radioactive materials operate over preferred routes. Preferred routes are defined as Interstate System highways. If an Interstate bypass or beltway exists around a city, these roads shall be used in place of an Interstate highway through the city. State routing agencies have the option of designating alternative routes in addition to, or in lieu of, Interstate routes.

Routes must be selected to reduce the time in transit over the preferred route segment of the trip. For pickup and delivery locations not on preferred routes, the route selected must be the shortest-distance route from the pickup location to the nearest preferred route entry location and the shortest distance from the nearest preferred route exit location.

DOE-MD, during preparation of the EA supporting the shipment of unirradiated MOX fuel elements from LANL to CRL, identified seven possible representative routes between LANL and the U.S.—Canadian border. Each U.S. route begins at LANL and ends at the U.S.—Canadian border.

For descriptive purposes, the routes are identified by the name of the nearest U.S. city at or near the U.S.—Canadian border. The routes were calculated using the HIGHWAY routing model (Ref. B2), which was developed by ORNL specifically for the purpose of selecting routes for shipments of radioactive materials using criteria set forth in DOT regulations. The selection of the different routes provides a spectrum of routes for comparative evaluation of the relative risks of transporting radioactive materials. Table B-1 summarizes the distances of the U.S. and Canadian portions of each of the possible shipment routes.

Sault Ste. Marie, MI, has been selected as the preferred border crossing point for the shipment.

[1] For example, Pu-239 has an A_2 value of .0054 Ci. Thus, shipment of more than 16.2 Ci of Pu-239 would be an HRCQ shipment and would require the shipment of Class 7 (Radioactive) materials to comply with route selection criteria per 49 CFR 397.101. These routing criteria are also know as HM-164.

Table B-1.
Summary—Representative Transportation Routes
Between LANL and the U.S. —Canadian Border

Border-Crossing	Distance from LANL to U.S.—Canadian Border
	miles
Pembina, ND	1532
Sault Ste. Marie, MI	1960
Port Huron, MI	1755
Detroit, MI	1715
Buffalo, NY	1896
Niagara Falls, NY	1918
Watertown, NY	2127

Description of Representative Routes

The following paragraphs describe the U.S. and Canadian[2] portions of the possible route for the shipment from Los Alamos to Chalk River. Final route selection will be made by agreement between DOE and AECL. The representative route description listed below are organized by their respective U.S.—Canadian border crossing locations. It is important to note, however, that since the proposed shipment contains less than an HRCQ, no specific shipment routes within the United States are required under U.S. regulations, and specific routes within Canada will be designated by the Canadian transport authorities. Table B-2 provides detailed listings of the route as reported by the HIGHWAY model.

Each HIGHWAY output has three general segments of information. The first provides a brief description and summary of the route, including summaries of the route by type of road. The second segment of the HIGHWAY output provides a detailed listing of the calculated route. Interpreting the route listing is as follows:

```
Routing through:   <beginning at the origin>
    .0             LOS ALAMOS                  NM      .0   0:00   2/25 @ 16:39
   6.0 LTRKR       BANDELIER N M  W  S4   LTRK NM     6.0   0:10   2/25 @ 16:49
..
.                  <and concluding at the destination>
73.0 K17   TCAN  CHALK RIVER                ON  2298.0  43:24   2/27 @ 14:01
------ ---------- ------------  -- --------- --  ------  -----  ----   -----
miles  road names  named place    *1 intersect *2  dist    time   date   hour

where:
miles          =      distance from previous named place to this named place
road names     =      list of up to two different road identifiers (K designates Canada)
named place    =      alphanumeric name
*1             =      position of the intersection relative to the named place
intersect      =      road identifiers for the intersection
*2             =      state/province
dist           =      cumulative distance (miles)
time           =      cumulative time (assuming speed limits, Max = 55 m.p.h)
date           =      date of shipment (default to current date)
hour           =      hour of day (default to current time, then cumulative)
```

[2] The K in front of the highway number indicates a provincial route, and the T in front of the highway number indicates a Trans-Canada Highway route.

The third segment provides a detailed listing of the population density and a summary that provides input to RADTRAN, the DOE's tool for calculating transportation risk assessment.

Sault Ste. Marie border-crossing:

- **LANL, NM, to Sault Ste. Marie, MI:** This runs northeast from LANL across the Midwest and Great Lakes states and enters Canada near Sault Ste. Marie, MI. The route would go from LANL to Santa Fe, NM, on state and U.S. highways. At Santa Fe, NM, the shipment would travel south on I-25 to Albuquerque, then east on I-40 across eastern New Mexico, the panhandle of Texas, and through Oklahoma to Oklahoma City, OK. Here, it would pick up I-44 and travel northeast through Tulsa, OK, into Missouri through Springfield, MO, to St. Louis, MO. At St. Louis, the shipment would pickup I-55 and travel north through Illinois to Joliet, IL, where it would use I-80 and I-94 to travel through northwest Indiana and southwest Michigan. At Marshall, MI, the shipment would turn north on I-69 through Lansing, MI, and Flint, MI, to the U.S.—Canadian border near Sault Ste. Marie, MI. The shipment would cross into Canada over the International Bridge at Sault Ste. Marie. No specific restrictions for transporting radioactive material are reported for the International Bridge. The estimated distance for this route is 1,960 miles, and the time required is 34 hours and 21 minutes.

References

B1. DOE Office of Fissile Materials Disposition, *Environmental Assessment for the Parallex Project Fuel Manufacturing and Shipment*, DOE/EA-1216, January 1999.
B2. P. E. Johnson, D. S. Joy, D. B. Clarke, and J. M. Jacobi, *HIGHWAY 3.1 — An Enhanced Highway Routing Model: Program Description, Methodology, and Revised User's Manual*, ORNL/TM-12124, March 1993.

Table B-2. HIGHWAY Results for Sault Ste. Marie, MI, Border Crossing

LANL to Sault Ste. Marie

```
                                    HIGHWAY  3.4                          Page    1

*****************************************************************************************************

          LOS ALAMOS                  NM       to       MIONBRDGSAULSAUL            MI

*****************************************************************************************************
            Leaving :  4/12/99 at 11:16 MDT Arriving:  4/13/99 at 23:35 EDT
            Total Road Time: 34:21          Total Miles: 1960.0

Route Type: Q with 2 Driver(s)   Time Bias:  1.00  Mile Bias:   .00  Toll Bias:  1.00

            The following constraints are in effect:
               Route avoids links prohibiting truck use
               Route follows HM-164/State preferred routes of high level radioactive waste
               Route avoids ferry crossings
               Route avoids access roads between nonintersecting Interstate Highways

            Weighting used with preferred highways:    30.0

            Mileage by Highway Sign Type:
                    Interstate: 1920.0    U.S.:   20.0  State:   13.0   Turnpike:     .0
                        County:     .0   Local:    6.0  Other:    1.0

            Mileage by Highway Lane Type:
                  Limited Access Multilane: 1920.0  Limited Access Single Lane:    1.0
                         Multilane Divided:   20.0         Multilane Undivided:     .0
                  Principal Highways:     .0   Through Highways:   13.0   Other:    6.0

                                         State Mileage
                                         -------------
                                          MI    486.0
                                          IN     47.0
                                          IL    301.0
                                          MO    285.0
                                          OK    356.0
                                          TX    177.0
                                          NM    308.0
```

HIGHWAY 3.4 Page 2

LOS ALAMOS NM to MIONBRDGSAULSAUL MI

.0			LOS ALAMOS				NM	.0	0:00	4/12/99	at 11:16
6.0	LTRKR		BANDELIER N M	W	S4	LTRK	NM	6.0	0:10	4/12/99	at 11:26
1.0	S4		BANDELIER N M	N	S4	S502	NM	7.0	0:12	4/12/99	at 11:28
12.0	S502		POJOAQUE		U285	S502	NM	19.0	0:27	4/12/99	at 11:43
18.0	U285	U84	SANTA FE		U285	U84	NM	37.0	0:47	4/12/99	at 12:03
2.0	U84		SANTA FE	S	I25	X282	NM	39.0	0:50	4/12/99	at 12:06
56.0	I25		ALBUQUERQUE	E	I25	I40	NM	95.0	1:39	4/12/99	at 12:55
536.0	I40		OKLAHOMA CITY	W	I40	I44	OK	631.0	10:36	4/12/99	at 22:52
10.0	I44		OKLAHOMA CITY	NE	I35	I44	OK	641.0	10:47	4/12/99	at 23:03
5.0	I35	I44	EDMOND	SE	I35	I44	OK	646.0	10:52	4/12/99	at 23:08
86.0	I44 $	TTRT$	OAKHURST	E	I44	X221	OK	732.0	12:13	4/13/99	at 0:28
20.0	I44		CATOOSA	S	I44	X241	OK	752.0	12:33	4/13/99	at 0:48
72.0	I44 $	TWRT$	MIAMI	E	I44	X313	OK	824.0	14:09	4/13/99	at 2:25
17.0	I44 $		JOPLIN	SW	I44	X1	MO	841.0	14:26	4/13/99	at 2:42
276.0	I44		ST LOUIS	SW	I270	I44	MO	1117.0	18:53	4/13/99	at 7:08
6.0	I270		ST LOUIS	S	I270	I55	MO	1123.0	18:59	4/13/99	at 7:14
26.0	I255		COLLINSVILLE	W	I255	I55	IL	1149.0	19:27	4/13/99	at 7:42
10.0	I55	I70	EDWARDSVILLE	SE	I270	I55	IL	1159.0	19:38	4/13/99	at 7:53
136.0	I55		BLOOMINGTON	SW	I55	I74	IL	1295.0	22:07	4/13/99	at 10:22
7.0	I55	I74	NORMAL	NW	I55	I74	IL	1302.0	22:44	4/13/99	at 10:59
88.0	I55		JOLIET	SW	I55	I80	IL	1390.0	24:20	4/13/99	at 12:35
29.0	I80		HOMEWOOD	NW	I294	I80	IL	1419.0	24:52	4/13/99	at 13:07
5.0	I294$	I80 $	LANSING	W	I294	I94	IL	1424.0	24:57	4/13/99	at 13:12
19.0	I80	I94	LAKE STATION	NE	I80	I94	IN	1443.0	25:18	4/13/99	at 13:33
139.0	I94		MARSHALL	NW	I69	I94	MI	1582.0	27:58	4/13/99	at 17:13
36.0	I69		LANSING	SW	I69	I96	MI	1618.0	28:31	4/13/99	at 17:46
7.0	I69	I96	LANSING	NW	I69	I96	MI	1625.0	28:38	4/13/99	at 17:53
56.0	I69		FLINT	SW	I69	I75	MI	1681.0	29:29	4/13/99	at 18:44
222.0	I75		MACKINAW CITY	S	I75	X338	MI	1903.0	33:25	4/13/99	at 22:39
6.0	I75 #		ST IGNACE		I75	X344	MI	1909.0	33:33	4/13/99	at 22:47
50.0	I75		SAULT ST MARIE		I75	X395	MI	1959.0	34:19	4/13/99	at 23:33
1.0	BRDG#		MIONBRDGSAULSAUL				MI	1960.0	34:21	4/13/99	at 23:35

Table B-2. HIGHWAY Results for Sault Ste. Marie, MI, Border Crossing (continued)

LANL to Sault Ste. Marie

HIGHWAY 3.4 Page 3

LOS ALAMOS NM to MIONBRDGSAULSAUL MI

State	Miles	MILEAGE WITHIN DENSITY LEVELS										
		0	<0.0 -5.0	5.0 -22.7	22.7 -59.7	59.7 -139	139 -326	326 -821	821 -1861	1861 -3326	3326 -5815	5815 -9996	>9996
MI	486.0	36.5	55.1	67.2	81.9	92.9	84.6	43.0	15.8	7.8	.9	.0	.0
IN	47.0	.8	1.0	3.6	2.4	6.4	7.1	8.5	9.9	3.8	2.1	1.4	.1
IL	301.0	26.0	62.2	55.5	44.7	30.0	24.9	23.0	16.5	11.0	4.7	2.2	.3
MO	285.0	17.8	52.4	56.2	62.2	35.8	24.4	18.8	10.4	4.2	2.1	.6	.0
OK	356.0	23.7	73.8	110.8	56.6	32.4	23.5	13.7	8.9	6.4	4.4	1.5	.0
TX	177.0	7.1	125.9	29.1	1.4	1.3	1.0	2.5	1.5	4.6	2.3	.3	.0
NM	308.0	65.8	149.7	26.1	23.8	17.1	5.3	4.7	4.8	3.1	4.6	2.9	.0
Route Total	1960.0	177.7	520.0	348.6	272.9	215.9	170.7	114.2	67.8	40.9	21.1	9.0	.5
Percentages		9.1	26.5	17.8	13.9	11.0	8.7	5.8	3.5	2.1	1.1	.5	.0

Basis: 1990 Census

RADTRAN Input Data	Rural	Suburban	Urban
Weighted Population			
People/sq. mi.	25.3	767.9	5629.8
People/sq. km.	9.8	296.5	2173.7
Distance			Total
Miles	1535.2	393.6	30.6 1960.0
Kilometers	2470.6	633.3	49.2 3154.2
Percentage	78.3	20.1	1.6
Basis (people/sq. mi.)	<139	139-3326	>3326 1990 Census

Note: Due to rounding, the sum of the mileages in the individual population categories may not equal the total mileage shown on this report.

ATTACHMENT C

EVALUATION OF SHIPMENT QUANTITIES FOR PROJECT PARALLEX SHIPMENTS

Attachment C

Evaluation of Shipment Quantities for Project Parallex Shipments

S. B. Ludwig
Oak Ridge National Laboratory

The purpose of this evaluation is to provide a general description of the materials that would be shipped under Project Parallex. Transportation planning requires specific information about the quantities of each isotope involved in the shipment.

Certain key assumptions were utilized to determine a "best guess" on the actual quantities of each isotope that would be involved in each shipment. These assumptions include:

1. The shipment is nine fuel rods (eight rods for irradiation and a ninth rod for archiving) that are composed of 3.1% intermediate homogeneity MOX.
2. Pu oxide was derived from a nuclear weapon "pit," and processed at LANL using ARIES hydride-dehydride "dry" processing system, followed by oxidation process to produce Pu oxide. This particular weapon's pit contained a small amount of HEU. A 1.3% impurity value, as determined by assay.
3. ORNL has included Am-241, which was measured by assay at a nominal value of 1490 ppm (1500 ppm was assumed in the assessment).
4. Each fuel element, when assembled, includes two natural uranium "shim" pellet. The shim pellet ensures that each fuel element contains the same total length of fuel. Each element contains approximately 36 pellets. LANL assumed a conservative estimate of 3.0 kg of "shim pellets" would be shipped. The actual amount is approximately 200 g of uranium per each 14 element bundle and 130 g of uranium per each nine element bundle (about 660 g total natural uranium for the total four bundle shipment).

Table C-1 shows the isotopic summary that represents the "best guess" of the amount of each isotope involved in each proposed shipment. When the shipment is prepared for transport, the actual amount will be listed on the shipping papers and package labels. From the standpoint of conformance to the transportation regulations, it appears that the shipment **will not be an HRCQ.** Based on the isotopes involved, the HRCQ limit is reached when the amount of Pu exceeds approximately 200 grams.

Table C-1. Characteristics of Nine Experimental MOX Fuel Rods for Shipment under Project Parallex

Isotope	Concentration (grams)	Radioactivity (curies)	Thermal Power (watts)	Fraction of A2[b]
U-235	11.5	2.49E-5	6.5E-7	Unlimited
U-238	4,010.0	1.35E-3	3.4E-5	Unlimited
Total U	4,022.0	1.37E-3	3.5E-5	Unlimited
Pu-238	0.01	0.17	5.7E-3	31.66
Pu-239	111.8	6.95	0.21	1,285
Pu-240	7.0	1.60	0.05	295.0
Pu-241	0.2	20.61	6.4E-4	76.34
Pu-242	0.04	1.53E-4	4.5E-6	0.03
Total Pu	119.1	29.3	0.27	1,688
Am-241[a]	0.18	0.61	0.02	113.3
Total Am	0.18	0.61	0.02	113.3
TOTAL	4,141	29.95	0.29	1,801

[a] Am-241 is assumed to be 1500 ppm of Pu. For conservatism, 1500 ppm was added to measured isotopic composition (per 5 Oct 1998 PuO2 Feedstock Report from LANL)

[b] A2 fraction is determined by taking the activity of each isotope and dividing it by the A2 value for each isotope found in 10 CFR Part 71 (or 49 CFR Part 173). If the sum of A2 values exceeds 3000, the shipment is designated an HRCQ.

ATTACHMENT D

GUIDE 165, RADIOACTIVE MATERIALS (Fissile/Low to High Level Radiation)
FROM THE 1996 NORTH AMERICAN EMERGENCY RESPONSE GUIDE

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.
- Undamaged packages are safe; contents of damaged packages may cause external and/or internal radiation exposure.
- Packages (drums or boxes) identified as "Type AF" or "IF" by marking on packages or by shipping papers contain materials that are not life endangering if released. External radiation levels are low and packages are designed, evaluated, and tested to control releases and to prevent a fission chain reaction under severe transport accident conditions.
- Packages (metal and usually very heavy) identified as "Type B(U)F" or "B(M)F" by marking on packages or by shipping papers contain potentially life endangering amounts. Because of design, evaluation, and testing of packages, fission chain reactions are prevented and releases are not expected to be life endangering for all accidents except those of utmost severity.
- The transport index (TI) shown on labels or a shipping paper might not indicate the radiation level at one meter from the package; instead, it may indicate controls needed during transport because of the fissile properties of the materials.
- Some radioactive materials cannot be detected by commonly available instruments.
- Water from cargo fire control is not expected to cause pollution.

FIRE OR EXPLOSION

- These materials are not flammable and packagings are designed to withstand fires without damage to contents.
- Radioactivity does not change flammability or other properties of materials.
- Type AF, Type IF, and Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475°F) for a period of 30 minutes.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- **Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.**
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. • Stay upwind. • Keep unauthorized personnel away.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection against internal radiation exposure, but not external radiation exposure.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY RESPONSE

FIRE

- Presence of radioactive material will not change effectiveness of fire control techniques.
- Move containers from fire area if you can do it without risk.
- Do not move damaged packages; move undamaged packages out of fire zone.

Small Fires

- Dry chemical, CO_2, water spray or regular foam.

Large Fires

- Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Slightly damaged or damp outer surfaces seldom indicate failure of packaging since most have an inner container.

Liquid Spills

- Package contents are seldom liquid. If any radioactive contamination resulting from a liquid release is present, it probably will be low-level.

FIRST AID

- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment and facilities.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

RISQUES POTENTIELS

SANTÉ

- La radioactivité représente un risque faible pour les travailleurs du transport, le personnel d'intervention d'urgence et le public lors d'accidents de transport. La durabilité des emballages est reliée aux dangers potentiels de la substance.
- Les colis non-endommagés sont sécuritaires; le contenu des colis endommagés peut causer une exposition au rayonnement externe et/ou interne.
- Les colis (barils et boîtes) identifiés "Type AF" ou "IF" sur l'emballage ou sur les documents d'expédition contiennent des substances qui ne posent pas de danger pour la vie si déversés. L'intensité du rayonnement externe est faible et les colis sont conçus, évalués, et testés afin de contrôler les fuites et prévenir la fission en chaîne en cas de sérieux accident.
- Les colis (en métal et généralement très lourds) identifiés "Type B(U)F" ou "B(M)F" sur l'emballage ou sur les documents d'expédition contiennent des substances qui peuvent présenter un danger pour la vie si déversés. La conception, l'évaluation et l'épreuve des colis font en sorte que la fission en chaîne est prévenue et les déversements ne poseront pas de danger pour la vie sauf pour les accidents d'ultime sévérité. • L'index de transport (IT) sur l'étiquette ou documents d'expédition peut indiquer les contrôles requis lors du transport dû aux propriétés fissiles de la matière plutôt que le niveau de rayonnement à un mètre du colis. • Certaines matières radioactives ne peuvent être détectées par les instruments couramment disponibles.
- La pollution par l'eau du combat de l'incendie de cargaison n'est pas anticipée.

INCENDIE OU EXPLOSION

- Ces substances ne sont pas inflammables et les emballages sont conçus pour supporter un feu sans causer de dommage à leur contenu.
- La radioactivité ne diminue en rien l'inflammmabilité ou toute autre propriété de ce produit.
- Les colis de Type AF, Type IF et Type B sont conçus et évalués pour résister à un engouffrement total par les flammes à une température de 800°C pour une période de 30 minutes.

SÉCURITÉ PUBLIQUE

- **COMPOSER le numéro de téléphone d'urgence indiqué sur les documents d'expédition. Si non-disponibles ou aucune réponse, COMPOSER le numéro d'urgence approprié indiqué à l'intérieur de la couverture arrière du guide.**
- **Le secours, les premiers soins, le contrôle des incendies et autres dangers sont plus importants que la détermination des niveaux de radioactivité.**
- L'Autorité responsable en matière de radioactivité doit être avisée des conditions entourant l'accident, elle est habituellement responsable des décisions.
- Isoler immédiatement dans un rayon minimum de 25 à 50 mètres autour du site du déversement.
- Demeurer en amont du vent. • Éloigner les curieux et le personnel non-autorisé.
- Détenir ou isoler les personnes non-blessées ou l'équipement dont on suspecte la contamination; retarder la décontamination et le nettoyage en attendant les conseils de l'Autorité responsable en matière de radioactivité.

VÊTEMENTS DE PROTECTION

- Un Appareil de Protection Respiratoire Autonome (APRA) à pression positive et un vêtement de protection pour feu d'immeuble fourniront une protection adéquate contre une exposition radioactive interne, mais non à une exposition externe.

ÉVACUATION

Déversement majeur • Envisager une première évacuation d'une distance de 100 mètres sous le vent.
Incendie • Lorsqu'une grande quantité de cette substance est impliquée dans un incendie majeur, envisager une première évacuation dans un périmètre de 300 mètres de rayon.

MESURES D'URGENCE

INCENDIE

- La présence de matières radioactives ne changera en rien l'efficacité des mesures de contrôle d'incendie.
- Éloigner les contenants de la zone de feu si cela peut se faire sans risque.
- Ne pas déplacer les colis endommagés; éloigner du feu les colis non endommagés.

Incendie mineur

- Poudre chimique sèche, CO_2, eau pulvérisée ou mousse régulière.

Incendie majeur

- Eau pulvérisée ou en brouillard (inonder d'eau).

DÉVERSEMENT OU FUITE

- Ne pas toucher aux contenants endommagés ou produits déversés.
- Une surface légèrement endommagée ou mouillée indique rarement une défaillance de l'emballage puisque la plupart ont un contenant interne.
- **Déversement liquide**
- Le contenu du colis est rarement liquide. Si une contamination radioactive résulte d'un liquide déversé, elle sera probablement de faible niveau.

PREMIERS SOINS

- Les problèmes médicaux sont plus importants que les dangers radiologiques.
- Appliquer les premiers soins relatifs à la nature des blessures.
- Toute personne sérieusement blessée doit être immédiatement soignée et transportée.
- En cas d'arrêt respiratoire, appliquer la respiration artificielle.
- En cas de gêne respiratoire, donner de l'oxygène.
- En cas de contact avec la substance, laver les yeux ou la peau immédiatement à l'eau courante pendant au moins 20 minutes.
- Les blessés qui ont contacté la substance peuvent représenter un danger de contamination minime pour les gens, l'équipement et les installations.
- Aviser le personnel médical de l'identité du produit afin qu'ils prennent les dispositions nécessaires pour assurer leur sécurité.

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