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Update to the
Fissile Materials Disposition Program
SST/SGT Transportation Estimation

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Glossary

ANL/W	Argonne National Laboratories, West at INEEL
BWXT	BWX Technologies, Inc., Lynchburg, Virginia
CSMO	Central Scrap Management Office
DCS	Consortium of Duke, Cogema, and Stone & Webster and other subcontractors
DOE	Department of Energy
EIS	Environmental Impact Statement
FL	A shipping container for transporting pits
HEU	Highly Enriched Uranium
IAEA	International Atomic Energy Agency
INEEL	Idaho National Engineering and Environmental Laboratory
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LTA	Lead Test Assemblies
MOX	Reactor Fuel made from mixed plutonium oxide and uranium oxide, referred to as Mixed OXide fuel
MT	Metric Tons
MTHM	Metric Tons Heavy Metal
NFS	Nuclear Fuels Services, Inc., Irwin, Tennessee
ORNL	Oak Ridge National Laboratories
PD&C	Pit Disassembly and Conversion Facility
Px	Pantex
RFETS	Rocky Flats Environmental Technology Site
SGT	SafeGuards Transport
SRS	Savannah River Site
SST	Safe Secure Transport
ST	Safe Transport, either an SST or an SGT
TSD	Transportation Safeguards Division
ZPPR	Zero Power Production Reactor

Introduction

This report is an update to “Fissile Materials Disposition Program SST/SGT¹ Transportation Estimation,” SAND98-8244, released in June of 1998. The Department of Energy (DOE) Office of Fissile Materials Disposition requested this update as a basis for providing the public with an updated estimation of the number of transportation loads, load-miles, and costs associated with the preferred alternative in the Surplus Plutonium Disposition Final Environmental Impact Statement (EIS). As such, it focuses on the changes to the plutonium disposition transportation estimations based on the preferred alternative in the EIS. Since Highly Enriched Uranium (HEU) disposition materials transportation is not the focus of this report, the HEU transportation estimations have not been updated; however, the original HEU estimations from the original report are included for ease of comparison between the reports.

This report is not intended to be a standalone document. It addresses changes from the original report without providing all of the underlying assumptions and uncertainties. The reader is encouraged to see the June 1998 report to understand these underlying assumptions and uncertainties.

DOE Decisions

Since the original report, the DOE has made several decisions that impact the number and schedule of Fissile Materials Disposition Program Secure Transport² (ST) loads:

- 1) Secretary Peña on June 28, 1998, selected the Savannah River Site (SRS) in South Carolina as the preferred site for the MOX fuel fabrication facility and SRS and the Pantex Plant (Px) in Texas as equally preferred locations to build the pit disassembly and conversion facility. The Secretary released these preferred site selections in conjunction with the release of the Surplus Plutonium Disposition Draft Environmental Impact Statement.
- 2) Then, on December 23, 1998, Secretary Richardson announced the selection of SRS as the preferred site for the pit disassembly and conversion facility.
- 3) The DOE Office of Environmental Management decided to proceed with an accelerated schedule for moving the fissile materials from Rocky Flats Environmental Technology Site (RFETS) in Colorado and the Hanford Site in Washington to the K-Area Material Storage facility at SRS. These early moves were discussed as a schedule uncertainty in the June 1998 report and were referred to as “Early Moves from RFETS and Hanford.”
- 4) The DOE Office of Fissile Materials Disposition awarded a contract to DCS (Duke, Cogema, and Stone & Webster) on March 22, 1999, to provide the MOX fuel fabrication and irradiation service. The DCS consortium consists of Duke Engineering, Cogema, and

¹ SST/SGT stands for Safe Secure Trailer or the newer SafeGuard Trailer.

² The term “Secure Transport” is used to encompass transport by either SST or SGT.

Stone and Webster as its main partners and includes several subcontractors. DCS is planning to use six reactors for irradiation of the MOX fuel: Catawba Nuclear Station Units 1 and 2, near Clover, South Carolina; McGuire Nuclear Station Units 1 and 2, near Cornelius, North Carolina; and North Anna Power Station Units 1 and 2, near Mineral, Virginia.

Effects of the Decisions

The results of these decisions on the number and schedule of Fissile Materials Disposition ST loads are as follows:

- 1) The EIS Alternative 3 becomes the preferred alternative based on the decisions selecting SRS as the preferred location for all the disposition facilities. Note that the Notice of Intent for the Surplus Plutonium Disposition EIS designated SRS as the preferred site for the immobilization facility prior to the June 1998 report.
- 2) The accelerated moves from RFETS and Hanford to SRS result in about 50 additional ST loads due to reduced bulk materials consolidation prior to shipment.
- 3) Since the six reactors put forth by DCS to irradiate the fresh MOX fuel are all pressurized water reactors, the number of ST loads from the MOX fuel fabrication plant to the reactors is approximately one-half the number used in the June 1998 report. The June 1998 report and the Surplus Plutonium Disposition Draft Environmental Impact Statement assumed a mix of two-thirds pressured water reactors and one-third boiling water reactors.

Additional Changes

Other changes to the number of loads in this report are the removal of loads completed in FY98 and the addition of loads to support development activities. Development activities include, but are not limited to, HYDOX³ and ceramification development at Lawrence Livermore National Laboratories (LLNL) and ARIES⁴ Demonstration at Los Alamos National Laboratories.

Schedules in the June 1998 report were balanced over the time period allotted for each category of material. In this report, actual site schedules are presented except for the HEU movements; Argonne National Laboratories, West⁵ (ANL/W), materials to SRS; and pits and

³ HYDOX is an acronym for HYdride-Dehydride-Oxide process. HYDOX is the baseline process for converting the plutonium in the pits to plutonium-oxide as feed to the MOX fuel fabrication facility.

⁴ ARIES is an acronym for Advanced Recovery and Integrated Extraction System. The ARIES Demonstration includes the modules (e.g., bisection, HYDOX or direct metal oxide, canning, can-out, and nondestructive assay) for processing a pit in pit disassembly and conversion.

⁵ Argonne National Laboratories, West, resides at Idaho National Environmental Engineering Laboratories (INEEL).

metal to the pit disassembly and conversion facility, which are still calculated as balanced moves.

Update on Container Uncertainties

The original report noted the concerns that the existing number of FL containers (used for transporting pits) is insufficient to complete the disposition mission and that the FL may not maintain its certification until 2004 when it is needed. As a result, DOE Albuquerque Operations' Nuclear Materials Steward Program is conducting a study to recommend a container design to replace the existing FL. DOE is including in its budgeting process funding for design, test, and certification of the replacement design and for acquiring approximately 600 of the new containers.

Input Data Update

Table 1 provides a summary of the updated materials, containers, and estimated loads. As in the original report some values are very general and other values are not presented to protect sensitive information. Table 2 provides the projected schedule of transporting the materials in Table 1.

Table 1. Materials, containers, and load input data.

Facility		Transport		Material form	Quantity	Container	Amount per container	Containers per SST	Total loads
From	To	From	To						
LTA ⁶ fab	Rx	LANL	McGuire	MOX fuel	4 MTHM ⁷	MO-1	1 assy	1	2
MOX fab	Rx	SRS	Catawba	MOX fuel	805 MTHM	New	4 assy	1	142
			McGuire						148
			North Anna						148
PD&C	Disp.	SRS	LANL	Piece Parts-A		UC-609			20
				Piece Parts-B		9968			10
PD&C	Disp.	SRS	Y-12	HEU to Y-12		DT-22		22	160
Storage	PD&C	Sites	SRS	Pits & metal	33 MT	New			530
Storage	Immob.	RFETS	SRS	Metals	934 cans	9975	2.8 kg	24	39
				Oxides	1,217 cans	9975		24	50
				Various	571 cans	9975		24	24
				Special	350 cans	9975		24-36	15
		Hanford	SRS	Metals & oxide	60 cans	6M	1 can	30	2
				Oxides	4000 cans	9975	1 can	24/36	144
		ANL/W	SRS	ZPPR ⁸ plates	29,000 ea	9975	10 ea	25	116
				ZPPR pins	20,000 ea	9975	20 ea	25	40
Dev.	Immob.	LANL	SRS	Oxide - LANL	750 kgs	9975	4.2 kg	25	9
		LLNL	SRS	Various	192 cans	9975	4.3 kg	25	8
Storage	Storage	RFETS	Pantex	Pits & metal		FL			10
Storage	Dev.	Hanford	LLNL	Metal & oxides	4 cans	9975	1 can	24	1
		RFETS	LANL	Pits & metal					4
		RFETS	LLNL	Pits & metal					1
		Pantex	LANL	Pits & metal					13
		Pantex	LLNL	Pits & metal					1
Storage	Blend	Portsmouth	NFS/BWX	HEU oxide	7 MT	DC-1/6M			35
		Y-12	NFS/BWX	HEU logs	10 MT	ES-2M	37 kg	20	12
		Y-12	NFS/BWX	HEU oxide	3.5 MT	ES-2LM	25 kg	20	7
		Y-12	NFS/BWX	Misc. HEU metal	30 MT	ES-2M	25 kg	20	51
		Y-12-IAEA ⁹	NFS/BWX	HEU logs	10 MT	ES-2M	37 kg	20	14
		Y-12	NFS/BWX	Various off-spec	13 MT				23
		SRS	NFS/BWX	Various off-spec	22 MT				40
		INEEL	NFS/BWX	Various off-spec	5 MT				9
		Y-12	NFS/BWX	Various metals	5 MT	ES-2M	25 kg	20	10
		Y-12	NFS/BWX	CSMO ¹⁰ HEU	2 MT				3
		Y-12	NFS/BWX	Remaining HEU	36 MT				65
		Sites	NFS/BWX	Remaining HEU	<2 MT				5

⁶ LTA – Lead Test Assembly

⁷ MTHM — Metric Tons Heavy Metal

⁸ ZPPR — Zero Power Production Reactor

⁹ IAEA — International Atomic Energy Agency

¹⁰ CSMO — Central Scrap Management Office

Table 2. Schedule input data.

Transport		FY																			
From	To	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
LANL	McGuire					2															
SRS	Catawba								11	11	22	11	11	22	11	11	22	10			
	McGuire								22	11	11	22	11	11	22	11	11	16			
	North Anna								22	11	11	22	11	11	22	11	11	16			
SRS	LANL														5	5	5	5			
														3	2	3	2				
SRS	Y-12								15	18	15	18	15	18	15	18	15	13			
Sites	SRS								53	53	53	53	53	53	53	53	53	53			
RFETS	SRS	4	28	7																	
			14	26	10																
		8	9	7																	
			15																		
Hanford	SRS	1	1																		
					9	15	18	9	30	30	30	3									
ANL/W	SRS								12	12	12	12	12	12	12	12	12	8			
									4	4	4	4	4	4	4	4	4	4			
LANL	SRS	4	5																		
LLNL	SRS	4	4																		
RFETS	Pantex	10																			
Hanford	LLNL	1																			
RFETS	LANL	4																			
RFETS	LLNL	1																			
Pantex	LANL	1	3	3	3	3															
Pantex	LLNL	1																			
Portsmouth	NFS/BWX	35																			
Y-12	NFS/BWX	3	2	2	3	2															
Y-12	NFS/BWX	2	1	1	2	1															
Y-12	NFS/BWX	10	11	10	10	10															
Y-12-IAEA	NFS/BWX	4	3	4	3																
Y-12	NFS/BWX	2	2	2	2	2	3	2	2	2	2	2									
SRS	NFS/BWX						8	8	8	8	8										
INEEL	NFS/BWX						2	2	1	2	2										
Y-12	NFS/BWX						3	2	3	2											
Y-12	NFS/BWX		1	1		1															
Y-12	NFS/BWX										7	7	8	7	7	7	8	7	7		
Sites	NFS/BWX										1	1	1	1	1						
Total		95	99	63	42	36	34	23	183	164	178	155	126	139	155	134	144	134	7	0	0

Update Results

Figures 1, 2, and 3 depict the major ST transportation legs with all the plutonium disposition facilities located at SRS, the preferred alternative. Figure 3 also includes an inset showing transport to the three reactor sites: McGuire Nuclear Station, Catawba Nuclear Station, and North Anna Power Station.

Figure 1. HEU-to-blending transportation.

Figure 2. 17-MT immobilization transportation to SRS.

Figure 3. Transportation for 33-MT irradiation with PD&C and MOX fabrication located at SRS.

Figure 4 and 5 show schedules by year for the resulting 1,911 total loads and 2,193 k total load-miles, respectively. These total loads and total load-miles are within the high and low values of the alternatives in the original report and are approximately 400 less loads and 650 k less load-miles than Alternate 3, the corresponding case in the original report. The peak years are from 2006 to 2015 with each year exceeding 120 loads and 125 k load-miles. The years 2006 through 2008 are the highest years in loads and, especially, in load-miles with over 160 loads and 255 k load-miles each of the three years. The overlap of the end of the Hanford materials to immobilization at SRS mission with the start of the MOX irradiation program is the cause of this peak.

Figure 4. Total loads for PD&C, MOX fabrication, and immobilization located at SRS.

Figure 5. Total loads-miles for PD&C, MOX fabrication, and immobilization located at SRS.

Effect of Changes to Input

As described earlier, there are uncertainties with regard to some of the containers. Table 3 summarizes the effect of some of these uncertainties.

Table 3. Effects of changes to input.

Change	Total loads	Average loads per year	Total miles	Average load-miles per year
Using only 9975s	+20	+7 in 2006 to 2008	+56 k	+19 k in 2006 to 2008
Using a 3-assembly MOX fresh fuel container	+150	+15 in 2006 to 2015	+45 k	+5 k in 2006 to 2008
Using a 2-assembly MOX fresh fuel container	+440	+45 in 2006 to 2015	+135 k	+14 k in 2006 to 2015

Costs

As in the original report, TSD provided costs for each individual transportation leg. These costs are presented in Table 4 along with the total ST transportation cost of the preferred alternative. It should be noted that Table 4 does not include the costs for transporting the HEU to blending.

The June 1998 report gave the total ST transportation cost for Alternative 3 as \$51.7 M. This compares to \$54 M total cost in Table 4. While the updated cost compares closely with the June 1998 estimate, there are some notable offsetting cost differentials. The reduction in the number of fresh MOX fuel assemblies and the nearness of the reactors to SRS results in a cost reduction of approximately two-thirds for the MOX fuel shipments, \$22 M to \$8 M. However, the addition of development shipments, the additional loads from RFETS and Hanford, and the inefficiencies of actual transportation schedules versus balanced load projections have offset this cost reduction.

Table 4. Cost data provided by TSD.

Shipper	Receiver	Trailers per trip	No. of trips	Total cost (\$k)
LANL-Los Alamos, NM	Cornelius, NC	2	1.	116
SRS-Aiken, SC	Clover, SC	3	57	1,903
Savannah River Ops, SC	Cornelius, NC	3	58	1,961
Savannah River Ops, SC	North Ana, VA	3	58	3,921
Savannah River Ops, SC	LANL-Los Alamos, NM	3	10	1,521
Savannah River Ops, SC	Y-12 Oakridge, TN	3	54	2,703
Pantex Plant, TX	Savannah River Ops, SC	3	177	14,924
Rocky Flats, CO	Savannah River Ops, SC	3	43	6,480
Hanford-Richland, WA	Savannah River Ops, SC	3	50	9,296
INEL-Idaho Falls, ID	Savannah River Ops, SC	3	52	9,668
LANL-Los Alamos, NM	Savannah River Ops, SC	3	3	456
LLNL-Livermore, CA	Savannah River Ops, SC	3	3	483
Rocky Flats, CO	Pantex Plant, TX	3	4	167
Hanford-Richland, WA	LLNL-Livermore, CA	1	1	95
Rocky Flats, CO	LANL-Los Alamos, NM	3	2	66
Rocky Flats, CO	LLNL-Livermore, CA	1	1	69
Pantex Plant, TX	LANL-Los Alamos, NM	3	5	145
Pantex Plant, TX	LLNL-Livermore, CA	1	1	83
Total preferred alternative cost =				54,057

Conclusions

The selection of SRS as the preferred site for all the surplus plutonium disposition facilities significantly reduced the number of transportation alternatives. Even though changes occurred, these changes have offset each other such that the total number of loads, the total number of load-miles, and the total cost have remained about the same (within the accuracy of the estimations). For the preferred alternative, the estimated number of total loads is 1,900, the estimated load-miles are 2.2 million, and the total cost is \$54 million.

Appendix — Mileage

From	To	Mileage
LANL	McGuire	1750
Hanford	LLNL	900
LANL	Pantex	400
Pantex	RFETS	500
Pantex	LLNL	1400
RFETS	Pantex	500
RFETS	LANL	400
RFETS	LLNL	1300
SRS	Catawba	175
SRS	McGuire	200
SRS	North Anna	550
SRS	Y-12	350
SRS	LANL	1800
SRS	Pantex	1500
SRS	RFETS	1650
SRS	Hanford	2800
SRS	INEEL	2400
SRS	LLNL	2800
SRS	Blend ¹¹	200
INEEL	Blend ¹²	2300
Portsmouth	Blend ¹³	500
Y-12	Blend ¹⁴	250

¹¹ SRS to BWX, Inc., Lynchburg, Virginia (BWX), is 150 and to NFS is 250.

¹² INEEL to BWX is 2400 and to Nuclear Fuels Services, Inc., Irwin, Tennessee (NFS), is 2200.

¹³ Portsmouth to BWX is 700 and to NFS is 500.

¹⁴ Y-12 to BWX is 350 and to NFS is 150.

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