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Idaho National Engineering Laboratory

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SUMMARY OF CONCEPTUAL COST FOR PIT 9

M. D. McKenzie

EG&G Idaho

Work performed under DOE Contract No. DE-AC07-76ID01570

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Summary of Conceptual Cost for Pit 9

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Project Manager/ F. P. Hughes — Date

ABSTRACT

This document presents the costs that appear in the *Proposed Plan for Cleanup of Pit 9 at the Radioactive Waste Management Complex, Idaho National Engineering Laboratory*. It is not meant to be a rigorous cost estimate, but rather, it is meant to give conceptual cost based on the assumptions listed in each section of this document.

CONTENTS

ACRONYMS

TRU	transuranic
RCRA	Resource Conservation and Recovery Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
INEL	Idaho National Engineering Laboratory
R&D	research and development

Summary of Conceptual Cost for Pit 9

1. INTRODUCTION

The purpose of this document is to provide a basis for the costs used in the *Proposed Plan for Cleanup of Pit 9 at the Radioactive Waste Management Complex, Idaho National Engineering Laboratory* (December 1991). The estimates in this document focus on the interim storage, transportation, and long-term disposal of processed waste from Pit 9. It should be noted that these estimates are conceptual and the information needed for a rigorous cost estimate is not available at this time. All costs used in this document have been developed by MK-Environmental Services. Costs estimated have been developed from several data sources. Pit 9 Comprehensive Demonstration Project, EG&G Idaho, and MK-Environmental Services provided estimates of areas and volumes, equipment estimates, and design and characterization concepts used in this summary. Where possible, actual costs of similar types of construction and equipment have been used as a basis. A summary of the cost estimate for Chemical Extraction and/or Physical Separation (Alternative 4) is presented in Appendix A, "Conceptual Cost Estimate for Pit 9, a Chemical Extraction and/or Physical Separation."

The costs for Alternative 2, In Situ Vitrification, are based on one-day order of magnitude estimates using existing estimated costs, adjusted for the hazards of working in Pit 9. This estimate and the assumptions used are found in Appendix B. Alternative 3, Ex Situ Vitrification, is based on estimates of areas and volumes, equipment estimates, and design and characterization concepts. This estimate and the assumptions used are found in Appendix C. Alternative 4, Chemical Extraction and/or Physical Separation, uses cost data and experience from a plutonium removal project at Johnston Atoll as a basis. This estimate and the assumptions used are found in Appendices A and D. Costs for Alternative 5, Complete Removal, Storage, Transportation, Treatment, and Offsite Disposal, have been derived from cost estimates for transuranic (TRU) waste going to offsite disposal locations. This estimate and the assumptions used are found in Appendix E. Cost estimates and assumptions used for transportation (Appendix F) and long-term storage (Appendix G) are also found in this document.

It should be noted that the $28.0 million costs presented under Chemical Extraction and/or Physical Separation in the Total Cost Comparison table in the Pit 9 proposed plan do not include the cost of treatment. The treatment costs are included in the Long-Term Storage and Offsite Disposal section of the Total Cost Comparison table and are listed under Interim Storage/Treatment.

2. DESCRIPTION OF ALTERNATIVES

2.1 Alternative 1—No Action

The Superfund program requires that the "no action" alternative be evaluated at every site to establish a baseline for comparison. Under this alternative, no further action would be taken at the site to prevent exposure to radionuclide (i.e.,americium and plutonium) contamination, although decay and dispersion of the radionuclides would occur over a long period of time (over 250,000 years). However, existing institutional controls would be maintained. No cost would be associated with the "no action" alternative.

2.2 Alternative 2—In Situ Vitrification

In situ vitrification is a process in which the contaminated material is heated to its melting temperature, then allowed to cool and solidify to a glassy mass. In the in situ vitrification process, electricity is applied to electrodes placed in the ground over the waste mass. The ground and waste mass heats and melts, and the melting zone grows downward. A hood is placed over the melt area to catch gases given off by the melting process. These gases are then treated to remove any air pollutants that may be present. Presumably, any organic materials in the waste mass would be thermally destroyed and the radionuclides present would be trapped in the glassy material formed by the melting process. This technology has not been used to melt actual mixed waste, although tests have been conducted on simulated waste. It is assumed that additional research and development would be necessary prior to the use of this technology on TRU type mixed waste. A cost breakdown for this alternative is presented in Appendix B.

2.3 Alternative 3—Ex Situ Vitrification

Vitrification would be performed on excavated materials on site in an electric furnace or in a rotary kiln, both called ex situ vitrification. In the first process, the materials are melted and poured into molds. In the second process, the contaminated materials are heated in a rotary kiln to form a solid mass. Although the second process may not necessarily produce a solid single mass, it may reduce availability of the radioactive constituent for leaching and may be more appropriate for containing radioactivity. The resulting products, in either case, would be returned to Pit 9. This process would be conducted in compliance with the Resource Conservation and Recovery Act (RCRA) requirements for hazardous and solid waste management, in accordance with Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A cost breakdown for this alternative is presented in Appendix C.

2.4 Alternative 4—Chemical Extraction and/or Physical Separation

The contaminated materials requiring treatment would be removed from Pit 9 and placed into a processing unit. Cleanup criteria will be applied to determine which materials will be removed from or returned to the pit. The removed contaminants are treated using several chemical or physical separation methods. Physical separation uses mechanical methods such as wet or dry screening, flotation, gravity concentration, sedimentation, and filtration to separate mixtures of solids and to concentrate the contaminants. Chemical separation uses chemicals to remove contaminants from the soil. The object of the separation technology is to concentrate the radioactive contaminants by chemical extraction, with the aim of reducing the volume of waste for disposal. This process would be conducted in compliance with the RCRA requirements for hazardous and solid waste management, in accordance with Section 121 of CERCLA. A cost breakdown for this alternative is presented in Appendices A and D.

2.5 Alternative 5—Complete Removal, Storage, and Offsite Disposal

This alternative would require the complete removal of all waste and contaminated soil within Pit 9. The waste would then be placed in interim storage, pending availability of offsite disposal facilities. Offsite disposal could be considered for either temporary storage or permanent disposal. The purpose would be to limit the exposure of Idaho National Engineering Laboratory (INEL) workers and the environment to the radionuclides (i.e., americium and plutonium). A removal/packaging facility and interim storage facility would need to be provided for this alternative. The waste materials would need to be stabilized so that they could be transported more easily. This process would be conducted in compliance with the RCRA requirements for hazardous and solid waste management, in accordance with Section 121 of CERCLA. A cost breakdown for this alternative is presented in Appendix E.

Offsite Transportation

This estimate presents the general cost for the transportation of waste, retrieved as part of the cleanup, to an offsite waste disposal site and/or long-term storage site.

Long-Term Storage Cost

This estimate presents the general cost and assumptions for the construction of a disposal/storage facility in a deep salt formation.

3. KEY ASSUMPTIONS

3.1 Assumptions for Long-Term Storage/Disposal Costs

- The estimate assumes development of a new TRU-contaminated waste storage/disposal facility in a salt formation.
- The facility will have a total volume of 6,000,000 cubic feet.
- The facility will have a 20-year combined construction/operating life.
- The facility will have construction and operation overlap.
- The facility will have a 20-year post-closure monitoring and observation period.
- The facility will have a 300,000 cubic feet per year handling capacity.
- Storage drums used will contain 6 cubic feet of waste per drum.
- The facility will have a handling capacity of 50,000 drums per year; 200 drums per day.
- The facility has 1,500,000 cubic feet of storage. This is based on 4 cubic feet of waste per cubic foot of total volume.

3.2 Assumptions for Waste Transportation Cost to an Offsite Facility

- Each shipment to the offsite treatment facility will be a 21-ton shipment.
- 189 cubic feet of waste per shipment is used for estimating the shipment cost per cubic foot.
- Transporting waste will require the purchase of 240 shipping containers.
- TRU-PAC type containers will be used for shipping. These will be new containers.
- The cost of shipping containers will be $3,500.00 per container.
- Shipping containers will be reused.

- The estimate uses $0.20 per ton per mile trucking cost.
- The estimate uses 1,764 miles as the distance for a one-way trip to the facility.
- 50,000 cubic feet of waste are used to generate the container cost per cubic foot.

3.3 Assumptions for In Situ Vitrification (Alternative 2)

- In situ vitrification will not require interim or long-term storage facilities because the vitrified waste would be removed from the pit
- In situ vitrification will require research and development before it could be used for remediation of Pit 9.

3.4 Assumptions for Ex Situ Vitrification (Alternative 3)

- Ex situ vitrification will not require interim or long-term storage facilities because the vitrified waste would be placed back in the pit
- Ex situ vitrification will require research and development before it could be used for remediation of Pit 9.

3.5 Assumptions for Retrieval and Onsite Treatment (Alternative 4)

- 50,000 cubic feet of waste and soil will be retrieved and treated
- Retrieval will be done by manned equipment
- Processed material found to contain less than 10 nCi per gram contamination will be returned to the pit
- Treatment of waste will take place on site.

NOTE: Detailed assumptions are contained in the conceptual cost estimate.

3.6 Assumptions for Retrieval and Offsite Treatment (Alternative 5)

- 250,000 cubic feet of waste and soil will be retrieved

- Treatment of waste will take place at a facility outside the INEL

- Treatment use at the offsite facility will be similar to the process for onsite treatment (Alternative 4).

3.7 Assumptions for an Onsite Interim Storage Facility

- Storage facility described is for Alternative 4, storage for Alternative 5 will be a larger facility

- Assumes development of a new TRU interim storage facility at the INEL

- The storage facility will require a 50,000 cubic feet storage capacity

- The facility will have a 15-year operating period

- Storage drums used will contain 6 cubic feet of waste per drum

- The storage pattern for waste drums will consist of stacked drums, four high; 16 drums per 100 square feet

- The ratio of storage space to aisle access will be 100%.

Appendix A

Conceptual Cost Estimate for Pit 9, A Chemical Extraction and/or Physical Separation

Note: This has been taken from "Conceptual Cost Estimate Buried Waste Program Remediation of Pit 9"

SECTION 1:

PROJECT DESCRIPTION, ASSUMPTIONS, AND SUMMARY OF COST ESTIMATE

1.1 Site

Site limits include Pit 9 and adjacent areas in the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL). Waste was placed in Pit 9 from November 1967 to June 1969. Pit 9 reportedly contains approximately 250,000 cubic feet of overburden soils, 150,000 cubic of original waste, and 350,000 cubic feet of interstitial soils; i.e., soils lying between or below the buried original waste containers.

The buried waste in Pit 9 includes a mixture of transuranic (TRU) alpha-emitters, and fission and activation products, which are beta gamma-emitters. The waste placed in Pit 9 is primarily from the Rocky Flats Office (RFO), with smaller contributions from INEL. Waste was placed in Pit 9 in drums or wooden containers and exists in a variety of forms: metals, stabilized blocks, sludges, bulk materials, and whole or partial pieces of equipment. Many of the original waste containers are thought to have degenerated and to have contaminated the surrounding interstitial soils.

1.2 Project Objectives

The project objectives addressed in this study and conceptual cost estimate include removing the 250,000 cubic feet of overburden soils that cover the pit and processing the 500,000 cubic feet of interstitial soils and original waste. The interstitial soils and original waste removed from the pit would be separated and sorted for volume reduction of the high-level nuclear waste. Materials containing less than 10 nCi per gram plutonium/americium/uranium will be returned to the pit. Contaminated material greater than 10 nCi per gram will be packaged in 55-gallon drums to await final disposal off site. Material separation and sorting would be accomplished using both manual and automated systems. The processing facility and supporting equipment would be designed and operated to minimize secondary waste and to minimize decontamination and decommissioning requirements.

1.3 Project Assumptions

1.3.1 The project will not be designed to special nuclear requirements. Additional costs for NQA-L level controls will not be included in equipment pricing.

1.3.2 No allowance will be made for shielding. Local shielding requirements will be determined by survey results after construction and are not included in this estimate.

1.3.3 No provision will be made to process the volatile organics and other toxic waste found in the pit. Lead, mercury, or other heavy metal contaminates will not be removed from the low-level contaminated or noncontaminated material.

1.3.4 All large pieces of metal or equipment (in excess of five tons) found in the pit will be left in place. Soils will be excavated from around these items, but they will not be moved except as required to ensure that all loose interstitial fill has been removed. These large items will not be decontaminated or characterized.

1.3.5 All necessary utilities (electrical, power, water, etc.) will be available at the site within 100 feet of the new containment enclosures.

1.3.6 The 250,000 cubic feet of overburden soil is uncontaminated and will not require processing or special handling.

1.3.7 The 250,000 cubic feet of overburden will be returned to the pit after completion of the remediation effort. Costing for additional fill assumes an existing stockpile no more than 500 feet from Pit 9.

1.3.8 Processed material found to contain less than 10 nCi per gram contamination will be returned to the pit to be used as backfill. This material will be returned regardless of any potentially hazardous contamination from organics, volatiles, or heavy metals.

1.3.9 Mobil excavation equipment will be operated directly by suited personnel from within the pit. These personnel will operate in Level B personal protection per OSHA requirements and the ALARA concept.

1.3.10 Monitoring will be maintained on a continuous basis during excavation to establish safe exposure distances from nuclear waste per OSHA requirements and the ALARA concept.

1.3.11 The guidelines for shielding and criticality of the excavated nuclear waste established in the *Safety Assessment for the Pit 9 Retrieval Demonstration at the Radioactive Waste Management Complex*, dated May 16, 1989, will be used in the separating, sorting, and storage of waste.

1.3.12 All secondary process waste streams will be processed by INEL. Any resulting costs are not included in this estimate.

1.3.13 Only waste that will be permanently removed from Pit 9 will be characterized.

1.3.14 Site-specific training and personnel dosimetry will be provided by INEL.

1.4 Design Basis and Process Description

1.4.1 MK-Ferguson Treatment Strategies

MK's cost estimate is based on the following treatment strategies:

Overburden Soils—250,000 cubic feet: This material will be removed following erection of the main pit containment building using conventional earth moving techniques. Care will be taken to ensure that no contaminated underling material is removed. The overburden soils will be transported to a nearby storage area and will be reused as capping material at the end of the project.

Interstitial Soils—350,000 cubic feet: This material is assumed to be lightly contaminated, with some possibility of encountering high concentrations of contaminates in localized areas because of leakage from the waste containers. This material will be processed through the sorting system, along with the original waste, to reduce contamination to levels less than 10 nCi per gram.

Original Waste—150,000 cubic feet: This material consists of various materials requiring separation and preparation before undergoing sorting and packaging for disposal. There are also several large pieces of equipment in the pit itself. It has been assumed that these very large items, such as the reactor vessel, will be left in place and potentially contaminated soils will be removed from around the largest items. These large items will only be moved to ensure that all contaminated soils have been excavated and processed.

1.4.2 Material Excavation

The data provided in the "Specification for Pit 9 Comprehensive Demonstration," Draft Revision 8, indicates that excavation can be accomplished using conventional means with the provision of personnel protection, localized ventilation, and monitoring. The radiological data provided indicates low levels of gamma-emitting waste with the majority being alpha and beta-emitting waste. In order to minimize personnel exposure, remote materials handling will be used for material sorting and segregation operations.

Interstitial soils and original waste will be excavated from the pit using a combination of a directly operated hydro-crane fitted with an articulated grapple, and a front end loader. Excavated material will be transported to the physical classification and separation area by the front-end loader(s). Material will be excavated, transported, and processed in batches of no more than 1.375 cubic feet to control problems of criticality. The crane and front end loader(s) will be used in a second shift to return processed low-level waste as backfill to the excavated portions of the pit.

1.4.3 Physical Classification and Separation

The contaminated materials in the pit represent a large variety of materials, ranging from rocks, soils, filled and empty drums, and wood containers, to large masses of solid metals or equipment. The front end loader(s) will deliver buckets of material to an initial separation/sorting area where material will be segregated according to size and type. Soils, rocks, and other loose bulk materials will be delivered to a size classification and separation system for further separation. Drums will be sent to a separate drum handling area, and large bulk items will be delivered to a separate handling area.

1.4.4 Loose Material Handling

Materials consisting of primarily loose soils, rocks, and or bulk materials not separated at the physical classification and separation stage will need to undergo further separation and preparation for sorting. This material will be delivered to a traveling rate type separator where loose soil and small rocks will be separated from larger materials such as rock, wood, metal parts, and plastic sheeting materials. The larger materials will be further sorted. Material not suitable for size reduction and ultimate sorting will be sent to the bulk material processing area. Large material suitable for further processing will be sent to a bulk material shredder for preliminary size reduction. After shredding, this material will be combined with the soils and small rock and sent to the plutonium sorting conveyors.

1.4.5 Drums and Containers

Steel drums and other similar containers will be separated from other materials at the initial physical classification and separation stage. All drums will be opened, contents removed, and crushed. Crushed drums will be sent to the bulk material processing area for further processing, packaging, and disposal.

The material removed from the drums will undergo further classification. Bulk materials not suitable for further processing will be sent to the bulk material processing area. The remaining bulk materials suitable for size reduction will be conveyed to the bulk material shredder for preliminary size reduction before being sent to the plutonium sorting conveyors. Sludges will be combined with clean soils in a mixer to improve the handling characteristics of the material. Clean soil will be used for mixing to eliminate any problems with producing a critical accumulation of plutonium. The mixed material will be sent to the plutonium sorting conveyors for further processing.

1.4.6 Large Bulk Materials

In addition to the soils, drums, and sludges found in the pit, it is anticipated that a number of large bulk items will be uncovered. Very large items, such as the reactor vessel already identified, will not be removed from the pit. Smaller items (approximately the size of 55-gallon drums or smaller) will be removed for further processing. These items could include complete or partially dismantled equipment, and large pieces of metal or other items that do not lend themselves to further sorting in the plutonium sorting conveyor system, and should be easily cleaned of contaminated soils. This type of material will be separated from other materials at the initial physical classification and separation stage and will be transported to a contained decontamination area. Bulk items will be scanned for radiation, cleaned, and rescanned. Cleaned material, less than 10 nCi/g, can be returned to the pit for reburial or sent to await other disposal options. Items that are greater than 10 nCi/g will be characterized and packaged for disposal off site. Potentially contaminated materials recovered in this system will be routed back to the plutonium sorting conveyors for separate processing.

1.4.7 Plutonium Sorting Conveyors

Material reporting to the plutonium sorting conveyors will first pass through a secondary sizing and crushing station. Material will be reduced in size to 1/2-inch diameter to pass under the plutonium detectors. The cushing station will use a closed circuit vibrating screen, jaw crusher, and impact crusher system. Dust reduction equipment will be used to reduce the potential of creating airborne particulates in this area. The jaw crusher will be equipped with an additional inlet hopper to allow introduction of special material for crushing and sorting. The plutonium sorting conveyors will consist of two parallel processing lines. Crushed material will be placed on a 36-inch flat belt conveyor in a layer no more than 3/4-inches deep. The moving layer of material will pass under an array of radiation detectors. Computer analysis of the resulting data will allow for identification of individual hot particles of plutonium or areas of high dispersed radiation in the bed of material. The layer of material will continue to the end of the conveyor, where a set of computer controlled gates will divert the areas of lower radiation, allowing the highly contaminated material to be further sorted. Diverted low radiation material will be conveyed back into the original pit, where it will be used as backfill material.

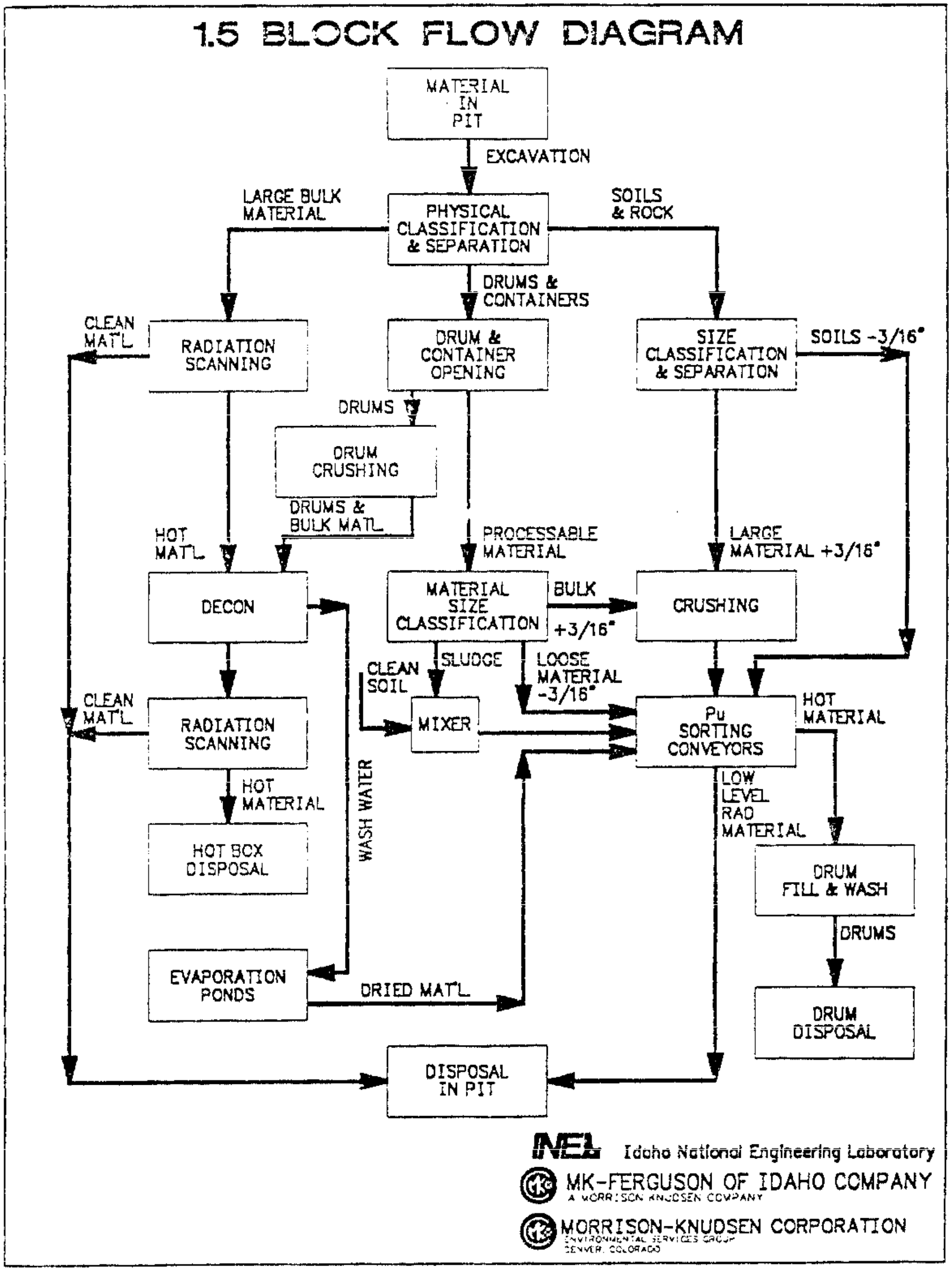
Hot material will go through a second set of sorting conveyors. These conveyors will operate at a slower speed in order to produce a finer final sort. Final sorted material will pass under a counting detector to ensure that a critical mass of plutonium is not placed onto a single conveyor and to provide for waste package characterization. Hot sorted material will be packaged into 55-gallon drums using an automated drum packaging system.

Per the *Safety Assessment for the Pit 9 Retrieval Demonstration at the Radioactive Waste Management Complex*, no more than 200 grams of plutonium will be placed in any one drum. Drums will be surveyed for surface contamination and conveyed to an interim storage area for disposal off site.

Engineering costs	$ 4,627,797.00
Construction costs	35,565,931.00
Operating and verification costs	11,068,427.00
Decontamination and decommissioning costs	1,877,865.00
TOTAL	$53,140,020.00

INEL BURIED WASTE PROGRAM
PIT 9 CLEANUP
ESTIMATE CLARIFICATIONS/ASSUMPTIONS

- This estimate is based on current dollars and no escalation has been included.
- This estimate is a $\pm$30% estimate with 90% certainty that it will fall into that range.
- All construction work is based on Level D personnel protection.
- All operations are based on Level B personnel protection.


1.5 BLOCK FLOW DIAGRAM
MATERIAL IN PIT
EXCAVATION
LARGE BULK MATERIAL
PHYSICAL CLASSIFICATION & SEPARATION
SOILS & ROCK
DRUMS & CONTAINERS
CLEAN MAT'L
RADIATION SCANNING
DRUM & CONTAINER OPENING
SIZE CLASSIFICATION & SEPARATION
SOILS -3/16"
DRUMS
DRUM CRUSHING
DRUMS & BULK MAT'L
HOT MAT'L
PROCESSABLE MATERIAL
LARGE MATERIAL +3/16"
DECON
MATERIAL SIZE CLASSIFICATION
BULK
+3/16"
CRUSHING
SLUDGE
CLEAN SOIL
LOOSE MATERIAL -3/16"
CLEAN MAT'L
RADIATION SCANNING
MIXER
Pu SORTING CONVEYORS
HOT MATERIAL
HOT MATERIAL
WASH WATER
LOW LEVEL RAD MATERIAL
HOT BOX DISPOSAL
DRUM FILL & WASH
DRUMS
EVAPORATION PONDS
DRIED MAT'L
DRUM DISPOSAL
DISPOSAL IN PIT
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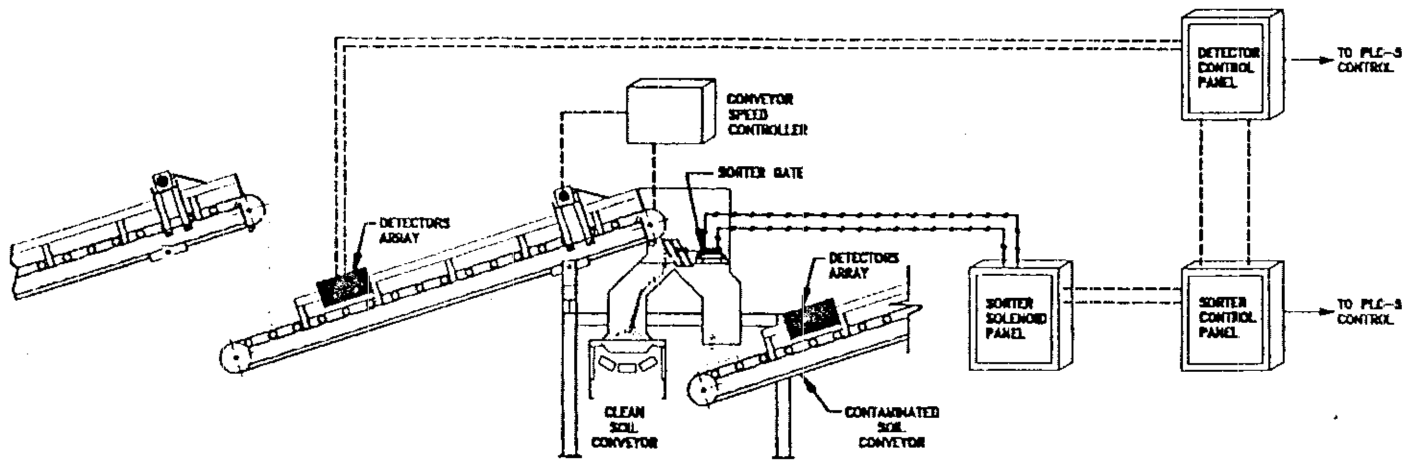
A MORRISON KNUDSEN COMPANY
MORRISON-KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP
DENVER, COLORADO

1.6 SORTER SYSTEM SCHEMATIC



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A MORRISON KNUDSEN COMPANY

MORRISON-KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP
DENVER, COLORADO

Engineering Costs

Engineering Costs	$4,627,797.00
TOTAL	$4,627,797.00

Construction Costs

Waste Pit Haul Road	$ 19,635
Evaporation Pond	12,791
EX/BKFL-Waste Enclosure	9,880
Concrete-Waste Enclosure	385,820
Erect Waste Enclosure	386,452
Purchase Wst Pit Enclos	4,187,024
Elec Waste Enclosure	258,649
Elec Waste Enc I & C	1,442,328
Phys Class/Separation EQP	1,691,844
DRM Cont Opng EQP	398,520
Drum Crushing EQP	115,903
Decon Unit EQP	888,386
Elec Air Handling	152,351
Waste Encl Building FP	215,000
Ex/Bkfl-Conveyor FDNS	461
EX/Bkfl-Shop/Chg/Ctrl Rm	5,594
Ex/Bkfl-Drum/Cont/Sort/dc	4,346
Ex/Bkfl-Decn/Hot Box/Stor	3,094
Concrete-Conveyor Fdns	11,670
Conc-Shop/Chg/Ctrl Rm	132,737
Conc-Drum/Cont/Sort/Decon	383,490
Conc-Decn/Hot Box/Stor	71,129
Pit Area Facilities	114,114
Generator Building	13,860
Elec Support Facilities	71,826
Elec Support Fac I & C	412,229
Wst Fac Sup Facil Fp	11,000
Elec Air Handling	4,619
Fire Pumps & Bldg	115,520
Piping—All Areas	344,706
Plumbing—All Reas	73,354
Concrete-Air Hndlg Fdns	557,289
Ex/Bkfl-Air Handling Fdns	21,953
HVAC—All Areas Eqp	6,365,262
HVAC—Control Rooms	42,000
Hvac Ductwork—All Areas	749,855
Ex/Bkfl—Process Enclosure	2,153
Concrete-Process Enclosure	100,132
Erect Proc Pit Enclosure	61,807
Purchase Proc Pit Enclosure	337,472
Elec Product Enclosure	33,835
Elec Product Bld I & C	5,052,640
Size Classification Eqp	102,160
Crushing Eqp	320,629
Pu Sorting Sys Eqp	1,173,024

Construction Costs (Continued)

Elec Prod Fac Air Handling	19,753
Proc Plnt Building Fp	30,000
Ex/Bkfl-Generator/Ww Gr	1,678
Ex/Bkfl-Size/Crush/Pu Srt	3,565
Ex/Bkfl-Shop/Chg/Cntl Rm	5,594
Ex/Bkfl-Drum Storage	4,429
Conc-Generator/Ww Gr	30,447
Conc-Size/Crush/Pu Sort	210,034
Conc-Shop/Chg/Ctrl Rm	132,737
Conc-Drum Storage	70,459
Plut Sorting Area Facil	114,114
Drum Strg/Shpg Bld	23,562
Drum Strg/Shpg Bld	17,672
Elec Lighting/Power	80,842
Elec Support Fac I & C	412,229
Elec Sup Fac Air Handling	1,850
Proc Fac Sup Facil Fp	16,000
Elec Site Pwr/Lighting	890,223
Constr Mgmnt & Fee	3,705,000
Construction Contingency	2,937,200
TOTAL	$35,565,931

OPERATING & VERIFICATION COSTS

Remove/Transport Drums	$ 5,364,391
Stripping Overburden	173,083
Backfill Pits	74,776
GE&OH/G&A/Fee/Conting	4,739,895
Management Contract	716,282
TOTAL	$11,068,427

DECONTAMINATION AND DECOMMISSIONING COSTS

Evaporation Pond Removal	$ 1,779
Decon Rem Facility	312,087
Remove Eqp Proc Plant	271,102
Dism Wst Enclo/Sup Fac	437,224
Rem Conc Proc Fac	81,653
Rem Elec Proc Fac	259,323
Decon Proc Plant	78,021
Rem Eqp Wst Enclo/Sup Fac	135,553
Dismntl Proc Pit Encl	88,222
Rem Conc Wst Enc/Sup Fac	40,827
Rem Elec Wst Enc/Sup Fac	172,074
TOTAL	$1,877,865
GRAND TOTAL	$53,140,020

Appendix B

Alternative 2 Cost Breakdown

Appendix B

Alternative 2 Cost Breakdown

ALTERNATIVE 2 SUMMARY IN SITU VITRIFICATION COST

DESIGN/CHARACTERIZATION	$3,000,000
RESEARCH AND DEVELOPMENT	$3,000,000
CONSTRUCTION/OPERATION	$24,000,000
MAINTENANCE	$5,000,000
CONTINGENCY	$17,500,000
	======
TOTAL	$52,500,000

ALTERNATIVE 2 DETAILED IN SITU VITRIFICATION COST

Design/Characterization	
Characterization	400,000
Design	2,600,000

Subtotal Design/Characterization	$3,000,000
R & D	
Containment	
Vapor release (melt material ejection)	
Contaminant migration	$3,000,000
Construction/Operation	
Operation Building (material handling)	9,837,000
ISV	11,500,000
Characterization	200,000
Mob/Debmob/Site Prep	400,000
Supervision/Labor	513,000
Capping Materials	600,000
Equipment	500,000
Mob/Debmob/Site Prep	200,000
Supervision/Labor	250,000

Subtotal Construction/Operation	$24,000,000
Maintenance	
Monitoring System	1,000,000
Sampling	4,000,000

Subtotal Maintenance	$5,000,000
	======
Subtotal:	$35,000,000
Contingency (50%)	$17,500,000
	======
Total	$52,500,000

Appendix C

Alternative 3 Cost Breakdown

Appendix C

Alternative 3 Cost Breakdown

ALTERNATIVE 3 SUMMARY EX SITU VITRIFICATION COST

COST ESTIMATE SUMMARY

DESIGN/CHARACTERIZATION	$4,000,000
RESEARCH AND DEVELOPMENT	$5,000,000
CONSTRUCTION/OPERATION	$26,500,000
MAINTENANCE	$2,500,000
CONTINGENCY	$19,000,000
	=======
TOTAL	$57,000,000

ALTERNATIVE 3 DETAILED EX SITU VITRIFICATION COST

Design/Characterization	
Characterization	400,000
Design	3,600,000

Subtotal Design/Characterization	$4,000,000
R & D	$5,000,000
Construction/Operation	
Plant Construction/Capital Equipment	11,137,000
Excavation Equipment	1,200,000
ESV	11,500,000
Characterization	200,000
Mob/Debmob/Site Prep	400,000
Supervision/Labor	513,000
Capping Materials	600,000
Equipment	500,000
Mob/Debmob/Site Prep	200,000
Supervision/Labor	250,000

Subtotal Construction/Operation	$26,500,000
Maintenance	
Monitoring System	500,000
Sampling	2,000,000

Subtotal Maintenance	$2,500,000
	======
Subtotal:	$38,000,000
Contingency (50%)	$19,500,000
	======
Total	57,000,000

Appendix D

Alternative 4 Cost Breakdown

Appendix D

Alternative 4 Cost Breakdown

ALTERNATIVE 4 COSTS SUMMARY

EXCAVATION/TREATMENT	$53,100,000
INTERIM STORAGE	$23,228,900
VERIFICATION	$5,000,000
TRANSPORTATION	$2,800,000
LONG TERM STORAGE	$30,850,000
	=======
TOTAL	$114,978,900

EXCAVATION/TREATMENT

Details for excavation/treatment are presented in detail in "Conceptual Cost Estimate for Pit 9, a Chemical Extraction and/or Physical Separation," which was prepared by MK-Environmental services. (Appendix A)

ALTERNATIVE 4 SUMMARY INTERIM STORAGE COSTS

ASSUMPTIONS

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1. Assumes development of new TRU interim storage facility at INEL.
2. 50,000 cubic feet of storage capacity.(this is for alternative 4 only, alternative 5 will require a larger facility)
3. 15 year operating period.
4. 6 cf per drum.
5. Drums stacked 4 high, 16 drums per 100 sq. feet.
6. 100% aisle/storage ratio.

COST SUMMARY

ENGINEERING	$4,774,000
CONSTRUCTION	$8,705,950
INTERIM STORAGE OPERATION	$5,877,500
CONTINGENCY	$3,871,490
	=======
TOTAL COST FOR INTERIM STORAGE	$23,228,940
COST PER CUBIC FOOT	$465

ALTERNATIVE 4 INTERIM STORAGE DETAIL COSTS BREAKDOWN

ENGINEERING

Manhours	$2,340,000
R&D	$2,000,000
Other (10%)	$434,000
Subtotal Engineering	$4,774,000

CONSTRUCTION

Adm. Office	$75,000
Worker Change Facilities	$17,500
Maintenance Shop	$12,000
Waste Receiving Facility	$500,000
Interim Waste Storage Facility	$4,220,000
On-site Lab	$90,000
Utility Installation (Transmission line/substation)	$1,500,000
Equipment (Loaders/cranes/lifts/remote handling)	$1,500,000
Other (10%)	$791,450
Subtotal Surface Facilities	$8,705,950

INTERIM STORAGE OPERATION

Administration	$3,375,000
Equipment Operation	$100,000
Utilities	$1,050,000
Sampling	$900,000
Other (10%)	$452,500
Subtotal Interim Storage Operation	$5,877,500

Appendix E

Alternative 5 Cost Breakdown

Appendix E

Alternative 5 Cost Breakdown

ALTERNATIVE 5 COSTS SUMMARY

COST SUMMARY	
ENGINEERING	$13,035,000
CONSTRUCTION	$55,933,000
INTERIM STORAGE OPERATION	$26,373,000
TREATMENT	$59,660,000
CONTINGENCY	$38,750,000
SUBTOTAL COST FOR INTERIM STORAGE	$193,751,000
LONG TERM STORAGE	$154,250,000
TRANSPORTATION	$14,000,000
VERIFICATION	$25,000,000
SUBTOTAL LONG TERM STORAGE/TRANSPORTATION	$193,250,000
TOTAL ALTERNATIVE 5	$387,000,000

ALTERNATIVE 5 INTERIM STORAGE COSTS AT THE INEL

ENGINEERING

Manhours	$5,850,000
Other (10%)	$585,000
Treatment Engineering (taken from MK estimate)	$6,600,000
Subtotal Engineering	$13,035,000

CONSTRUCTION

Adm. Office	$150,000
Worker Change Facilities	$35,000
Maintenance Shop	$24,000
Waste Receiving Facility	$2,000,000
Interim Waste Storage Facility	$42,000,000
On-site Lab	$90,000
Utility Installation (Transmission line/substation)	$1,500,000
Equipment (Loaders/cranes/lifts/remote handling)	$6,000,000
Other (10%)	$3,934,000
Subtotal Surface Facilities	$55,933,000

INTERIM STORAGE OPERATION

Administration	$10,125,000
Equipment Operation	$200,000
Utilities	$7,350,000
Sampling	$6,300,000
Other (10%)	$2,398,000
Subtotal Interim Storage Operation	$26,373,000

TREATMENT

Cost based on MK estimate and amount of material excavated	$59,660,000

Appendix F

Transportation Cost

Appendix F

Transportation Cost

TRANSPORTATION COST FOR SHIPMENT OF TRU WASTE TO AN OFFSITE FACILITY FOR ALTERNATIVES 4 AND 5

ASSUMPTIONS

- Assumes a 21-ton shipment
- 189 cubic feet waste per shipment used for shipment cost per cubic foot
- 240 shipping containers purchased
- $3500.00 per shipping container TRU-PAC type (new cost)
- Shipping containers are reused
- $0.20 per ton per mile trucking cost
- 1764 mile one-way trip to facility
- 50,000 cubic feet of waste used to generate cost container cost per cubic feet.

COST SUMMARY

Container cost	$840,000
Transportation cost per shipment	$7,409
Container cost per cubic foot	$17
Transportation cost per cubic foot	$39
Total cost per cubic foot	$56

TRANSPORTATION

Cost per shipment per mile	
Total cost per shipment to facility	$7409

CONTAINER COST

Total cost of containers	$840,000

Appendix G

Long-Term Storage/Disposal Costs

Appendix G

Long-Term Storage/Disposal Costs

ASSUMPTIONS

- Assumes development of a new TRU storage/disposal facility in a salt formation
- 6,000,000 cf. total volume
- 20-year combined construction/operating life
- Construction and operation overlap
- 20-year post-closure monitor/observation period
- 300,000 cubic feet per year handling capacity
- 6 cf per drum
- 50,000 drums per year; 200 drums per day
- 1,500,000 feet of storage room (4 cubic feet of waste per cubic foot of total volume).

Cost estimate summary

Total repository site characterization/engineering	$106,106,000
Subtotal construction	$965,269,000
Subtotal repository operation	$1,947,308,000
Total decommission repository facility	$65,713,000
Contingency (20%)	$616,879,000
	========
Total repository facility cost	$3,701,275,000
Cost per cubic foot	$617

LONG-TERM STORAGE/DISPOSAL DETAIL COSTS BREAKDOWN

REPOSITORY SITE CHARACTERIZATION/ENGINEERING

Characterization

Manhours	$14,040,000
Drilling	$17,500,000
Other (10%)	$3,154,000
Subtotal Characterization	$34,694,000

Engineering

Manhours	$49,920,000
R&D	$15,000,000
Other (10%)	$6,492,000
Subtotal Engineering	$71,412,000
TOTAL REPOSITORY SITE CHARACTERIZATION/ENGINEERING	$106,106,000

CONSTRUCTION

Surface Facilities

Adm. Office		$3,750,000
Worker Change Facilities		$700,000
Maintenance		$600,000
Rad Waste Receiving Facility		$1,000,000
Temp. Rad Waste Storage Facility		$2,000,000
Repackaging Facility		$2,500,000
Onsite Lab		$3,000,000
Utility Installation (Transmission line/substation)		$8,500,000
Surface Equipment (Loaders/cranes/lifts/remote handling)	$35,000,000	
Other (10%)		$5,705,000
Subtotal Surface Facilities		$62,755,000

Surface to Repository Access Facilities

Elevator Shafts	$37,500,000
Mat'l Hdlg/Hoist Systems	$60,000,000
Other (10%)	$9,750,000
Subtotal Subsurface Access Facilities	$107,250,000

Repository HVAC/HEPA Facilities

Elevator Shafts	$37,500,000
HVAC/HEPA	$25,500,000
Other (10%)	$6,300,000

Subtotal Subsurface Access Facilities	$69,300,000

Subsurface Repository Support Facilities

Adm. Office	$750,000
Worker Support Facilities	$350,000
Maintenance	$1,200,000
Rad Waste Receiving Facility	$1,000,000
Temp. Rad Waste Storage Facility	$400,000
Utility Installation	$2,500,000
Subsurface Equipment	$22,500,000
Other (10%)	$620,000

Subtotal Surface Facilities	$29,320,000

Repository Level Access Facilities

Access Corridors	$44,563,000
Utility Installation	$2,500,000
Other (10%)	$4,707,000

Subtotal Repository Level Access Facilities	$51,770,000

Repository Storage Panel Facilities

Storage Panels	$562,500,000
Monitoring/Instrumentation	$11,250,000
Utility Installation	$12,500,000
Other (10%)	$58,625,000

Subtotal Repository Storage Facilities	$644,875,000
	=======
TOTAL CONSTRUCTION	$965,270,000

REPOSITORY OPERATION/MONITORING

Repository Operation	
Administration	$180,000,000
Hourly	$240,000,000
Waste Handling/Backfill Equipment	$35,000,000
Replacement Equipment	$87,500,000
Subsurface Container Units	$265,000,000
Equipment Operation	$455,000,000
Utilities	$183,960,000
Other (10%)	$144,646,000
Subtotal Repository Operation	$1,591,106,000
Post Closure Monitoring	
Administration	$90,000,000
Hourly	$120,000,000
Equipment Operation	$52,500,000
Utilities	$61,320,000
Other (10%)	$32,382,000
Subtotal Repository Operation	$356,202,000
TOTAL REPOSITORY OPERATION	$1,947,308,000

DECOMMISSION REPOSITORY FACILITY

Surface Facilities	$2,700,000
Surface to Repository Access Facilities	
Elevator Shafts	$15,000,000
Mat'l Hdlg/Hoist Systems	$6,000,000
Other (10%)	$2,100,000
Subtotal Subsurface Access Facilities	$23,100,000
Repository HVAC/HEPA Facilities	
Elevator Shafts	$15,000,000
HVAC/HEPA	$6,000,000
Other (10%)	$2,100,000
Subtotal Subsurface Access Facilities	$23,100,000

Subsurface Repository Facilities	$3,250,000
Repository Level Access Facilities	
Corridors	$13,563,000
	=======
TOTAL DECOMMISSION REPOSITORY FACILITY	$65,713,000