APPENDIX G
COST ANALYSES

This appendix provides supporting data and calculations for Section 4.17 of this Environmental Impact Statement (EIS). It contains five major sections: G.1 Cost Estimating Bases, G.2 Processing Durations and Schedules, G.3 Major Schedule Uncertainties, G.4 Availability and Capability of DOE Facilities, and G.5 Estimated Absolute and Incremental Costs for Each Processing Option. The objective is to support the estimates of total and incremental costs, schedule durations, and uncertainties.

G.1 COST ESTIMATING BASES

This section describes the cost estimating bases used in this EIS. It is divided into the following six parts:

- Facilities and Equipment Costs
- Labor and Site Overhead Costs
- Transuranic Waste Costs, Including Variable Costs of Disposal at WIPP
- Low-level Waste Costs at Rocky Flats and Los Alamos National Laboratory
- Other Materials Storage, Shipping, and Disposal Costs, Including Costs at the Savannah River Site
- Costs Related to Interim Storage of Stabilized Residue and Transuranic Waste at Rocky Flats.

G.1.1 Facilities and Equipment Costs

Facilities and equipment costs are divided into two groups: (1) costs that have been incurred, are being incurred, or will be incurred in support of the plutonium residues clean-up independent of the Record of Decision in the present EIS, and (2) costs that will be incurred pursuant to the Record of Decision in the present EIS. The former group includes costs to bring the facilities into compliance with DOE regulations and Defense Nuclear Facilities Safety Board recommendations, to upgrade the facilities for their missions, to install facility-specific equipment, and to complete operational readiness reviews and startup tests. These common costs, plus ongoing research and development costs, are allocable to the plutonium residues program, but are not incremental (i.e., decisional) in the present EIS. Allocable costs in most alternatives are $180 million for facilities and equipment ($30 million per facility at Rocky Flats and an average of six facilities) and $10 million for research and development. Processing costs are based on facilities and equipment that are (or would be) up-and-running for this program rather than on developmental technologies. Decommissioning costs at all three sites are part of site-wide programs outside the scope of this EIS

Costs for expensive, specialized pieces of equipment that would not be purchased except for specific processing options in this EIS are directly assigned to these options. These costs, which are incremental to existing DOE budgets and decisional in this EIS, consist of:

- $30 million for two Silver II electrochemical dissolvers for mediated electrochemical oxidation of incinerator ash, graphite fines, graphite, or inorganic residues at the Savannah River Site F-Canyon or H-Canyon, (WSRC 1997) or at Rocky Flats.

- $20 million for pre-installation decontamination and decommissioning of highly contaminated equipment at HB-Line for mediated electrochemical oxidation of incinerator ash, graphite fines, graphite, or inorganic residues at the Savannah River Site H-Canyon (WSRC 1997).

- $4 million for distillation equipment at Rocky Flats for IDC 409 electrorefining and molten salt extraction salt residues or other electrorefining and molten salt extraction salts (DOE 1996c).

- $37 million for distillation equipment at Los Alamos National Laboratory for IDC 409 electrorefining and molten salt extraction salt residues (LANL 1998).

- $115 million for distillation equipment and vault upgrades at Los Alamos National Laboratory for other electrorefining and molten salt extraction salts (LANL 1998).

- $1.75 million for cold ceramification equipment at Rocky Flats for incinerator ash; sand, slag, and crucible; graphite fines, and inorganic ash..

Because it is not possible to allocate shared equipment costs to individual processing options except as part of a complete alternative, equipment costs that could be shared are excluded from the summary costs on Table G-12. Equipment and vault upgrade costs at Los Alamos National Laboratory for distillation of electrorefining and molten salt extraction salts ($37 million for IDC 409 residues and $115 million for other residues) are included on the summary tables since these costs are not shared.

Table G–1 shows the Rocky Flats facilities used in the No Action Alternative. These facilities are Modules A, D, E, F and J in Building 707 and Room 3701 in Building 371. These facilities, plus Building 707 Module B and Building 371 Room 3305 (used in scrubbing, distilling, or water leaching salt residues) represent all the facilities at Rocky Flats proposed for use in this EIS. This EIS assumes that facilities-related upgrades, compliance with Defense Nuclear Facilities Safety Board recommendations, etc., will take place independent of the decisions made in this EIS. Thus, common costs at these facilities are not incremental to the No Action Alternative or incremental to DOE. For rooms or modules at Building 371 or Building 707 that may be used in an alternative but are not used in the No Action Alternative, this approach understates the actual cost of the alternative. This understatement may be material but is difficult to calculate without analyzing site-wide facilities plans. This level of detail is beyond the scope of the present EIS.

Table G-2 shows projected fiscal-year 1998 development and testing expenditures at Rocky Flats and Los Alamos National Laboratory for processing options identified in the present EIS. These expenditures are independent the Record of Decision in the present EIS. Total spending is estimated at about $10 million for the fiscal year. Although development and testing work is ongoing at Rocky Flats and Los Alamos National Laboratory, all processing costs are based on facilities and equipment that are (or will be) up-and-running at production scale for this program, rather than on developmental or bench-scale technologies.

G.1.2 Labor and Site Overhead Costs

Labor and site overhead costs are estimated as a function of the number of hours that operations and support personnel are exposed to radiation (not the amount of radiation they are exposed to). These exposure-hours are then multiplied by a factor that relates allocable labor hours at the site to exposure-hours. The more allocable labor-hours per exposure-hour, the greater the multiplier. The multiplier captures the hours spent by: (1) exposed individuals in non-exposed activities (e.g., preparing for operations, down-time during maintenance, and administrative matters), (2) non-exposed individuals in direct support of the operations, and

(3) indirect site support personnel. The relationships between exposure-hours and allocable labor costs are based on empirical observations from a sample of recent residues management activities at Rocky Flats.

Table G–1 Facilities Required for No Action Alternative

No Action Processing Option	*Facilities*	*Number of No Action Processing Options at the Facility or Facilities*
Calcine and Cement Incinerator Ash	371–3701	13
Calcine and Cement Sand, Slag, and Crucible	371–3701	13
Cement Graphite Fines	371–3701	13
Calcine and Cement Inorganic Ash	371-3701	13
Pyro-Oxidize IDC 409 Electrorefining and Molten Salt Extraction Salts	707A, 707B, 707D, 707E	4,4,8,8
Pyro-Oxidize Other Electrorefining and Molten Salt Extraction Salts	707A, 707B, 707D, 707E	4,4,8,8
Pyro-Oxidize IDC 365, 413, and 427 Direct Oxide Reduction Salts	707A, 707B, 707D, 707E	4,4,8,8
Pyro-Oxidize Other Direct Oxide Reduction Salts	707A, 707B, 707D, 707E	4,4,8,8
Neutralize/Dry Aqueous Contaminated-Combustibles	371–3701	13
Thermal Desorption Organic-Contaminated Combustibles	371–3701	13
Direct Repackage Dry Combustibles	707D, 707E, 707F	8,8,3
Acid Dissolve Plutonium Fluorides	707J, 371–3701	1,13
Neutralize/Dry IDC 331 Ful Flo Filters	371-3701	13
Neutralize/Dry IDC 338 High-Efficiency Particulate Air Filters	371–3701	13
Neutralize/Dry Other High-Efficiency Particulate Air Filters	371–3701	13
Filter/Dry Sludge	371–3701	13
Neutralize/Dry Glass	371–3701	13
Repackage Graphite	707D, 707E, 707F	8,8,3
Repackage Inorganics	707D, 707E, 707F	8,8,3
Repackage Scrub Alloy	707D, 707E	8,8

Table G–2 Development And Testing Costs for Rocky Flats and Los Alamos National Laboratory Processing Technologies

Technology	*Cost ($000)*
Cementation	500
Calcination/Vitrification (except Scrub Alloy)	645
Calcination/Vitrification (Scrub Alloy)	500
Neutralize/Dry	81
Blend Down	250
Acid Dissolve Plutonium Oxide Recovery	200
Catalytic Chemical Oxidation	2,000
Sonic Wash	1,000
Mediated Electrochemical Oxidation	2,000
Salt Distillation	2,000
Salt Scrub	500
Water Leach	500

The following steps describe the process used to develop the exposure-hour multipliers (SAIC 1997a):

- Identify total labor costs previously developed at Rocky Flats for work scheduled under certain processing options for fiscal year 1998. Labor cost estimates were available for distillation of salt residue, sonic wash of wet combustibles, repackaging of dry combustibles, and vitrification of ash (incinerator ash, graphite fines, and sand, slag, and crucible).

- Divide total annual labor costs by $100,000 per person-year, resulting in an estimate of the number of full-time equivalent personnel for each processing option per year.

- Divide annual full-time equivalent personnel by annual personnel exposure (calculated separately). The result is the ratio of personnel-hours to exposure-hours for each processing option. For the four specified residue categories and processing options, the resulting ratios were salt distillation, 3.1; sonic wash wet combustibles, 5.8; repackage dry combustibles, 1.1; and vitrify ash, 4.2.

- Apply the calculated exposure-hour multipliers to the other processing options according to the similarity of the options (e.g., vitrification and blending are estimated at 4.2, distillation and pyro-oxidation are estimated at 3.1). **Tables G–3** and **G–4** show the complete estimates for Rocky Flats and the Savannah River Site, respectively. Costs at the Los Alamos National Laboratory are similar to those at Rocky Flats for the same types of activities.

Table G–3 Exposure-Years, Person-Year Multiplier, Allocable Labor Costs (Dollars in Millions) at Rocky Flats

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
Incinerator Ash	Calcine & Cement at Rocky Flats	190	5.8	110
Incinerator Ash	Vitrification at Rocky Flats	82	4.2	34
Incinerator Ash	Cold Ceramification at Rocky Flats	58	5.8	34
Incinerator Ash	Blend Down at Rocky Flats	123	4.2	52
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site F-Canyon	76	1.1	8
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site H-Canyon	76	1.1	8
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	54	1.1	6
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	54	1.1	6
Incinerator Ash	Calcine & Cement at Rocky Flats (Alternative 4)	189	5.8	110
Incinerator Ash	Repackage at Rocky Flats (Alternative 4)	38	1.1	4
Sand, slag, & crucible	Calcine & Cement at Rocky Flats	27	5.8	16
Sand, slag, & crucible	Vitrification at Rocky Flats	12	4.2	5
Sand, slag, & crucible	Blend Down at Rocky Flats	17	4.2	7
Sand, slag, & crucible	Repackage and Purex process at the Savannah River Site F-Canyon	9	1.1	1
Sand, slag, & crucible	Repackage and Purex process at the Savannah River Site H-Canyon	9	1.1	1
Sand, slag, & crucible	Calcine & Cement at Rocky Flats (Alternative 4)	28	5.8	16

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
Sand, slag, & crucible	Repackage at Rocky Flats (Alternative 4)	5	1.1	1
Graphite Fines	Cement at Rocky Flats	12	5.8	7
Graphite Fines	Vitrification at Rocky Flats	7	4.2	3
Graphite Fines	Blend Down at Rocky Flats	8	4.2	3
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	4	1.1	0
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	4	1.1	0
Graphite Fines	Cement at Rocky Flats (Alternative 4)	12	5.8	7
Graphite Fines	Repackage at Rocky Flats (Alternative 4)	3	1.1	0
Inorganic Ash	Calcine & Cement at Rocky Flats	11	5.8	6
Inorganic Ash	Vitrification at Rocky Flats	5	4.2	2
Inorganic Ash	Blend Down at Rocky Flats	7	4.2	3
Inorganic Ash	Calcine & Cement at Rocky Flats (Alternative 4)	11	5.8	6
Inorganic Ash	Repackage at Rocky Flats (Alternative 4)	2	1.1	0
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats	37	3.1	12
MSE/ER Salts (IDC 409)	Blend Down at Rocky Flats	71	4.2	30
MSE/ER Salts (IDC 409)	Distillation at Rocky Flats	24	3.1	7
MSE/ER Salts (IDC 409)	Water Leach at Rocky Flats	46	5.8	27
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	18	3.1	5
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	21	3.1	6
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	21	3.1	6
MSE/ER Salts (IDC 409)	Pyro-oxidize, Blend, Repackage (Alternative 4)	18	4.2	8
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats	91	3.1	28
MSE/ER Salts (All Others)	Blend Down at Rocky Flats	173	4.2	73
MSE/ER Salts (All Others)	Distillation at Rocky Flats	57	3.1	18
MSE/ER Salts (All Others)	Water Leach at Rocky Flats	112	5.8	65
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	43	3.1	13
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	51	3.1	16
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	51	3.1	16
MSE/ER Salts (All Others)	Pyro-oxidize (Alternative 4)	87	3.1	27
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats	39	3.1	12
DOR Salts (IDCs 365, 413, 427)	Blend Down at Rocky Flats	42	4.2	18
DOR Salts (IDCs 365, 413, 427)	Water Leach at Rocky Flats	28	5.8	16
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	3	3.1	1

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	3	3.1	1
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	12	3.1	4
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	12	3.1	4
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize, Blend, Repackage (Alternative 4)	11	4.2	4
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats	14	3.1	4
DOR Salts (All Others)	Blend Down at Rocky Flats	15	3.1	5
DOR Salts (All Others)	Water Leach at Rocky Flats	10	5.8	6
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	1	3.1	0
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	1	3.1	0
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	4	3.1	1
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	4	3.1	1
DOR Salts (All Others)	Pyro-oxidize (Alternative 4)	14	3.1	4
Aqueous-Contaminated Combustibles	Neutralize/Dry at Rocky Flats	3	5.8	2
Aqueous-Contaminated Combustibles	Sonic Wash at Rocky Flats	4	5.8	2
Aqueous-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	12	5.8	7
Aqueous-Contaminated Combustibles	Blend Down at Rocky Flats	1	4.2	1
Aqueous-Contaminated Combustibles	Mediated Electrochemical Oxidation	3	5.8	2
Aqueous-Contaminated Combustibles	Neutralize/Dry (Alternative 4)	3	5.8	2
Organic-Contaminated Combustibles	Thermal Desorption/Steam Passivation at Rocky Flats	6	5.8	3
Organic-Contaminated Combustibles	Sonic Wash at Rocky Flats	3	5.8	2
Organic-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	9	5.8	5
Organic-Contaminated Combustibles	Blend Down at Rocky Flats	1	4.2	0
Organic-Contaminated Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	2	5.8	1
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation (Alternative 4)	6	5.8	3
Dry Combustibles	Repackage at Rocky Flats	1	1.1	0
Dry Combustibles	Sonic Wash at Rocky Flats	2	5.8	1
Dry Combustibles	Catalytic Chemical Oxidation at Rocky Flats	7	5.8	4
Dry Combustibles	Blend Down at Rocky Flats	1	4.2	0

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
Dry Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	2	5.8	1
Dry Combustibles	Repackage at Rocky Flats (Alternative 4)	1	1.1	0
Plutonium Fluorides	Acid Dissolution at Rocky Flats	22	5.8	13
Plutonium Fluorides	Blend Down at Rocky Flats	56	4.2	23
Plutonium Fluorides	Acid Dissolution at Rocky Flats	22	5.8	13
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	4	1.1	0
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	4	1.1	0
Ful Flo Filter Media	Neutralize/Dry at Rocky Flats	5	5.8	3
Ful Flo Filter Media	Blend Down at Rocky Flats	2	4.2	1
Ful Flo Filter Media	Sonic Wash at Rocky Flats	4	5.8	2
Ful Flo Filter Media	Mediated Electrochemical Oxidation at Rocky Flats	3	5.8	2
HEPA Filters (IDC 338)	Neutralize/Dry at Rocky Flats	22	5.8	13
HEPA Filters (IDC 338)	Vitrification at Rocky Flats	10	4.2	4
HEPA Filters (IDC 338)	Blend Down at Rocky Flats	11	4.2	5
HEPA Filters (IDC 338)	Sonic Wash at Rocky Flats	19	5.8	11
HEPA Filters (IDC 338)	Mediated Electrochemical Oxidation at Rocky Flats	14	5.8	8
HEPA Filters (IDC 338)	Neutralize/Dry (Alternative 4)	22	5.8	13
HEPA Filters (All Others)	Neutralize/Dry at Rocky Flats	0	5.8	0
HEPA Filters (All Others)	Vitrification at Rocky Flats	0	4.2	0
HEPA Filters (All Others)	Blend Down at Rocky Flats	1	4.2	0
HEPA Filters (All Others)	Sonic Wash at Rocky Flats	0	5.8	0
HEPA Filters (All Others)	Mediated Electrochemical Oxidation at Rocky Flats	0	5.8	0
HEPA Filters (All Others)	Blend and Repackage at Rocky Flats (Alternative 4)	1	4.2	0
Sludge (IDCs 089, 099, 332)	Filter/Dry at Rocky Flats	0	5.8	0
Sludge (IDCs 089, 099, 332)	Vitrification at Rocky Flats	0	4.2	0
Sludge (IDCs 089, 099, 332)	Blend Down at Rocky Flats	0	4.2	0
Sludge (IDCs 089, 099, 332)	Blend and Repackage at Rocky Flats (Alternative 4)	0	4.2	0
Sludge (All Others)	Filter/Dry at Rocky Flats	5	5.8	3
Sludge (All Others)	Vitrification at Rocky Flats	3	4.2	1
Sludge (All Others)	Blend Down at Rocky Flats	3	4.2	1
Sludge (All Others)	Acid Dissolution at Rocky Flats	24	5.8	14
Sludge (All Others)	Filter/Dry at Rocky Flats (Alternative 4)	5	5.8	3
Glass	Neutralize/Dry at Rocky Flats	1	5.8	0
Glass	Vitrification at Rocky Flats	0	4.2	0
Glass	Blend Down at Rocky Flats	1	4.2	0
Glass	Sonic Wash at Rocky Flats	1	5.8	1
Glass	Mediated Electrochemical Oxidation at Rocky Flats	1	5.8	0
Glass	Neutralize/Dry (Alternative 4)	1	5.8	0
Graphite	Repackage at Rocky Flats	9	1.1	1
Graphite	Cement at Rocky Flats	20	1.1	2
Graphite	Vitrification at Rocky Flats	9	4.2	4
Graphite	Blend Down at Rocky Flats	9	4.2	4

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
Graphite	Mediated Electrochemical Oxidation at Rocky Flats	14	5.8	8
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	8	1.1	1
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	8	1.1	1
Graphite	Repackage at Rocky Flats (Alternative 4)	9	1.1	1
Inorganics	Repackage at Rocky Flats	2	1.1	0
Inorganics	Vitrification at Rocky Flats	2	4.2	1
Inorganics	Blend Down at Rocky Flats	2	4.2	1
Inorganics	Mediated Electrochemical Oxidation at Rocky Flats	3	5.8	2
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	1	1.1	0
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	1	1.1	0
Inorganics	Repackage at Rocky Flats (Alternative 4)	2	1.1	0
Scrub Alloy	Repackage at Rocky Flats	3	1.1	0
Scrub Alloy	Calcine and Vitrification at Rocky Flats	99	4.2	41
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	4	1.1	0
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	4	1.1	0

MSE/ER = molten salt extraction/electrorefining DOR = direct oxide reduction HEPA = high-efficiency particulate air

Table G–4 Exposure-Years, Person-Year Multiplier, Allocable Labor Costs (Dollars in Millions) at Savannah River Site

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site F-Canyon	227.1	5.8	132
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site H-Canyon	652.3	5.8	378
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	126.3	5.8	73
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	120.3	5.8	70
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site F-Canyon	31.7	5.8	18
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site H-Canyon	89.8	5.8	52
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	8.1	5.8	5
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	7.7	5.8	4

Material	*Process*	*Exposure Years*	*Multiplier*	*Labor Costs*
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	8.0	5.8	5
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	10.9	5.8	6
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	60.7	5.8	35
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	83.0	5.8	48
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	3.9	5.8	2
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	5.4	5.8	3
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	7.8	5.8	5
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	10.7	5.8	6
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	18.7	5.8	11
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	53.7	5.8	31
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	23.1	5.8	13
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	20.9	5.8	12
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	4.8	5.8	3
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	4.5	5.8	3
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	18.4	5.8	11
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	25.3	5.8	15

MSE/ER = molten salt extraction/electrorefining DOR = direct oxide reduction

As a practical matter, the only processing options for which the differences in *incremental* labor costs to DOE are likely to be significant are those with much higher exposure-years than the others. For example, Table G-3 shows that the duration of exposures at Rocky Flats to calcine and cement incinerator ash is more than double that to vitrify ash. This difference is outside the range of uncertainty in the processing technologies and the cost estimating approaches. On the other hand, exposure durations for vitrifying ash and fusing ash (for shipment to the Savannah River Site) differ by about 10 percent. This difference is within the range of uncertainty in the processing technologies. Costs, however, are shown as differing by a factor of four since vitrification has a labor multiplier of 4.2 and fusion and packaging has a multiplier of 1.1. Actual costs are unlikely to differ to this degree.

Three important caveats attach to the exposure multipliers. First, they are based on a very small sample. Four processes provide four very different multipliers that are then applied to more than 100 processing options. Increasing the sampling basis would certainly add to the set of multipliers. Second, the multipliers are applied to broadly similar processes without any adjustments. Detailed option-specific cost estimation (which will be conducted once the management alternative has been selected and schedules have been established) would

obviously increase the accuracy of the estimates. Third, regardless of the true (but unknown) multiplier for a single processing option, detailed costing and scheduling for a complete management alternative will force the multipliers towards a narrower range than 1.1 to 5.8. This narrower range will arise because of the relative fixity of many indirect and support costs; e.g., security and site administration. This is particularly true at the Savannah River Site, where all of the individual options are assigned a 5.8 labor multiplier based on their similarity to high-multiplier processing options at Rocky Flats, rather than direct or indirect costs at the Savannah River Site. Each of these three factors suggests that greater weight should be given to exposure-hours as a decision factor than to the implied labor costs. For example, the estimated decisional cost of the Preferred Alternative is about 40 percent higher than the Minimum Cost Management Approach ($334 million to $238 million) but exposures are only about 30 percent higher (306 exposure-years to 235 exposure-years). This suggests that the actual difference in the cost of the Preferred Alternative and the Minimum Cost Management Approach is likely to be smaller than implied by the multiplied labor costs.

G.1.3 Transuranic Waste Costs

Transuranic waste costs are estimated on a unit cost basis, as shown on **Table G–5. Table G–6** shows the total cost for acquiring the drums, characterizing the waste, shipping the waste drums to WIPP, disposing of the drums at WIPP, and so forth, by site, in millions of dollars.

Table G–5 Transuranic Waste—Cost Factors

Cost Factor	*Description*	*Value*	*References*
Transuranic Drum		$150/drum	1
Transuranic Pipe	TRUPACT-II pipe (2,800 fissile gram equivalent)	$2,000/drum	4
Interim Storage at Rocky Flats (drums certified for disposal at WIPP)	Transuranic drums prior to the WIPP shipping	$100/drum/yr for 3 years	3,2
Transuranic Shipping	14 drums per TRUPACT-II 3 TRUPACT-IIs per shipment		1
Shipping Cost - Rocky Flats to WIPP	1408 miles round-trip at $4,630 plus $10.87 per mile for each shipment	$475/drum for a 42-drum shipment	1
Shipping Cost - Los Alamos National Laboratory to WIPP	343 miles round-trip at $4,630 plus $10.87 per mile for each shipment	$199/drum for a 42-drum shipment	1
Shipping Cost - Savannah River Site to WIPP	3170 miles round-trip at $4,630 plus $10.87 per mile for each shipment	$931/drum for a 42-drum shipment	1
Transuranic Characterization Cost for WIPP	• Headspace gas sampling and analysis ($1,200/drum) • Real-time radiography and radioassay ($2,500/drum) • Data reporting and project management ($1,000/drum) • Resource Conservation and Recovery Act characterization ($1,000/drum) • Visual examination and inner bag gas sampling ($1,000/drum)	$6,700/drum	3
Variable Cost for Transuranic Disposal at WIPP	$5,500 per shipment	$131/drum for a 42-drum, 3-TRUPACT-II shipment	5

References:
1. DOE 1996c.
2. SAIC 1997c.
3. DOE 1996a.
4. DOE 1997a.

5. DOE 1996d (for *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE Carlsbad Area Office, April 1996.)

In the No-Action Alternative, transuranic waste and stabilized residues are created during the stabilization activities. The transuranic waste is packaged, characterized, and shipped as in the other alternatives. The stabilized residues will be retained at Rocky Flats for an indeterminate period of time (assumed for cost purposes to be 2015) before being shipped off-site. As a practical matter, the stabilized residues must ultimately be shipped somewhere and must ultimately be characterized to some disposal standard. For cost estimation, DOE estimates the costs for disposition of the stabilized residues to be the sum of the costs for interim on-site storage at Rocky Flats and the costs for packaging, characterization, transportation, and disposal at WIPP. Section G.1.6 summarizes the costs for interim on-site storage at Rocky Flats.

Table G–6 Transuranic Waste Packaging, Characterizing, Shipping, and Disposal Cost by Site (Dollars in Millions)

Material	*Process*	*Rocky Flats*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*Cost*
Incinerator Ash	Calcine & Cement at Rocky Flats at Rocky Flats	51.3	0.0	0.0	0.7	52.0
Incinerator Ash	Vitrification at Rocky Flats	50.2	0.0	0.0	0.7	51.0
Incinerator Ash	Cold Ceramification at Rocky Flats	49.8	0.0	0.0	0.7	50.5
Incinerator Ash	Blend Down at Rocky Flats	59.7	0.0	0.0	0.8	60.6
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site F-Canyon	4.4	1.2	0.0	0.1	5.7
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site H-Canyon	4.4	1.2	0.0	0.1	5.7
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	4.4	2.0	0.0	0.1	6.6
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	4.4	2.0	0.0	0.1	6.6
Incinerator Ash	Calcine & Cement at Rocky Flats (Alternative 4)	51.3	0.0	0.0	0.7	52.0
Incinerator Ash	Repackage at Rocky Flats (Alternative 4)	51.7	0.0	0.0	0.7	52.4
Sand, Slag, & Crucible	Calcine & Cement at Rocky Flats	11.1	0.0	0.0	0.2	11.3
Sand, Slag, & Crucible	Vitrification at Rocky Flats	10.9	0.0	0.0	0.2	11.0
Sand, Slag, & Crucible	Blend Down at Rocky Flats	13.0	0.0	0.0	0.2	13.1
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site F-Canyon	0.9	0.1	0.0	0.0	1.0
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site H-Canyon	0.9	0.1	0.0	0.0	1.0
Sand, Slag, & Crucible	Calcine & Cement at Rocky Flats (Alternative 4)	4.0	0.0	0.0	0.0	4.0
Sand, Slag, & Crucible	Repackage at Rocky Flats (Alternative 4)	9.4	0.0	0.0	0.1	9.5
Graphite Fines	Cement at Rocky Flats	3.3	0.0	0.0	0.0	3.4
Graphite Fines	Vitrification at Rocky Flats	3.2	0.0	0.0	0.0	3.3
Graphite Fines	Blend Down at Rocky Flats	3.8	0.0	0.0	0.1	3.9
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	0.3	0.1	0.0	0.0	0.4
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	0.3	0.1	0.0	0.0	0.4
Graphite Fines	Cement at Rocky Flats (Alternative 4)	3.3	0.0	0.0	0.0	3.4
Graphite Fines	Repackage at Rocky Flats (Alternative 4)	3.3	0.0	0.0	0.0	3.4
Inorganic Ash	Calcine & Cement at Rocky Flats	7.4	0.0	0.0	0.1	7.5
Inorganic Ash	Vitrification at Rocky Flats	7.2	0.0	0.0	0.1	7.3

Material	*Process*	*Rocky Flats*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*Cost*
Inorganic Ash	Blend Down at Rocky Flats	8.6	0.0	0.0	0.1	8.7
Inorganic Ash	Calcine & Cement at Rocky Flats (Alternative 4)	7.4	0.0	0.0	0.1	7.5
Inorganic Ash	Repackage at Rocky Flats (Alternative 4)	7.4	0.0	0.0	0.1	7.6
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats	14.0	0.0	0.0	0.2	14.2
MSE/ER Salts (IDC 409)	Blend Down at Rocky Flats	13.5	0.0	0.0	0.2	13.7
MSE/ER Salts (IDC 409)	Distillation at Rocky Flats	0.7	0.0	0.0	0.0	0.7
MSE/ER Salts (IDC 409)	Water Leach at Rocky Flats	12.0	0.0	0.0	0.2	12.2
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	0.7	0.0	0.6	0.0	1.3
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	1.3	0.1	0.0	0.0	1.5
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	1.3	0.1	0.0	0.0	1.5
MSE/ER Salts (IDC 409)	Pyro-oxidize, Blend, Repackage (Alternative 4)	11.2	0.0	0.0	0.2	11.4
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats	39.5	0.0	0.0	0.6	40.0
MSE/ER Salts (All Others)	Blend Down at Rocky Flats	101.4	0.0	0.0	1.4	102.8
MSE/ER Salts (All Others)	Distillation at Rocky Flats	3.9	0.0	0.0	0.1	3.9
MSE/ER Salts (All Others)	Water Leach at Rocky Flats	89.3	0.0	0.0	1.6	90.8
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	3.5	0.0	3.4	0.1	7.0
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	8.6	0.7	0.0	0.2	9.4
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	8.6	0.7	0.0	0.2	9.4
MSE/ER Salts (All Others)	Pyro-oxidize (Alternative 4)	39.5	0.0	0.0	0.6	40.0
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats	5.8	0.0	0.0	0.1	5.9
DOR Salts (IDCs 365, 413, 427)	Blend Down at Rocky Flats	6.6	0.0	0.0	0.1	6.7
DOR Salts (IDCs 365, 413, 427)	Water Leach at Rocky Flats	5.9	0.0	0.0	0.1	6.0

Material	*Process*	*Rocky Flats*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*Cost*
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	0.3	0.0	5.9	0.1	6.4
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	0.3	0.0	5.8	0.1	6.2
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	0.6	0.0	0.0	0.0	0.7
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	0.6	0.0	0.0	0.0	0.7
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize, Blend, Repackage (Alternative 4)	8.1	0.0	0.0	0.1	8.2
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats	3.3	0.0	0.0	0.0	3.4
DOR Salts (All Others)	Blend Down at Rocky Flats	13.0	0.0	0.0	0.2	13.2
DOR Salts (All Others)	Water Leach at Rocky Flats	11.6	0.0	0.0	0.2	11.8
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	0.4	0.0	11.4	0.2	12.0
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	0.4	0.0	11.2	0.2	11.8
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	1.1	0.1	0.0	0.0	1.2
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	1.1	0.1	0.0	0.0	1.2
DOR Salts (All Others)	Pyro-oxidize (Alternative 4)	3.3	0.0	0.0	0.0	3.4
Aqueous-Contaminated Combustibles	Neutralize/Dry at Rocky Flats	3.3	0.0	0.0	0.1	3.4
Aqueous-Contaminated Combustibles	Sonic Wash at Rocky Flats	1.7	0.0	0.0	0.0	1.7
Aqueous-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	4.3	0.0	0.0	0.1	4.4
Aqueous-Contaminated Combustibles	Blend Down at Rocky Flats	0.8	0.0	0.0	0.0	0.8
Aqueous-Contaminated Combustibles	Mediated Electrochemical Oxidation	4.0	0.0	0.0	0.1	4.1
Aqueous-Contaminated Combustibles	Neutralize/Dry (Alternative 4)	3.3	0.0	0.0	0.1	3.4
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation at Rocky Flats	2.3	0.0	0.0	0.0	2.4
Organic-Contaminated Combustibles	Sonic Wash at Rocky Flats	1.2	0.0	0.0	0.0	1.2
Organic-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	3.0	0.0	0.0	0.1	3.1

Material	*Process*	*Rocky Flats*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*Cost*
Organic-Contaminated Combustibles	Blend Down at Rocky Flats	0.6	0.0	0.0	0.0	0.6
Organic-Contaminated Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	2.8	0.0	0.0	0.0	2.9
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation (Alternative 4)	2.3	0.0	0.0	0.0	2.4
Dry Combustibles	Repackage at Rocky Flats	1.9	0.0	0.0	0.0	1.9
Dry Combustibles	Sonic Wash at Rocky Flats	1.0	0.0	0.0	0.0	1.0
Dry Combustibles	Catalytic Chemical Oxidation at Rocky Flats	2.4	0.0	0.0	0.0	2.5
Dry Combustibles	Blend Down at Rocky Flats	0.5	0.0	0.0	0.0	0.5
Dry Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	2.3	0.0	0.0	0.0	2.3
Dry Combustibles	Repackage at Rocky Flats (Alternative 4)	1.9	0.0	0.0	0.0	1.9
Plutonium Fluorides	Acid Dissolution at Rocky Flats	3.5	0.0	0.0	0.1	3.6
Plutonium Fluorides	Blend Down at Rocky Flats	37.1	0.0	0.0	0.5	37.6
Plutonium Fluorides	Acid Dissolution at Rocky Flats	2.5	0.0	0.0	0.0	2.5
Plutonium Fluorides	Repackage at Rocky Flats and Purex process at the Savannah River Site F-Canyon	0.2	0.1	0.0	0.0	0.3
Plutonium Fluorides	Repackage at Rocky Flats and Purex process at the Savannah River Site H-Canyon	0.2	0.1	0.0	0.0	0.3
Ful Flo Filter Media	Neutralize/Dry at Rocky Flats	11.8	0.0	0.0	0.2	12.0
Ful Flo Filter Media	Blend Down at Rocky Flats	2.4	0.0	0.0	0.0	2.5
Ful Flo Filter Media	Sonic Wash at Rocky Flats	3.1	0.0	0.0	0.0	3.2
Ful Flo Filter Media	Mediated Electrochemical Oxidation at Rocky Flats	6.4	0.0	0.0	0.1	6.5
HEPA Filters (IDC 338)	Neutralize/Dry at Rocky Flats	25.1	0.0	0.0	0.4	25.6
HEPA Filters (IDC 338)	Vitrification at Rocky Flats	5.9	0.0	0.0	0.1	6.0
HEPA Filters (IDC 338)	Blend Down at Rocky Flats	5.1	0.0	0.0	0.1	5.2
HEPA Filters (IDC 338)	Sonic Wash at Rocky Flats	6.6	0.0	0.0	0.1	6.7
HEPA Filters (IDC 338)	Mediated Electrochemical Oxidation at Rocky Flats	13.7	0.0	0.0	0.2	13.9
HEPA Filters (IDC 338)	Neutralize/Dry (Alternative 4)	25.1	0.0	0.0	0.4	25.6
HEPA Filters (All Others)	Neutralize/Dry at Rocky Flats	0.8	0.0	0.0	0.0	0.8
HEPA Filters (All Others)	Vitrification at Rocky Flats	0.4	0.0	0.0	0.0	0.4
HEPA Filters (All Others)	Blend Down at Rocky Flats	0.4	0.0	0.0	0.0	0.4

Material	*Process*	*Rocky Flats*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*Cost*
HEPA Filters (All Others)	Sonic Wash at Rocky Flats	0.5	0.0	0.0	0.0	0.5
HEPA Filters (All Others)	Mediated Electrochemical Oxidation at Rocky Flats	1.0	0.0	0.0	0.0	1.0
HEPA Filters (All Others)	Blend and Re-repackage (Alternative 4)	0.7	0.0	0.0	0.0	0.7
Sludge (IDCs 089, 099, 332)	Filter/Dry at Rocky Flats	0.4	0.0	0.0	0.0	0.4
Sludge (IDCs 089, 099, 332)	Vitrification at Rocky Flats	0.0	0.0	0.0	0.0	0.0
Sludge (IDCs 089, 099, 332)	Blend Down at Rocky Flats	0.1	0.0	0.0	0.0	0.1
Sludge (IDCs 089, 099, 332)	Blend and Re-repackage (Alternative 4)	0.1	0.0	0.0	0.0	0.1
Sludge (All Others)	Filter/Dry at Rocky Flats	8.6	0.0	0.0	0.2	8.8
Sludge (All Others)	Vitrification at Rocky Flats	1.9	0.0	0.0	0.0	2.0
Sludge (All Others)	Blend Down at Rocky Flats	1.9	0.0	0.0	0.0	1.9
Sludge (All Others)	Acid Dissolution at Rocky Flats	4.9	0.0	0.0	0.1	5.0
Sludge (All Others)	Filter/Dry (Alternative 4)	8.6	0.0	0.0	0.2	8.8
Glass	Neutralize/Dry at Rocky Flats	0.1	0.0	0.0	0.0	0.2
Glass	Vitrification at Rocky Flats	0.4	0.0	0.0	0.0	0.4
Glass	Blend Down at Rocky Flats	0.4	0.0	0.0	0.0	0.4
Glass	Sonic Wash at Rocky Flats	0.4	0.0	0.0	0.0	0.4
Glass	Mediated Electrochemical Oxidation at Rocky Flats	1.1	0.0	0.0	0.0	1.1
Glass	Neutralize/Dry (Alternative 4)	0.1	0.0	0.0	0.0	0.2
Graphite	Repackage at Rocky Flats	6.7	0.0	0.0	0.1	6.8
Graphite	Cement at Rocky Flats	6.8	0.0	0.0	0.1	6.9
Graphite	Vitrification at Rocky Flats	6.0	0.0	0.0	0.1	6.1
Graphite	Blend Down at Rocky Flats	6.0	0.0	0.0	0.1	6.1
Graphite	Mediated Electrochemical Oxidation at Rocky Flats	15.4	0.0	0.0	0.3	15.6
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	0.6	0.3	0.0	0.0	0.9
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	0.6	0.3	0.0	0.0	0.9
Graphite	Repackage at Rocky Flats (Alternative 4)	6.7	0.0	0.0	0.1	6.8
Inorganics	Repackage at Rocky Flats	1.3	0.0	0.0	0.0	1.3
Inorganics	Vitrification at Rocky Flats	1.1	0.0	0.0	0.0	1.1
Inorganics	Blend Down at Rocky Flats	1.1	0.0	0.0	0.0	1.1
Inorganics	Mediated Electrochemical Oxidation at Rocky Flats	3.6	0.0	0.0	0.1	3.7

Material	*Process*	*Rocky Flats*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*Cost*
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	0.1	0.1	0.0	0.0	0.2
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	0.1	0.1	0.0	0.0	0.2
Inorganics	Repackage at Rocky Flats (Alternative 4)	1.3	0.0	0.0	0.0	1.3
Scrub Alloy	Repackage at Rocky Flats	2.5	0.0	0.0	0.0	2.5
Scrub Alloy	Calcine and Vitrification at Rocky Flats	26.5	0.0	0.0	0.4	26.9
Scrub Alloy	Repackage at Rocky Flats and Purex process at the Savannah River Site F-Canyon	0.3	0.2	0.0	0.0	0.5
Scrub Alloy	Repackage at Rocky Flats and Purex process at the Savannah River Site H-Canyon	0.3	0.2	0.0	0.0	0.5

MSE/ER = molten salt extraction/electrorefining DOR = direct oxide reduction HEPA = high-efficiency particulate air

Transuranic waste drums are shipped in TRUPACT-II containers. DOE assumes that drums of processed or repackaged residues from Rocky Flats are packed at the maximum allowable level of 14 per TRUPACT-II and three TRUPACT-II's per truck (42 drums per truck). This assumption is possible because the waste mass in the drums is limited by plutonium content rather than total mass. The plutonium limitation results in very light drums and thus does not approach weight limits per drum, TRUPACT-II, or truck.

The major cost components of preparing for disposal at WIPP are about $6,700 per drum for characterization of the transuranic waste and about $2,000 per drum for the pipe component[1] Shipping costs for a 42-drum shipment are estimated at $199 per drum from the Los Alamos National Laboratory, $435 per drum from Rocky Flats, and $931 per drum from the Savannah Rive Site. Disposal at WIPP is based on the *incremental* cost of disposal. Based on a disposal cost per shipment (regardless of drum count) of $5,500 and the maximum 42 drums per shipment, the variable cost of disposal at WIPP is about $131 per drum. For the preferred alternative and all of the other plausible management approaches, this unit cost implies a total variable cost at WIPP of $1 to $3 million. Fixed costs at WIPP (which are roughly $7,000 per drum) are not decisional in the present EIS since they have already been charged to the overall WIPP program and cannot be affected by the number of drums shipped pursuant to the Record of Decision in the present EIS.

G.1.4 Low-Level Waste Costs

Low-level waste costs and cost factors for Rocky Flats and the Los Alamos National Laboratory are estimated on a unit cost basis, as shown on **Table G–7**. The total cost of shipping and disposal is just over $1,050 per drum. Low-level waste characterization, shipping, and disposal costs exceed $2 million in seven processing options at Rocky Flats and two at the Los Alamos National Laboratory. The seven at Rocky Flats are calcine and cementation of incinerator ash ($3 million), distillation of IDC 409 electrorefining and molten salt extraction salts ($4 million), water leach of other direct oxide reduction salts ($4 million), water leach of other

[1]*Not all drums of transuranic waste require or allow a pipe component. See the products and wastes tables in Chapter 4 regarding drum counts and pipe components for each processing option.*

electrorefining and molten salt extraction salts ($29 million), and mediated electrochemical oxidation of Ful Flo filters ($2 million), other high-efficiency particulate air filters ($4 million), and graphite. ($5 million). At the Los Alamos National Laboratory, water leach and acid dissolution of other direct oxide reduction salts each generate about $4 million in low-level waste-related costs. No activity at the Savannah River Site generates economically significant quantities of low-level waste.

Table G–7 Low-Level Waste Costs and Cost Factors (Rocky Flats and the Los Alamos National Laboratory)

Cost Factor	*Description*	*Cost*	*Reference*
Drum		$150/drum	1
Interim Storage at Rocky Flats		$50/year for 1 year	2
Characterization	Real-time radiography and radioassay ($133/drum) NDA ($116/drum) Data reporting, movement and management ($439/drum)	$688/drum	3
Shipping		$30/drum	4
Disposal		$150/drum	5

References:
1. Same drum as for transuranic waste.
2. SAIC estimate.
3. SAIC 1997c.
4. SAIC 1997b.
5. DOE 1996a.

G.1.5 Other Materials, Storage, Shipping, and Disposal Costs

Processing wastes generated at the Savannah River Site are disposed as low-level waste at the Savannah River Site, intermediate-level waste as saltstone at the Savannah River Site, transuranic waste at WIPP, and high-level waste as vitrified glass logs (Defense Waste Processing Facility logs) at the future monitored geologic repository. **Table G–8** shows unit costs for these wastes, excluding transuranic waste, which was shown on Table G-5. The combined costs to dispose of low-level and intermediate-level wastes from any alternative at the Savannah River Site is less than $1 million. Total costs related to transuranic waste disposal exceed $2 million only for mediated electrochemical oxidation of incinerator ash ($2 million). The costs to manufacture and dispose of Defense Waste Processing Facility logs exceed $2 million for mediated electrochemical oxidation of incinerator ash ($52 million), graphite fines ($4 million), and graphite ($16 million); and Purex processing of fused incinerator ash ($8 million) and sand, slag, and crucible ($8 million). Costs for disposing of wastes generated at H-Canyon or F-Canyon are about the same. In the case of mediated electrochemical oxidation at the Savannah River Site H-Canyon, decontamination and decommissioning of contaminated equipment at HB-Line would generate 1,800 cubic feet (about 250 drums) of transuranic waste, 2,000 cubic feet of low-level waste, and 20 cubic feet of mixed transuranic waste. Disposal costs for this amount of waste would be about $2 million.

Certain processing options at Rocky Flats or Los Alamos National Laboratory separate americium or plutonium that must be stored onsite for some period of time before shipment in 3013 containers and Safe, Secure Trailers. Costs for these functions are estimated in Table G–8. Plutonium storage costs are based on a long-run average of $3,500/position/year in the Savannah River Site's modified 235F or FB-Line vaults and $1,000/position/year in the New Plutonium Storage Vault, scheduled to start in May, 2002. Each 3013 container is assumed to contain 4 kg (8.8 lbs) of refined plutonium. A Safe, Secure Trailer is assumed to carry twenty-four 3013 containers. In practice, the amount of refined plutonium in a 3013 container may be more or less than 4 kg (8.8 lbs) (up to 4.99 kg [11 lbs] in some cases), depending on the batch size of the processes. The cost impact of batches in the 2- to 4-kg (4.4- to 8.8-lb) range is small. The cost impact of increasing the Safe, Secure Trailer loading to the maximum of thirty 3013 containers is also insignificant. At 4 kg (8.8 lbs), the cost of 3013 storage is in the $2 million range only for distillation or water leach of other electrorefining or molten salt extraction salts at Rocky Flats or incinerator ash processing (Purex or mediated electrochemical

oxidation) at the Savannah River Site. The higher costs at Rocky Flats for the smaller quantity of plutonium is due to the post-storage shipping costs from Rocky Flats to the Savannah River Site for ultimate disposition. The cost for disposition is based on DOE's current life-cycle cost estimate of $1.83 billion (undiscounted 1996 dollars) to dispose of 50 metric tons of plutonium.

Table G–8 Other Storage and Shipping Costs

Cost Factor	*Description*	*Cost*	*Reference*
3013 Container Storage	Facility cost	$1,500/container/year for 5 years	2
3013 Container Transfer	To secure storage	$3,000/container	1
Safe, Secure Trailer Shipping	Rocky Flats to Los Alamos National Laboratory	$18,000/Safe Secure Trailer	1
	Rocky Flats to the Savannah River Site	$66,800/Safe Secure Trailer	1
Low-Level Waste at the Savannah River Site	Onsite storage	$2.50/cubic feet	1
Low-Level Waste Saltstone at the Savannah River Site	Onsite storage	$675/cubic yard	1
High-Level Waste Glass	Defense Waste Processing Facility and Repository	$2M/log	1
Fissile Materials Disposition	Can-in-canister immobilization	$36,600/kilogram	3

References:
1. DOE 1996a.
2. Assuming 5 years' storage prior to acceptance by the fissile materials disposition program.
3. DOE 1996b.

G.1.6 Costs Related to Interim Storage of Stabilized Residues and Transuranic Waste at Rocky Flats

DOE estimates that if any of the No Action processing options were selected, stabilized residues that could not be shipped to WIPP would have to be stored on-site on an interim basis. The cost to store stabilized residues at an otherwise shutdown site would be $23 million per year. These residues would be stored in Building 371. Activities under other EISs at Rocky Flats (e.g., plutonium solutions, highly enriched uranium) and at other sites (e.g., WIPP, the Savannah River Site, and Los Alamos National Laboratory) are assumed to not affect the Rocky Flats closure schedule. Similarly, activities in this EIS that would accelerate the removal of particular residues from particular facilities compared to the baseline shutdown years (2003 for Building 707, and 2006 for Building 371) are excluded (DOE 1997b). The EIS allocates storage costs for twenty years, starting when DOE is assumed to have closed the site (about 2006 with accelerated shipment of all materials off site). The year 2006 is also about the time when processing under the No Action Alternative would be completed. The longest duration operations under the No Action Alternative take place at Building 371, Room 3701. They require an estimated 7.2 years of processing. The residues in the present EIS are not on the critical path for site closure if shipment to WIPP under Alternative 4 is selected for the bulk of the ash and salt residues. The Preferred Alternative includes such shipments.

Under the assumption that the stabilized residues stored at Rocky Flats will ultimately have to be disposed somewhere, this EIS develops cost estimates as if the residues were disposed at WIPP in 2025. The undiscounted cost for interim storage over 20 years is estimated at $460 million ($23 million per year for 20 years).

G.2 PROCESSING DURATIONS AND SCHEDULES

The following facilities at Rocky Flats are candidates for use under this EIS: Building 707, Modules A, B, D, E, F, and J; and Building 371, Rooms 3701 and 3305. The only facilities that could be on the critical path for Rocky Flats' closure are Modules A and E at Building 707 and Room 3701 at Building 371. **Table G–9** shows the longest duration processing options individually for the activities at Building 707, Modules A and E, and Building 371, Room 3701. For each processing option, the value on Table G–9 is the duration (in years) of the longest phase of the processing options at the specified facility. At Rocky Flats (and the Los Alamos National Laboratory), the duration of the processing is based on plutonium concentrations and plutonium mass.[2] All phases include estimated down-time for maintenance, facility availability, unscheduled down-time, and so forth. **Table G–10** shows the duration of the longest phase of each processing option (in weeks), regardless of facility.

Table G–9 Long-Duration Activities, Years for Longest Phase at Critical Path Facilities

Processing option	*Building 707, Module A*	*Building 707, Module E*	*Building 371, Room 3701*
Blend other electrorefining and molten salt extraction salts at Rocky Flats	6.7	6.3	
Blend IDC 409 electrorefining and molten salt extraction salts at Rocky Flats	2.8	2.6	
Pyro-oxidize other electrorefining and molten salt extraction salts at Rocky Flats under Alternative 4	2.4	2.3	
Pyro-oxidize other electrorefining and molten salt extraction salts at Rocky Flats for shipment to the Los Alamos National Laboratory	1.6		1.6
Blend IDC 365, 413, 427 direct oxide reduction salts at Rocky Flats	1.6	1.5	
Blend incinerator ash at Rocky Flats		2.5	
Calcine and vitrify scrub alloy at Rocky Flats		2.2	
Furnace vitrify incinerator ash at Rocky Flats		2.2	
Blend plutonium fluorides at Rocky Flats		1.6	
Calcine and cement incinerator ash at Rocky Flats			3.0
Water leach other electrorefining and molten salt extraction salts at Rocky Flats			1.5
Neutralize/dry IDC 338 filter media at Rocky Flats			1.1

Table G–10 Duration of Longest Phase at Primary and Secondary Facility, by Material (Same Phase, Potential Critical Path Secondary Facilities Only)

Material	*Process*	*Duration (Weeks)*	*Primary Facility*	*Duration (Weeks)*	*Secondary Facility*
Incinerator Ash	Calcine & Cement at Rocky Flats	155.7	3701	0	0
Incinerator Ash	Vitrification at Rocky Flats	113.5	707	0	0
Incinerator Ash	Cold Ceramification at Rocky Flats	68.1	707	0	0
Incinerator Ash	Blend Down at Rocky Flats	129.7	707	0	0
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site F-Canyon	78.1	707	0	0
Incinerator Ash	Fusion at Rocky Flats and Purex process at the Savannah River Site H-Canyon	78.1	707	0	0

[2]*Processing time at the Savannah River Site is a function of total residue mass.*

Material	*Process*	*Duration (Weeks)*	*Primary Facility*	*Duration (Weeks)*	*Secondary Facility*
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	56.2	707	0	0
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	56.2	707	0	0
Incinerator Ash	Calcine & Cement at Rocky Flats (Alternative 4)	155.7	3701	0	0
Incinerator Ash	Repackage at Rocky Flats (Alternative 4)	55.8	707	0	0
Sand, Slag, & Crucible	Calcine & Cement at Rocky Flats	22.1	3701	0	0
Sand, Slag, & Crucible	Vitrification at Rocky Flats	16.1	707	0	0
Sand, Slag, & Crucible	Blend Down at Rocky Flats	18.4	707	0	0
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site F-Canyon	16.8	707	0	0
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site H-Canyon	16.8	707	0	0
Sand, Slag, & Crucible	Calcine & Cement at Rocky Flats (Alternative 4)	25.8	3701	0	0
Sand, Slag, & Crucible	Repackage at Rocky Flats (Alternative 4)	8.0	707	0	0
Graphite Fines	Cement at Rocky Flats	12.7	3701	0	0
Graphite Fines	Vitrification at Rocky Flats	9.2	707	0	0
Graphite Fines	Blend Down at Rocky Flats	10.6	707	0	0
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	4.6	707	0	0
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	4.6	707	0	0
Graphite Fines	Cement at Rocky Flats (Alternative 4)	12.7	3701	0	0
Graphite Fines	Repackage at Rocky Flats (Alternative 4)	4.5	707	0	0
Inorganic Ash	Calcine & Cement at Rocky Flats	8.7	3701	0	0
Inorganic Ash	Vitrification at Rocky Flats	6.4	707	0	0
Inorganic Ash	Blend Down at Rocky Flats	7.3	707	0	0
Inorganic Ash	Calcine & Cement at Rocky Flats (Alternative 4)	8.7	3701	0	0
Inorganic Ash	Repackage at Rocky Flats (Alternative 4)	3.1	707	0	0
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats	52.2	707A	49	707
MSE/ER Salts (IDC 409)	Blend Down at Rocky Flats	143.6	707A	135	707
MSE/ER Salts (IDC 409)	Distillation at Rocky Flats	33.4	707A	0	0
MSE/ER Salts (IDC 409)	Water Leach at Rocky Flats	32.5	3701	0	0
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	34.8	707A	34	707D
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	19.6	707A	0	0

Material	*Process*	*Duration (Weeks)*	*Primary Facility*	*Duration (Weeks)*	*Secondary Facility*
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	19.6	707A	0	0
MSE/ER Salts (IDC 409)	Pyro-oxidize, Blend, Repackage (Alternative 4)	14.7	707A	15	707
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats	126.6	707A	119	707
MSE/ER Salts (All Others)	Blend Down at Rocky Flats	348.5	707A	328	707
MSE/ER Salts (All Others)	Distillation at Rocky Flats	81.1	707A	0	0
MSE/ER Salts (All Others)	Water Leach at Rocky Flats	78.9	3701	0	0
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	84.4	707A	81	707D
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	47.5	707A	0	0
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	47.5	707A	0	0
MSE/ER Salts (All Others)	Pyro-oxidize (Alternative 4)	126.6	707A	119	707
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats	52.0	707A	52	707
DOR Salts (IDCs 365, 413, 427)	Blend Down at Rocky Flats	84.2	707A	79	707
DOR Salts (IDCs 365, 413, 427)	Water Leach at Rocky Flats	19.1	3701	0	0
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	6.8	707A	6	707D
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	6.8	707A	6	707D
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	11.5	707A	0	0
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	11.5	707A	0	0
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize Blend, Repackage (Alternative 4)	8.6	707A	9	707
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats	19.1	707A	19	707
DOR Salts (All Others)	Blend Down at Rocky Flats	30.9	707A	29	707
DOR Salts (All Others)	Water Leach at Rocky Flats	7.0	3701	0	0
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	2.5	707A	0	0
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	2.5	707A	0	0
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	4.2	707A	0	0
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	4.2	707A	0	0

Material	*Process*	*Duration (Weeks)*	*Primary Facility*	*Duration (Weeks)*	*Secondary Facility*
DOR Salts (All Others)	Pyro-oxidize (Alternative 4)	19.1	707A	19	707
Aqueous-Contaminated Combustibles	Neutralize/Dry at Rocky Flats	7.7	3701	0	0
Aqueous-Contaminated Combustibles	Sonic Wash at Rocky Flats	7.2	3701	0	0
Aqueous-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	24.5	3701	0	0
Aqueous-Contaminated Combustibles	Blend Down at Rocky Flats	1.3	3701	0	0
Aqueous-Contaminated Combustibles	Mediated Electrochemical Oxidation	17.6	3701	0	0
Aqueous-Contaminated Combustibles	Neutralize/Dry (Alternative 4)	7.7	3701	0	0
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation at Rocky Flats	20.2	3701	0	0
Organic-Contaminated Combustibles	Sonic Wash at Rocky Flats	5.1	3701	0	0
Organic-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	17.2	3701	0	0
Organic-Contaminated Combustibles	Blend Down at Rocky Flats	0.9	3701	0	0
Organic-Contaminated Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	12.3	3701	0	0
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation (Alternative 4)	20.2	3701	0	0
Dry Combustibles	Repackage at Rocky Flats	1.2	707D	0	0
Dry Combustibles	Sonic Wash at Rocky Flats	4.1	3701	0	0
Dry Combustibles	Catalytic Chemical Oxidation at Rocky Flats	14.1	3701	0	0
Dry Combustibles	Blend Down at Rocky Flats	0.8	3701	0	0
Dry Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	10.1	3701	0	0
Dry Combustibles	Repackage at Rocky Flats (Alternative 4)	1.2	707D	0	0
Plutonium Fluorides	Acid Dissolution at Rocky Flats	25.4	3701	0	0
Plutonium Fluorides	Blend Down at Rocky Flats	81.7	707	0	0
Plutonium Fluorides	Acid Dissolution at Rocky Flats	25.4	3701	0	0
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	9.0	3701	0	0
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	9.0	3701	0	0
Ful Flo Filter Media	Neutralize/Dry at Rocky Flats	12.4	3701	0	0
Ful Flo Filter Media	Blend Down at Rocky Flats	2.8	3701	0	0
Ful Flo Filter Media	Sonic Wash at Rocky Flats	11.3	3701	0	0
Ful Flo Filter Media	Mediated Electrochemical Oxidation at Rocky Flats	4.6	3701	0	0
HEPA Filters (IDC 338)	Neutralize/Dry at Rocky Flats	57.7	3701	0	0
HEPA Filters (IDC 338)	Vitrification at Rocky Flats	11.6	707	0	0
HEPA Filters (IDC 338)	Blend Down at Rocky Flats	13.0	3701	0	0

Material	*Process*	*Duration (Weeks)*	*Primary Facility*	*Duration (Weeks)*	*Secondary Facility*
HEPA Filters (IDC 338)	Sonic Wash at Rocky Flats	52.5	3701	0	0
HEPA Filters (IDC 338)	Mediated Electrochemical Oxidation at Rocky Flats	21.5	3701	0	0
HEPA Filters (IDC 338)	Neutralize/Dry (Alternative 4)	57.7	3701	0	0
HEPA Filters (All Others)	Neutralize/Dry at Rocky Flats	2.0	3701	0	0
HEPA Filters (All Others)	Vitrification at Rocky Flats	0.3	707	0	0
HEPA Filters (All Others)	Blend Down at Rocky Flats	1.0	3701	0	0
HEPA Filters (All Others)	Sonic Wash at Rocky Flats	1.2	3701	0	0
HEPA Filters (All Others)	Mediated Electrochemical Oxidation at Rocky Flats	0.5	3701	0	0
HEPA Filters (All Others)	Blend and Repackage at Rocky Flats (Alternative 4)	1.1	707	0	0
Sludge (IDCs 089, 099, 332)	Filter/Dry at Rocky Flats	0.5	707	0	0
Sludge (IDCs 089, 099, 332)	Vitrification at Rocky Flats	3.3	707	0	0
Sludge (IDCs 089, 099, 332)	Blend Down at Rocky Flats	1.7	707	0	0
Sludge (IDCs 089, 099, 332)	Blend and Repackage at Rocky Flats (Alternative 4)	0.8	707	0	0
Sludge (All Others)	Filter/Dry at Rocky Flats	10.4	707	0	0
Sludge (All Others)	Vitrification at Rocky Flats	3.3	707	0	0
Sludge (All Others)	Blend Down at Rocky Flats	3.2	707	0	0
Sludge (All Others)	Acid Dissolution at Rocky Flats	45.9	3701	0	0
Sludge (All Others)	Filter/Dry at Rocky Flats (Alternative 4)	10.4	3701	0	0
Glass	Neutralize/Dry at Rocky Flats	1.9	3701	0	0
Glass	Vitrification at Rocky Flats	0.6	707	0	0
Glass	Blend Down at Rocky Flats	0.7	3701	0	0
Glass	Sonic Wash at Rocky Flats	2.1	3701	0	0
Glass	Mediated Electrochemical Oxidation at Rocky Flats	1.2	3701	0	0
Glass	Neutralize/Dry (Alternative 4)	1.9	3701	0	0
Graphite	Repackage at Rocky Flats	12.2	707	0	0
Graphite	Cement at Rocky Flats	16.6	3701	0	0
Graphite	Vitrification at Rocky Flats	12.2	707	0	0
Graphite	Blend Down at Rocky Flats	12.2	707	0	0
Graphite	Mediated Electrochemical Oxidation at Rocky Flats	23.8	3701	0	0
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	22.3	3701	10	707
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	22.3	3701	10	707

Material	*Process*	*Duration (Weeks)*	*Primary Facility*	*Duration (Weeks)*	*Secondary Facility*
Graphite	Repackage at Rocky Flats (Alternative 4)	12.2	707	0	0
Inorganics	Repackage at Rocky Flats	2.2	707	0	0
Inorganics	Vitrification at Rocky Flats	2.2	707	0	0
Inorganics	Blend Down at Rocky Flats	2.2	707	0	0
Inorganics	Mediated Electrochemical Oxidation at Rocky Flats	3.5	3701	0	0
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	2.7	3701	0	0
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	2.7	3701	0	0
Inorganics	Repackage at Rocky Flats (Alternative 4)	2.2	707	0	0
Scrub Alloy	Repackage at Rocky Flats	5.7	707	0	0
Scrub Alloy	Calcine and Vitrification at Rocky Flats	115.1	707	0	0
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	6.3	3701	0	0
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	6.3	3701	0	0

MSE/ER = molten salt extraction/electrorefining DOR = direct oxide reduction HEPA = high-efficiency particulate air

Because all activities have multiple phases (e.g., unload, bag-in, feed preparation, treatment, nondestructive analysis, bag-out, load transport), the duration of a processing option at a facility is longer than that of the single longest phase. Also, because facilities will be down while the transition is made from one residue or processing option to the next, the duration of time associated with a series of processing options is longer than the sum of the individual processing options. Combining these two timing factors, DOE estimates that the actual time required for processing a residue is about 15 percent greater than the time for the single longest phase of the processing option. The 15 percent adder is an approximation for use in estimating the impacts from a series of processing options where multiple phases, batch sizes, facilities, and transitions are involved.

Note that the time required at Rocky Flats to complete a management alternative is processing time, not calendar-time from a fixed date. For example, pyro-oxidation of certain materials (which is required for stabilization on-site and is also required as a precursor to certain processing options) began in October, 1997. Use of this pyro-oxidized material could accelerate certain scenarios. On the other hand, qualification of sand, slag, and crucible for disposal at WIPP under Alternative 4 may require several months of additional characterization to ensure that reactivity and pyrophoricity limits are not exceeded.

Note also that the shortest total processing time at Rocky Flats is not necessarily the sum of the shortest individual processing options. **Table G-11** shows the durations of the eight strategic management approaches. The table shows that the critical path facility is Building 707, Module E in four cases, Building 707, Module A in two cases, and Building 371, Room 3701 in two cases. In each case, the total duration of processing at Rocky Flats can be reduced by shifting some activities out of the critical path facility and into one or more other facilities. For example, the minimum time at Rocky Flats can be reduced from an estimated 2.6 years to about 1.8 years by selecting processing options that optimize the integrated duration of activities across the site rather than the individual durations at each facility. None of the durations shown in this section include

technical or schedule uncertainties, deferred start-up due to technology demonstration and testing, or schedule interactions among processing options, facilities, or sites. Section G.3 discusses these issues.

Table G–11 Durations of Strategic Management Approaches

	No Action	*Preferred*	*Minimum Time at Rocky Flats*	*Lowest Cost*	*All at Rocky Flats*	*Fewest at Rocky Flats*	*Maximum Plutonium Separation*	*No Separation*
Years	**7.2**	**5.5**	**2.6**	**3.2**	**5.1**	**2.8**	**3.4**	**10.2**
Critical Path	371-3701	707E	707E	707A	707E	707A	371- 3701	707E

G.3 MAJOR SCHEDULE UNCERTAINTIES

Major schedule uncertainties are outlined below. Technical uncertainties were summarized in Section 4.17.4 and 4.17.7. For each category, the estimated time beyond the Record of Decision is provided. No schedule delays due to general facilities or equipment upgrades a re envisioned.

- *Acid Dissolution (Rocky Flats)*—Acid dissolution for processing plutonium fluorides or sludges is a proven process, but the capabilities for it are not currently available at Rocky Flats. Also, this process would take place in the same area of Building 371 as the neutralize/dry process for combustibles (including combustibles below Safeguard Termination Limits). Because the acid dissolution of fluorides or sludges would be required to follow all combustibles processing, it might not be able to start for 4 years.

- *Catalytic Chemical Oxidation*—Catalytic chemical oxidation has been demonstrated commercially but not as a production process at the scale or with the characteristics required for the plutonium residues. The time required to demonstrate a consistent process and develop procedures and supporting analyses is estimated at four years.

- *Cementation*—Rocky Flats would have to install or remodel gloveboxes to provide additional area for the curing stage. The time required to be fully operational is estimated at one year.

- *Cold Ceramification*—Cold ceramification is a relatively simple process (similar to cementation) but it is still in the development stage. Rocky Flats has proposed additional demonstrations of surrogate testing and actual residue testing to be performed in FY 1998, with processing operations to begin in mid-FY 1999.

- *Mediated Electrochemical Oxidation (Rocky Flats)*—The mediated electrochemical oxidation technology has been demonstrated for radioactive materials, although not in DOE production operations. Equipment would have to be installed in Building 371 adjacent to the liquid treatment facilities. Requirements for these treatment facilities by higher priority residues (e.g., combustibles) would delay the start of operations by at least four years.

- *Mediated Electrochemical Oxidation (Savannah River Site)*—Installation of the new dissolvers, start-up tests, etc. are estimated to require three years from the Record of Decision at the Savannah River Site. In the case of H-Canyon, decontamination and decommissioning of existing equipment and facilities prior to installation of the mediated electrochemical oxidation equipment is estimated to require an additional two years.

- *Repackaging under Alternative 4*—Repackaging under Alternative 4 minimizes schedule uncertainty except for sand, slag, and crucible. For sand, slag, and crucible, repackaging under Alternative 4 magnifies

schedule uncertainties by creating conflicts with the schedules at the Savannah River Site F-Canyon in particular and the Rocky Flats / Savannah River Site programs in general, including the shipment of metals and oxides from Rocky Flats to the Savannah River Site under a different EIS. The key schedule uncertainty is related to Rocky Flats' need to characterize the sand, slag, and crucible to ensure that reactivity and pyrophoricity limits are not exceeded and the Savannah River Site's need to receive and Purex process the material (if it is to be Purex processed) before Rocky Flats could complete its characterization activities. If repackaging under Alternative 4 were selected and then found unsuitable, leading to a new requirement for Purex processing at the Savannah River Site, the integrated schedules of the sites in general and F-Canyon in particular would be adversely affected.

- *Salt Distillation (Rocky Flats)*—Salt distillation has been demonstrated at a pilot scale at the Los Alamos National Laboratory with residue materials. Optimization studies are ongoing and final designs are not yet available. Capabilities for production-scale distillation could be available in 2 years at Rocky Flats.

- *Salt Distillation (Los Alamos National Laboratory)*—Salt distillation has been demonstrated at a pilot scale at the Los Alamos National Laboratory with residue materials. Optimization studies are ongoing and final designs are not yet available. Capabilities for production-scale distillation could be available in two to four years at the Los Alamos National Laboratory. Depending on the quantity of salts to be distilled at the Los Alamos National Laboratory (i.e., up to 14 metric tons of electrorefining and molten salt extraction salts), up to 6-8 years would be required for capital upgrades, installation of extra distillation units, and additional vault storage space.

- *Sonic Wash*—Sonic washing has been demonstrated with residue-type material at a bench scale. The time required to demonstrate a consistent full-scale process and develop the procedures and supporting analyses is estimated at two years.

- *Water Leach (Rocky Flats)*—Water leaching is a well-demonstrated technology for dissolving chloride salts. The equipment required for water leaching would have to be installed in Building 371 adjacent to the liquid treatment facilities. Requirements for these treatment facilities by higher priority residues (e.g., combustibles) would delay the start of operations by at least four years.

- *Water Leach (Los Alamos National Laboratory)*—The capability for water leaching is installed and operational at Los Alamos National Laboratory on a limited scale. Additional capabilities are available using a similar aqueous dissolution process. If any other capabilities were necessary they could be available in two to four years.

Ideally, all processes requiring liquid processing at Rocky Flats would follow the processing of combustibles (including combustibles below Safeguard Termination Limits) in Building 371. If the selected approach for managing plutonium fluoride residues is packaging at Rocky Flats for shipment to the Savannah River Site, fluoride packaging would follow the processing of wet combustibles, but precede the processing of dry combustibles. The insertion of fluoride packaging into the Building 371 time-line adds three to six months to the total length of operations at Rocky Flats compared to processing all the combustibles followed by fluoride packaging. The interruption is necessary to coordinate the processing windows of Rocky Flats and the Savannah River Site. Other processes that use the liquid processing capabilities of Building 371 would follow both the fluoride and the combustibles processes. Certain sequences could thus add time to the total processing duration at Rocky Flats. Depending on the selected processing options, other integration issues and shipment constraints could be expected to result in additional extensions to the total processing duration.

G.4 AVAILABILITY AND CAPABILITY OF DOE FACILITIES

This section summarizes the availability and capability of Rocky Flats, the Savannah River Site, and Los Alamos National Laboratory to process the plutonium residues. These capabilities should be considered in the light of the technical uncertainties discussed in Sections 4.17.4 and 4.17.7 and the schedule uncertainties discussed in Section G.3.

G.4.1 Availability and Capability of Rocky Flats

Different materials processes at Rocky Flats require different facilities and technologies. Shipment to WIPP under Alternative 4 consists of repackaging materials into drums for shipment to WIPP. Repackaging is a proven technology. The capability for repackaging in the shipment to WIPP under Alternative 4 should be available for ash and salt residues before the end of FY 1998. To vitrify incinerator ash, graphite fines, and inorganic ash would require Rocky Flats to buy and install furnaces in new or modified gloveboxes. Ash vitrification has never been performed at Rocky Flats. If shipment to WIPP under Alternative 4 is not selected and technical issues related to vitrification cannot be resolved, it is likely that calcination/cementation would be selected. Purex processing of ash at the Savannah River Site is problematic because of Resource Conservation and Recovery Act permitting issues. Blending ash generates a large number of transuranic waste drums and carries high costs. Calcination and cementation of incinerator ash has been previously conducted at Rocky Flats.

Distillation of electrorefining salts and molten salt extraction salts has never been performed at Rocky Flats. All new equipment would need to be purchased and installed, and start-up issues would need to be resolved before processing. The only non-Purex option remaining if distillation is not available (for the salts that cannot be shipped using shipment to WIPP under Alternative 4) is blending, which creates large waste quantities and incurs high costs.

Pyro-oxidation at Rocky Flats is the front-end process for the processing options that ship the salt to the Los Alamos National Laboratory for further processing. Since pyro-oxidation has been identified as a stabilization technology to be used prior to storage or shipment, it is possible that distillation could still be performed without pyro-oxidation. However, since pyro-oxidation is required for transportation, non-pyro-oxidized direct oxide reduction salts could not be sent to Los Alamos National Laboratory. The next alternative for front-end processing at Rocky Flats would likely be salt scrub, which generates scrub alloy that can be Purex-processed at the Savannah River Site. The salt scrub process is, however, in question for some portion of the salts that have oxidized or absorbed moisture over time. The only remaining option for pyro-oxidized direct oxide reduction salts is blending, which creates large quantities of transuranic waste. Pyro-oxidized salts cannot be Purex-processed.

With respect to aqueous combustibles and glass residues, Rocky Flats has both the availability and the capability in place to neutralize/dry these residues, with no increase in capital expenditures. With respect to dry combustibles, graphite, and inorganics, Rocky Flats has both the availability and the capability in place to repackage these residues, with no increase in capital expenditures. With respect to organic-contaminated combustibles, Rocky Flats has never performed the preferred thermal desorption/steam passivation process. If thermal desorption/steam passivation is not feasible, Rocky Flats could select from several other options, including mediated electrochemical oxidation, sonic wash, catalytic chemical oxidation, and blend down.

G.4.2 Availability and Capability of the Savannah River Site

Purex processing at the Savannah River Site's F-Canyon is part of the preferred alternative for sand, slag, and crucible; plutonium fluorides; and scrub alloy. Purex processing of these residues at the Savannah River Site is included in the current site schedules and thus adds no time to the planned operation of the canyons. Purex processing of other residues or mediated electrochemical oxidation of any residues would affect canyon operating schedules and plans for shutting down the canyons.

If F-Canyon is shut down before it can complete processing of all scheduled shipments from Rocky Flats, or if residues scheduled for some other form of management (especially salts and ash) ultimately cannot be processed as planned, the costs for management outside of F-Canyon Purex could be very high. The Savannah River Site's H-Canyon is technically suited to Purex processing of the Rocky Flats residues but requires more time and has higher costs.

Similarly, although F-Canyon and H-Canyon could complete the mediated electrochemical oxidation process on suitable residues in about the same processing time, mediated electrochemical oxidation at H-Canyon would require an up-front expenditure of $20 million for decontamination and decommissioning of contaminated equipment. The decontamination and decommissioning process at H-Canyon would take 2 years, generate 60 rem, and generate additional transuranic and low-level waste (WSRC 1997). Installation of two Silver II electrochemical dissolvers (at either F-Canyon or H-Canyon) for mediated electrochemical oxidation would require 3 years.

While the Savannah River Site could Purex-process all of the Rocky Flats salts if they were scrubbed, it could not Purex-process any of them if they were pyro-oxidized. The pyro-oxidation issue is particularly acute for IDC 409 and other molten salt extraction salts (because of the americium). In this case, it is conceivable that if post-oxidation distillation or water leaching fails, the only remaining non-Purex processing option would be blending.

The Savannah River Site does not currently have the capability to receive and store americium-rich transuranic oxides that would be produced at the Los Alamos National Laboratory through acid dissolution. This capability is expected to be available when the new Actinide Packaging and Storage Facility is opened in 2001. It does have the capability to store the plutonium-americium output from distillation at the Los Alamos National Laboratory.

G.4.3 Availability and Capability of the Los Alamos National Laboratory

The Los Alamos National Laboratory Plutonium Facility currently has the aqueous chloride and aqueous nitrate capability to support the disposition of IDC 365, 413, 427, and other direct oxide reduction salt residues. The aqueous chloride capacity could also be enhanced significantly with the final installation of the already constructed chloride extraction and actinide recovery line. Water leaching, which is a subset of the aqueous processing capacity, is also applicable to these salt residues. Although the process is still under development, it could simplify the processing scheme and reduce secondary waste generation.

With the installation of new salt distillation units within the pyrochemical area, the Los Alamos National Laboratory could distill the IDC 409 and other electrorefining and molten salt extraction salts. As a contingency, residues that are not adequately treated by the salt distillation process could be managed through the available aqueous capacity.

Los Alamos National Laboratory has the interim capability to store the americium-rich transuranic oxides resulting from the aqueous dissolution processes and distillation processes available for management of the various salt residues.

G.4.4 Resource Conservation and Recovery Act Designation

Some materials, such as ash, have Resource Conservation and Recovery Act designation. Processing of Resource Conservation and Recovery Act materials requires treatment permits. Unless the Savannah River Site gets a Resource Conservation and Recovery Act treatment, storage, and disposal permit, it cannot accept ash for temporary storage, treatment, or final disposition. WIPP is qualified to handle the Resource Conservation and Recovery Act wastes generated from the plutonium processing activities at Rocky Flats (subject to permitting) but the proposed high-level geologic repository is not planned as a Resource Conservation and Recovery Act-qualified site. This raises certain issues regarding the ability of the Savannah River Site to accept certain residues and the disposition of Resource Conservation and Recovery Act wastes in high-level waste generated by the Savannah River Site's Defense Waste Processing Facility. No cost or schedule impacts for this issue have been determined.

G.5 ESTIMATED ABSOLUTE AND INCREMENTAL COSTS FOR EACH PROCESSING OPTION

Table G–12 shows the individually allocable undiscounted absolute and incremental costs, respectively, in 1997 dollars for each processing option. Absolute costs at each site are the sum of direct and indirect labor (including site overheads) for processing and waste management; high-level waste, low-level waste, and transuranic waste packaging, shipping, and disposal; Safe, Secure Trailer shipping (if required), and 3013 packaging and on-site storage (if required). Incremental costs are determined by subtracting the absolute costs for individual processing options from the absolute cost for the No Action Alternative processing option, including costs for interim storage of stabilized residues and transuranic waste.

Costs for itemized equipment (excluding distillation equipment and vault upgrades at Los Alamos National Laboratory in the cases for distillation of electrorefining and molten salt extraction salts) must be added separately, depending on how many options share a piece of itemized equipment in a particular alternative. These itemized equipment costs are listed in the second paragraph of Section G.1.1. In the Preferred Alternative and the Minimum Duration Management Approach, no itemized equipment is required. In the Minimum Cost Management Approach, $4 million is required for distillation equipment at Rocky Flats. The only management approach requiring more than $4 million in itemized equipment is the Maximum Plutonium Separation Management Approach, which incurs $64 million in itemized costs. Of this $64 million, $4 million is for distillation equipment at Rocky Flats, $30 million is for mediated electrochemical oxidation equipment at Rocky Flats and $30 million is for mediated electrochemical oxidation equipment at the Savannah River Site F-Canyon[3].

Other important factors include:

- Costs for common facilities and equipment (typically $180 million) and research and development ($10 million) are not decisional to the present EIS and are excluded from the table.

- Costs for processing at Rocky flats under the No Action Alternative and Rocky Flats under the No Action Alternative are shown separately. Cost for interim storage in the No Action Alternative are allocated according to the percentage of drums of stabilized residues and transuranic waste for each processing option against a fixed cost of $23 million per year for 20 years to keep the site open for storage and surveillance.

- Values in the MD (i.e., materials disposition) column represent fixed and variable to dispose of separated fissile materials. No particular site is associated with these costs.

- Values in the WIPP column represent variable costs to dispose of transuranic waste at WIPP.

- The costs for salt pyro-oxidation as a No Action processing option at Rocky Flats exceed the costs for the pyro-oxidation phase of processes at Rocky Flats that ship the salts to the Los Alamos National Laboratory for further processing. Pro-oxidation as a No Action processing option requires different and more expensive processing for stabilization than for production of an input to the distillation, acid dissolution, or water leaching processing options.

[3] *To achieve maximum plutonium separation, mediated electrochemical oxidation would be required at Rocky Flats and the Savannah River Site. This is a highly uneconomical and inefficient way to increase the quantity of separated plutonium and would not be selected even if plutonium separation were an objective.*

Absolute and incremental costs should be viewed in the light of the discussions on labor multipliers in Section G.1.12. Costs for itemized, shared equipment, summarized in Section G.1.1 must be added separately.

Table G–12 Individually Allocable Absolute and Incremental Costs, Millions of Undiscounted 1997 Dollars (Excluding Itemized, Shared Equipment)

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
Incinerator Ash	Calcine & Cement at Rocky Flats	165	99	0	0	1	0	264.39	
Incinerator Ash	Vitrification at Rocky Flats	86	0	0	0	1	0	86.63	-178
Incinerator Ash	Cold Ceramification at Rocky Flats	85	0	0	0	1	0	85.53	-179
Incinerator Ash	Blend Down at Rocky Flats	113	0	0	0	1	0	113.42	-151
Incinerator Ash	Fusion at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	22	0	144	0	0	33	198.04	-66
Incinerator Ash	Fusion at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	22	0	390	0	0	33	444.69	180
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	17	0	130	0	0	33	179.91	-84
Incinerator Ash	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	17	0	126	0	0	33	176.42	-88
Incinerator Ash	Calcine & Cement at Rocky Flats (Alternative 4)	164	0	0	0	1	0	164.70	-100
Incinerator Ash	Repackage at Rocky Flats (Alternative 4)	57	0	0	0	1	0	57.82	-207
Sand, Slag, & Crucible	Calcine & Cement at Rocky Flats	27	22	0	0	0	0	49.15	
Sand, Slag, & Crucible	Vitrification at Rocky Flats	16	0	0	0	0	0	16.18	-33
Sand, Slag, & Crucible	Blend Down at Rocky Flats	21	0	0	0	0	0	20.72	-28
Sand, Slag, & Crucible	Repackage and Purex Process at the Savannah River Site F-Canyon	4	0	27	0	0	5	35.56	-14
Sand, Slag, & Crucible	Repackage and Purex process at the Savannah River Site H-Canyon	4	0	61	0	0	5	69.23	20
Sand, Slag, & Crucible	Calcine & Cement at Rocky Flats (Alternative 4)	21	0	0	0	0	0	20.68	-28
Sand, Slag, & Crucible	Repackage at Rocky Flats (Alternative 4)	11	0	0	0	0	0	10.79	-38
Graphite Fines	Cement at Rocky Flats	11	6	0	0	0	0	17.04	-32
Graphite Fines	Vitrification at Rocky Flats	6	0	0	0	0	0	6.17	-11
Graphite Fines	Blend Down at Rocky Flats	7	0	0	0	0	0	7.42	-10
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	1	0	9	0	0	3	13.00	-4

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
Graphite Fines	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	1	0	9	0	0	3	12.78	-4
Graphite Fines	Cement at Rocky Flats (Alternative 4)	11	0	0	0	0	0	10.70	-6
Graphite Fines	Repackage at Rocky Flats (Alternative 4)	4	0	0	0	0	0	3.80	-13
Inorganic Ash	Calcine & Cement at Rocky Flats	14	14	0	0	0	0	28.51	
Inorganic Ash	Vitrification at Rocky Flats	9	0	0	0	0	0	9.42	-19
Inorganic Ash	Blend Down at Rocky Flats	12	0	0	0	0	0	11.78	-17
Inorganic Ash	Calcine & Cement at Rocky Flats (Alternative 4)	14	0	0	0	0	0	14.07	-14
Inorganic Ash	Repackage at Rocky Flats (Alternative 4)	8	0	0	0	0	0	7.94	-21
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats	26	32	0	0	0	0	57.75	
MSE/ER Salts (IDC 409)	Blend Down at Rocky Flats	44	0	0	0	0	0	43.88	-14
MSE/ER Salts (IDC 409)	Distillation at Rocky Flats	9	0	0	0	0	9	17.64	-40
MSE/ER Salts (IDC 409)	Water Leach at Rocky Flats	44	0	0	0	0	8	52.13	-6
MSE/ER Salts (IDC 409)	Pyro-oxidize at Rocky Flats and distillation at Los Alamos National Laboratory	7	0	0	43	0	9	58.20	0
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	8	0	5	0	0	8	22.15	-36
MSE/ER Salts (IDC 409)	Salt Scrub at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	8	0	7	0	0	8	23.84	-34
MSE/ER Salts (IDC 409)	Pyro-oxidize, Blend, Repackage (Alternative 4)	19	0	0	0	0	0	19.15	-39
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats	69	86	0	0	1	0	155.01	
MSE/ER Salts (All Others)	Blend Down at Rocky Flats	175	0	0	0	1	0	176.54	22
MSE/ER Salts (All Others)	Distillation at Rocky Flats	25	0	0	0	0	21	45.41	-110
MSE/ER Salts (All Others)	Water Leach at Rocky Flats	186	0	0	0	2	20	207.58	53

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
MSE/ER Salts (All Others)	Pyro-oxidize at Rocky Flats and Distillation at Los Alamos National Laboratory	18	0	0	132	0	20	170.90	16
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	26	0	39	0	0	20	85.92	-69
MSE/ER Salts (All Others)	Salt Scrub at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	26	0	52	0	0	20	98.87	-56
MSE/ER Salts (All Others)	Pyro-oxidize (Alternative 4)	67	0	0	0	1	0	67.95	-87
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats	18	13	0	0	0	0	31.26	
DOR Salts (IDCs 365, 413, 427)	Blend Down at Rocky Flats	24	0	0	0	0	0	24.38	-7
DOR Salts (IDCs 365, 413, 427)	Water Leach at Rocky Flats	25	0	0	0	0	5	29.61	-2
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	1	0	0	10	0	5	16.99	-14
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	1	0	0	11	0	5	17.55	-14
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site F-Canyon	5	0	3	0	0	5	12.47	-19
DOR Salts (IDCs 365, 413, 427)	Salt Scrub at Rocky Flats and Purex process at the Savannah River Site H-Canyon	5	0	4	0	0	5	13.30	-18
DOR Salts (IDCs 365, 413, 427)	Pyro-oxidize, Blend, Repackage (Alternative 4)	13	0	0	0	0	0	12.75	-19
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats	8	7	0	0	0	0	14.84	
DOR Salts (All Others)	Blend Down at Rocky Flats	18	0	0	0	0	0	18.07	3
DOR Salts (All Others)	Water Leach at Rocky Flats	22	0	0	0	0	2	23.54	9
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Acid Dissolution at Los Alamos National Laboratory	1	0	0	16	0	2	19.06	4
DOR Salts (All Others)	Pyro-oxidize at Rocky Flats and Water Leach at Los Alamos National Laboratory	1	0	0	16	0	2	19.05	4

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	3	0	5	0	0	2	9.49	-5
DOR Salts (All Others)	Salt Scrub at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	3	0	7	0	0	2	11.16	-4
DOR Salts (All Others)	Pyro-oxidize (Alternative 4)	8	0	0	0	0	0	7.92	-7
Aqueous-Contaminated Combustibles	Neutralize/Dry at Rocky Flats	5	9	0	0	0	0	14.32	
Aqueous-Contaminated Combustibles	Sonic Wash at Rocky Flats	4	0	0	0	0	0	4.00	-10
Aqueous-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	13	0	0	0	0	0	13.20	-1
Aqueous-Contaminated Combustibles	Blend Down at Rocky Flats	1	0	0	0	0	0	1.51	-13
Aqueous-Contaminated Combustibles	Mediated Electrochemical Oxidation	7	0	0	0	0	0	7.86	-6
Aqueous-Contaminated Combustibles	Neutralize/Dry (Alternative 4)	5	0	0	0	0	0	5.20	-9
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation at Rocky Flats	6	6	0	0	0	0	12.11	
Organic-Contaminated Combustibles	Sonic Wash at Rocky Flats	3	0	0	0	0	0	2.72	-9
Organic-Contaminated Combustibles	Catalytic Chemical Oxidation at Rocky Flats	8	0	0	0	0	0	8.20	-4
Organic-Contaminated Combustibles	Blend Down at Rocky Flats	1	0	0	0	0	0	0.97	-11
Organic-Contaminated Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	4	0	0	0	0	0	4.53	-8
Organic-Contaminated Combustibles	Thermal Desorption / Steam Passivation (Alternative 4)	6	0	0	0	0	0	5.68	-6
Dry Combustibles	Repackage at Rocky Flats	2	5	0	0	0	0	7.30	
Dry Combustibles	Sonic Wash at Rocky Flats	2	0	0	0	0	0	2.29	-5
Dry Combustibles	Catalytic Chemical Oxidation at Rocky Flats	8	0	0	0	0	0	7.57	0
Dry Combustibles	Blend Down at Rocky Flats	1	0	0	0	0	0	0.86	-6
Dry Combustibles	Mediated Electrochemical Oxidation at Rocky Flats	4	0	0	0	0	0	4.62	-3
Dry Combustibles	Repackage at Rocky Flats (Alternative 4)	2	0	0	0	0	0	2.12	-5

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
Plutonium Fluorides	Acid Dissolution at Rocky Flats	17	3	0	0	0	0	20.43	
Plutonium Fluorides	Blend Down at Rocky Flats	61	0	0	0	1	0	61.18	41
Plutonium Fluorides	Acid Dissolution at Rocky Flats	17	0	0	0	0	5	21.84	1
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	1	0	12	0	0	5	18.00	-2
Plutonium Fluorides	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	1	0	32	0	0	5	38.29	18
Ful Flo Filter Media	Neutralize/Dry at Rocky Flats	15	34	0	0	0	0	49.24	
Ful Flo Filter Media	Blend Down at Rocky Flats	4	0	0	0	0	0	3.67	-46
Ful Flo Filter Media	Sonic Wash at Rocky Flats	6	0	0	0	0	0	5.76	-43
Ful Flo Filter Media	Mediated Electrochemical Oxidation at Rocky Flats	10	0	0	0	0	1	11.09	-38
HEPA Filters (IDC 338)	Neutralize/Dry at Rocky Flats	38	73	0	0	0	0	111.47	
HEPA Filters (IDC 338)	Vitrification at Rocky Flats	11	0	0	0	0	0	10.61	-101
HEPA Filters (IDC 338)	Blend Down at Rocky Flats	10	0	0	0	0	0	10.42	-101
HEPA Filters (IDC 338)	Sonic Wash at Rocky Flats	18	0	0	0	0	0	18.32	-93
HEPA Filters (IDC 338)	Mediated Electrochemical Oxidation at Rocky Flats	26	0	0	0	0	3	29.87	-82
HEPA Filters (IDC 338)	Neutralize/Dry (Alternative 4)	38	0	0	0	0	0	38.59	-73
HEPA Filters (All Others)	Neutralize/Dry at Rocky Flats	1	2	0	0	0	0	3.29	
HEPA Filters (All Others)	Vitrification at Rocky Flats	1	0	0	0	0	0	0.56	-3
HEPA Filters (All Others)	Blend Down at Rocky Flats	1	0	0	0	0	0	0.80	-2
HEPA Filters (All Others)	Sonic Wash at Rocky Flats	1	0	0	0	0	0	0.76	-3
HEPA Filters (All Others)	Mediated Electrochemical Oxidation at Rocky Flats	1	0	0	0	0	0	1.59	-2
HEPA Filters (All Others)	Blend and Repackage at Rocky Flats (Alternative 4)	1	0	0	0	0	0	1.04	-2
Sludge (IDCs 089, 099, 332)	Filter/Dry at Rocky Flats	0	1	0	0	0	0	1.47	

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
Sludge (IDCs 089, 099, 332)	Vitrification at Rocky Flats	0	0	0	0	0	0	0.07	-1
Sludge (IDCs 089, 099, 332)	Blend Down at Rocky Flats	0	0	0	0	0	0	0.12	-1
Sludge (IDCs 089, 099, 332)	Blend and Repackage at Rocky Flats (Alternative 4)	0	0	0	0	0	0	0.11	-1
Sludge (All Others)	Filter/Dry at Rocky Flats	12	25	0	0	0	0	36.62	
Sludge (All Others)	Vitrification at Rocky Flats	3	0	0	0	0	0	3.24	-33
Sludge (All Others)	Blend Down at Rocky Flats	3	0	0	0	0	0	3.20	-33
Sludge (All Others)	Acid Dissolution at Rocky Flats	21	0	0	0	0	1	21.58	-15
Sludge (All Others)	Filter/Dry at Rocky Flats (Alternative 4)	12	0	0	0	0	0	11.86	-25
Glass	Neutralize/Dry at Rocky Flats	0	0	0	0	0	0	0.48	-0
Glass	Vitrification at Rocky Flats	1	0	0	0	0	0	0.60	-0
Glass	Blend Down at Rocky Flats	1	0	0	0	0	0	0.63	-0
Glass	Sonic Wash at Rocky Flats	1	0	0	0	0	0	1.04	
Glass	Mediated Electrochemical Oxidation at Rocky Flats	2	0	0	0	0	0	2.11	1
Glass	Neutralize/Dry (Alternative 4)	0	0	0	0	0	0	0.48	-0
Graphite	Repackage at Rocky Flats	8	13	0	0	0	0	21.25	
Graphite	Cement at Rocky Flats	9	0	0	0	0	0	9.54	-12
Graphite	Vitrification at Rocky Flats	10	0	0	0	0	0	10.14	-11
Graphite	Blend Down at Rocky Flats	10	0	0	0	0	0	9.93	-11
Graphite	Mediated Electrochemical Oxidation at Rocky Flats	29	0	0	0	0	3	32.43	11
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	3	0	30	0	0	4	36.18	15
Graphite	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	3	0	29	0	0	4	34.91	14
Graphite	Repackage at Rocky Flats (Alternative 4)	8	0	0	0	0	0	8.24	-13
Inorganics	Repackage at Rocky Flats	2	2	0	0	0	0	3.98	
Inorganics	Vitrification at Rocky Flats	2	0	0	0	0	0	1.87	-2
Inorganics	Blend Down at Rocky Flats	2	0	0	0	0	0	2.05	-2
Inorganics	Mediated Electrochemical Oxidation at Rocky Flats	6	0	0	0	0	1	7.12	3

Material	*Process*	*Rocky Flats*	*Rocky Flats (Excluding Interim Storage)*	*Savannah River Site*	*Los Alamos National Laboratory*	*WIPP*	*MD*	*Absolute*	*Incremental*
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site F-Canyon	1	0	5	0	0	1	6.14	2
Inorganics	Repackage at Rocky Flats and Mediated Electrochemical Oxidation at the Savannah River Site H-Canyon	1	0	5	0	0	1	6.01	2
Inorganics	Repackage at Rocky Flats (Alternative 4)	2	0	0	0	0	0	1.58	-2
Scrub Alloy	Repackage at Rocky Flats	3	6	0	0	0	0	9.27	
Scrub Alloy	Calcine and Vitrification at Rocky Flats	68	0	0	0	0	0	68.40	59
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site F-Canyon	1	0	12	0	0	7	20.39	11
Scrub Alloy	Repackage at Rocky Flats and Purex Process at the Savannah River Site H-Canyon	1	0	16	0	0	7	24.44	15

MD = materials disposition MSE/ER = molten salt extraction/electrorefining DOR = direct oxide reduction HEPA = high-efficiency particulate air

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