3551

SANDIA REPORT
SAND85—1964 • UC—70
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Printed June 1987

SCP
5-1765

NNA.870106.0013

Nevada Nuclear Waste Storage Investigations Project

Cost Estimate of the Yucca Mountain Repository Based on the Site Characterization Plan Conceptual Design

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Prepared by
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for the United States Department of Energy
under Contract DE-AC04-76DP00789

"Prepared by Nevada Nuclear Waste Storage Investigations (NNWSI) Project participants as part of the Civilian Radioactive Waste Management Program (CRWM). The NNWSI Project is managed by the Waste Management Project Office (WMPO) of the U. S. Department of Energy, Nevada Operations Office (DOE/NV). NNWSI Project work is sponsored by the Office of Geologic Repositories (OGR) of the DOE Office of Civilian Radioactive Waste Management (OCRWM)."

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Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed copy: A06
Microfiche copy: A01

Distribution
Category UC-70

SAND85-1964
Unlimited Release
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COST ESTIMATE OF THE YUCCA MOUNTAIN REPOSITORY BASED ON THE SITE CHARACTERIZATION PLAN CONCEPTUAL DESIGN

by

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ABSTRACT

This report of the life-cycle costs of a mined repository in tuff is based on the site characterization conceptual design and contains estimates of two methods of waste emplacement--vertical and horizontal. The life cycle of the repository progresses from design and construction to emplacement operations that last 25 yr. When emplacement has ended, a caretaker period begins and continues until 50 yr from emplacement of the first waste. The life of the repository concludes with closure and decommissioning, which includes backfilling and sealing the repository, decontaminating and razing the surface facilities, restoring the land to as near its original condition as possible, and marking the site. The estimates, developed for each phase of the life cycle of the repository, are based on January 1986 constant (unescalated) dollars and include an allowance for contingency. This report mainly comprises explanations of design and operating assumptions, estimating methods, exclusions, definition of cost accounts, calculating procedures, data sources, staffing and other qualifying remarks. Cost estimates are approximations of value and should not be construed as exact. The cost and staffing detail provided in this estimate is commensurate with the detail in the conceptual design.

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ACKNOWLEDGMENT

The following individuals contributed to this report:

R. T. Chiu (BNI)

C. A. Horne (LATA)

J. T. Juterbock (BNI)

P. Leong (PBQD)

P. D. O'Brien (SNL)

V. J. Stephens (LATA)

R. E. Stinebaugh (SNL)

W. Streeter (PBQD)

R. R. Hill (SNL) and H. R. MacDougall (SNL) were technical peer reviewers.

EXECUTIVE SUMMARY

This report of the life-cycle costs of a mined repository in tuff is based on the conceptual design supporting site characterization and contains estimates of two methods of waste emplacement--vertical and horizontal.

The life cycle of the repository progresses from design and construction to emplacement operations that last 25 yr. When emplacement has ended, a caretaker period begins and continues until 50 yr from emplacement of the first waste. The life of the repository concludes with closure and decommissioning, which includes backfilling and sealing the repository, decontaminating and razing the surface facilities, restoring the land to as near its original condition as possible, and marking the site. The estimates, developed for each phase of the life cycle of the repository, are based on January 1986 constant (unescalated) dollars and include an allowance for contingency.

This report mainly comprises explanations of design and operating assumptions, estimating methods, exclusions, definition of cost accounts, calculating procedures, data sources, staffing and other qualifying remarks. Cost estimates are approximations of value and should not be construed as exact. The cost and staffing detail provided in this estimate is commensurate with the detail in the conceptual design.

Table ES-1 is a summary of the total life-cycle costs for four major categories by method of emplacement.

TABLE ES-1

COST ESTIMATES BY MAJOR COST CATEGORY FOR THE LIFE OF THE REPOSITORY--HORIZONTAL AND VERTICAL EMPLACEMENT
(in millions of 1986 constant dollars)

Cost Category	Emplacement Configuration	
	Horizontal	Vertical
• Management and Integration	389	415
• Surface Facilities	3,396	3,447
• Subsurface Facilities	1,547	2,132
• Waste Packages	603	603
Repository Life-Cycle Cost	5,935	6,597

Table ES-2 is a summary of the total life-cycle costs for the three life-cycle phases by emplacement method.

TABLE ES-2

COST ESTIMATES BY LIFE-CYCLE PHASE FOR THE LIFE OF THE REPOSITORY--HORIZONTAL AND VERTICAL EMPLACEMENT
(in millions of 1986 constant dollars)

Life-Cycle Phase	Emplacement Configuration	
	Horizontal	Vertical
• Construction and Design	1,350	1,417
• Operations	4,415	4,809
• Decommissioning	170	371
Repository Life-Cycle Cost	5,935	6,597

Construction labor and repository staffing are significant cost components and are summarized in Tables ES-3 and ES-4. These tables show that only the subsurface workers are affected by the emplacement method and that about 10% fewer workers are required during the emplacement period for the horizontal method.

TABLE ES-3

REPOSITORY WORKERS FOR THE VERTICAL EMPLACEMENT METHOD

	Construction	Operations		Decomis-sioning
		Emplacement	Caretaker	
	1996	2005	2025	2049
Surface	1,800	1,045	100	350
Subsurface	516	562	103	206
TOTAL	2,316	1,607	203	556

TABLE ES-4

REPOSITORY WORKERS FOR THE HORIZONTAL EMPLACEMENT METHOD

	Construction	Operations		Decomis-sioning
		Emplacement	Caretaker	
	1996	2005	2025	2049
Surface	1,800	1,045	100	350
Subsurface	438	397	95	178
TOTAL	2,338	1,442	195	528

1.0 INTRODUCTION

This report is a cost estimate for the proposed mined geologic repository for radioactive waste located at Yucca Mountain, an area on and near the southwest corner of the Nevada Test Site. It is based on a conceptual design of the repository for the Nevada Nuclear Waste Storage Investigations (NNWSI) project and the U.S. Department of Energy (DOE), Office of Geologic Repositories.

As described fully in the Mission Plan for the Civilian Radioactive Waste Management Program (DOE, 1985), the proposed repository is designed to fulfill the requirements of the Nuclear Waste Policy Act (NWPA) of 1982. The conceptual design of the repository, upon which this estimate is based, is described in the "Site Characterization Plan-Conceptual Design Report" (SNL, 1987). This document should be consulted for additional information regarding the basis for design, operation of the repository, conceptual design descriptions, closure and decommissioning, performance objectives, performance and design analysis, design issues and data needs, quality assurance plan, reference documents, and drawings.

Cost estimates for two methods of waste emplacement--vertical and horizontal--are included in this report. The reference case, identified as vertical emplacement, involves emplacing a single waste package in a short vertical borehole (25 ft) drilled in the floor of an emplacement drift. In the alternative case, horizontal emplacement, up to 14 spent fuel waste packages are emplaced in a borehole that is approximately 360 ft long drilled in the wall of an emplacement drift. The disposal container, the shell of the waste package, is the same design for both cases.

In both emplacement methods, waste is commingled. That is, defense high-level waste (DHLW) is emplaced between the spent fuel boreholes in some emplacement drifts. The horizontal DHLW boreholes are approximately

300 ft long and contain about 18 waste packages. The length of the horizontal borehole for both spent fuel and DHLW may be shorter depending upon the borehole's location in the repository.

Preceding the conceptual design, a study was performed to determine the impact on the schedule and cost of constructing a repository in two stages (SNL, 1986) in order to evaluate alternate approaches to meeting the receipt schedule. The two-stage construction approach, which requires two waste-handling buildings if spent fuel rods are consolidated at the repository, is reflected in the conceptual design and schedule of the repository.

1.1 Purpose and Scope

This report is an estimate of the life-cycle costs of a repository at Yucca Mountain for current and near-future project budgeting, planning, and management. It describes the cost accounts, presents the resulting costs and staffing estimates, and discusses the estimating procedures but does not contain detailed design information or calculations. This cost estimate will contribute to the cost data base for the next design stage.

1.2 Contents and Organization

The report has five chapters. The first chapter, Introduction, identifies the project, states its purpose, and outlines the contents of the report. Chapter 2, Cost Summary, compares the costs for major cost categories and activity periods of both emplacement configurations for the life of the repository. Chapter 3, Basis for Cost Estimates, references the technical basis and the conceptual design, lists the general assumptions and major exclusions, describes the three chronological phases, and presents the repository life-cycle schedule. Chapter 4, Methodology, identifies the sources of the direct costs; summarizes and defines the cost account codes; and rationalizes the direct and indirect labor costs, the material and equipment costs, the

operating and maintenance costs, engineering design costs, contingency, and applicable taxes. Chapter 5, Staffing, explains and presents the repository staffing estimates.

The appendices support the text and tables in Chapters 1 through 5. Appendix A contains the repository life-cycle costs (RLCC) that support the RLCC summary, analysis, and comparison presented in Section 2. Appendix B describes each cost account in detail. Appendix C describes the function and dimensions of the surface and underground facilities. Appendix D summarizes disposal container costs and quantities, and Appendix E contains staffing data.

1.3 Cost Uncertainties and Exclusions

This cost estimate does not include cost allowances for changes in scope, licensing delays, construction and/or operating labor problems, and mandates relating to total retrieval activities. Any of these uncertainties could have a significant impact on cost and/or schedule.

Also, this estimate does not include the cost for sinking and developing exploratory shafts for site characterization, management by governmental agencies, any offsite nuclear waste preparation and transport, or any costs that occur before license application design.

1.4 Major Design Issues Affecting Cost

Of the many design issues that affect the repository life-cycle costs, several are significant. Table 1-1 identifies a few of these issues and states the basis for the cost estimates included in this report.

TABLE 1-1

MAJOR DESIGN ISSUES THAT SIGNIFICANTLY IMPACT THE REPOSITORY LIFE-CYCLE COSTS

Design Issue	Basis for the RLCC Estimate
1. Backfilling drifts	1. Backfill 100% of the repository.
2. Disposal of site-generated radioactive waste	2. Ship to nearest offsite licensed low-level waste repository.
3. Spent fuel rod consolidation	3. Consolidate fuel rods in waste-handling building 2.
4. Disposal container QA requirements	4. Use NQA-1 welded thinwall stainless steel container.
5. Demolition of surface facilities	5. Raze the surface facilities to 2 ft below grade and return site to as near an original appearance as possible.
6. Horizontal borehole length	6. Horizontal borehole is 360 ft long.

2.0 COST SUMMARY

This chapter presents cost estimates for the reference and alternative repositories in several ways. Tables 2-1 and 2-2 summarize the repository life-cycle costs (RLCC) for the major cost categories during three main life-cycle phases. Tables 2-3 and 2-4 put the costs of the major categories into perspective with respect to the RLCC. Table 2-5 compares the costs and shows the differences between the reference and alternative methods of emplacement.

2.1 Summary

Tables 2-1 and 2-2 summarize four major cost categories and three subaccounts in each category for the three main life-cycle phases of the repository for the two methods of waste emplacement. Data for each table have been extracted from life-cycle cost estimates of nearly 350 cost accounts and 7 life-cycle phases. These life-cycle cost estimates are included in Appendix A. In summary, every cost for each major account in the vertical emplacement repository is greater than or equal to the respective cost for the alternative horizontal emplacement repository.

2.2 Analysis

Tables 2-3 and 2-4 list the four major cost categories for each of the three life-cycle phases as a percent of the RLCC. From this simple analysis, one can recognize the relative impact on cost that these categories and subaccounts have. In the vertical emplacement method, the operations phase, for example, is more than three times as costly (73% of the RLCC) as the construction of the physical plant (21.5% of RLCC), and the cost of decommissioning is only 5.6%.

The costs of the support functions when compared to the costs of waste handling during operations are of interest, because there is very little difference between these costs for either the surface or the underground. For example, in the reference design in Table 2-3, the cost

TABLE 2-1

SUMMARY OF LIFE-CYCLE COSTS FOR VERTICAL EMPLACEMENT
(in millions of 1986 constant* dollars)

Cost Category Description	Construction	Operations	Decommissioning	Total
Management and Integration				
• Architect/engineer	217	0	14	
• Construction management	74	0	2	
• Other	55	49	4	
Subtotal	346	49	20	415
Surface Facilities				
• Site	167	114	38	
• Waste-handling facilities	488	1,242	33	
• Balance of plant	130	1,190	45	
Subtotal	785	2,546	116	3,447
Subsurface Facilities				
• Shafts and ramps	62	28	3	
• Excavation and emplacement	136	838	101	
• Service systems	88	744	132	
Subtotal	286	1,610	235	2,132
Waste Packages	0	603	0	603
• Spent fuel	0	351	0	
• Defense high-level waste	0	128	0	
• Other	0	125	0	
Subtotal	0	603	0	603
Total	1,417	4,809	371	6,597

*Unescalated for the life of the repository.

TABLE 2-2

SUMMARY OF LIFE-CYCLE COSTS FOR HORIZONTAL EMPLACEMENT
(in millions of 1986 constant* dollars)

Cost Category Description	Construction	Operations	Decommissioning	Total
Management and Integration				
• Architect/engineer	206	0	7	
• Construction management	70	0	2	
• Other	53	49	2	
Subtotal	329	49	11	389
Surface Facilities				
• Site	167	104	38	
• Waste-handling facilities	488	1,242	34	
• Balance of plant	120	1,190	14	
Subtotal	775	2,536	85	3,396
Subsurface Facilities				
• Shafts and ramps	60	28	1	
• Excavation and emplacement	110	645	46	
• Service systems	76	553	27	
Subtotal	246	1,227	74	1,547
Waste Packages				
• Spent fuel	0	351	0	
• Defense high-level waste	0	128	0	
• Other	0	125	0	
Subtotal	0	603	0	603
Total	1,350	4,415	170	5,935

*Unescalated for the life of the repository.

TABLE 2-3

LIFE-CYCLE COST ESTIMATE ANALYSIS FOR VERTICAL EMPLACEMENT
(1986 constant* dollars)

Cost Category Description	Construction			Operations			Decommissioning			Total	
	Millions ($)	Percent of Account	Percent of RLCC	Millions ($)	Percent of Account	Percent of RLCC	Millions ($)	Percent of Account	Percent of RLCC	($)	Percent of RLCC
Management and Integration	346	100	5.2	49	100	.7	20	100	.3	415	6
• Architect/engineer	217	63		0	0		14	71			
• Construction management	74	21		0	0		2	11			
• Other	55	16		49	100		4	18			
Surface Facilities	785	100	12	2,546	100	39	116	100	1.8	3,447	52
• Site	167	21		114	5		38	33			
• Waste-handling facilities	488	62		1,242	48		34	29			
• Balance of plant	130	17		1,190	47		45	38			
Subsurface Facilities	286	100	4.3	1,610	100	24	235	100	3.6	2,131	32
• Shafts and ramps	62	21		28	2		3	1			
• Excavation and emplacement	136	48		838	52		101	43			
• Service systems	88	31		744	46		132	56			
Waste Packages	0	NA	NA	603	100	9.1	0	100	NA	603	9
• Spent fuel	0			351	58		0	0			
• Defense high-level waste	0			128	21		0	0			
• Other	0			125	21		0	0			
Total	1,417		21	4,809		73	371		5.6	6,597	100

*Unescalated for the life of the repository.
NA Not applicable.

TABLE 2-4

LIFE-CYCLE COST ESTIMATE ANALYSIS FOR HORIZONTAL EMPLACEMENT
(1986 constant* dollars)

Cost Category Description	Construction			Operations			Decommissioning			Total	
	Millions ($)	Percent of Account	Percent of RLCC	Millions ($)	Percent of Account	Percent of RLCC	Millions ($)	Percent of Account	Percent of RLCC	($)	Percent of RLCC
Management and Integration	329	100	6	49	100	.8	11	100	.2	389	7
• Architect/engineer	206	63		0	0		7	64			
• Construction management	70	21		0	0		2	20			
• Other	53	16		49	100		2	16			
Surface Facilities	775	100	13	2,536	100	43	85	100	1.4	3,396	57
• Site	167	22		104	4		38	45			
• Waste-handling facilities	488	63		1,242	49		34	40			
• Balance of plant	120	15		1,190	47		14	16			
Subsurface Facilities	246	100	4	1,227	100	21	74	100	1.2	1,547	26
• Shafts and ramps	60	24		28	2		1	1			
• Excavation and emplacement	110	45		645	53		46	63			
• Service systems	76	31		553	45		27	36			
Waste Packages	0	NA	0	603	100	10	0	100	NA	603	10
• Spent fuel	0			351	58		0	0			
• Defense high-level waste	0			128	21		0	0			
• Other	0			125	21		0	0			
Total	1,350		23	4,415	NA	74	170	NA	3	5,935	100

*Unescalated for the life of the repository.
NA Not applicable.

of the surface support function balance of plant is 46.8% and is almost the same as the cost of the surface waste-handling facilities at 48.8%. Correspondingly, the cost of the underground service systems is 46.2% compared to 52.0% for the excavation and waste emplacement functions.

2.3 Comparison

Table 2-5 compares the differences in cost between vertical and horizontal emplacement for the major cost categories by life-cycle phases and expresses these differences as a percent of the RLCC. Overall, the cost of a repository based on horizontal emplacement is $660 million less than the cost of the reference case. It is readily apparent that the largest cost difference is in the operating phase of the subsurface facilities. This difference can be explained by comparing the amount of tuff excavated for each emplacement method (Appendix C).

TABLE 2-5

COMPARISON BETWEEN LIFE-CYCLE COSTS FOR HORIZONTAL AND VERTICAL EMPLACEMENT
(in millions of 1986 constant* dollars)

Major Cost Category	Construction			Operations			Decommissioning			Total Diff in RLCC
	Horiz	Vert	Diff	Horiz	Vert	Diff	Horiz	Vert	Diff	
Management and Integration	330	346	-16	49	49	0	11	20	-9	-25
Surface Facilities	775	785	-10	2,536	2,546	-10	85	116	-31	-51
Subsurface Facilities	246	286	-40	1,227	1,610	-383	74	235	-161	-584
Waste Packages	0	0	0	603	603	0	0	0	0	0
Total	1,351	1,417	-66	4,415	4,808	-393	170	371	-201	-660

*Unescalated for the life of the repository.

3.0 BASIS FOR COST ESTIMATES

The cost estimate for the repository facilities is based on the conceptual design engineering performed by Sandia National Laboratories, Albuquerque; Bechtel National, Inc.; Los Alamos Technical Associates, Inc.; and Parsons Brinckerhoff Quade & Douglas, Inc. to support the Site Characterization Plan-Conceptual Design Report (SNL, 1987).

The estimates, developed for each phase of the life cycle of the repository, are based on January 1986 constant dollars (unescalated) and include an allowance for contingency. Escalation has not been included in any of the cost estimates, nor have any costs that might be incurred by the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), or any other federal agency or DOE prime contractor supporting the work breakdown elements. For a detailed discussion of the cost components included in the estimates, see Chapter 4.0.

The bases for estimating each phase of the repository life-cycle costs (RLCC) are described in the sections that follow.

3.1 Engineering and Construction

This phase starts with the license application design (LAD) and ends with the emplacement of the first waste package in the underground facility and completion of Waste-Handling Building 2 (WHB-2).

Costs have been included for a DOE support contractor to manage and integrate only the architect/engineering (A/E) services. Estimated A/E costs for the facilities include LAD engineering, final procurement and construction design (FPCD), and engineering services during construction.

Repository construction costs include construction of approximately 100 mi of railroad from a location near Las Vegas, 16 mi of highway from a nearby interstate highway, site development, construction of buildings,

and special equipment such as hot-cell equipment. Construction costs also include sinking and outfitting the men-and-materials shaft, and an exhaust ventilation shaft, mining and outfitting the waste and tuff ramps, modifying the exploratory shaft to serve as ventilation shaft, and mining and outfitting the underground service facilities. Sufficient underground emplacement panels are developed to accommodate the first emplacement of waste simultaneously with continuing development. Standard equipment required for initial operation of both surface and underground facilities plus construction management costs are also included. The cost of construction is based on

- construction contracts based on competitive bids and fixed-price contracts;
- design and QA procedures similar to those applied to current commercial nuclear projects;
- equipment and material from U.S. sources;
- commercially available delivery schedules;
- availability of craft and professional personnel in the general project area, including Las Vegas;
- craft wages that comply with the Davis-Bacon wage rates (DOL, 1986);
- an uninterrupted schedule (no major funding, labor, or supply problems); and
- a project that proceeds according to the Mission Plan schedule (DOE, 1985).

The construction cost estimates do not include any costs that may be required for offsite railroad maintenance facilities, nor do they include any costs associated with the exploratory shaft program.

Another cost element included in the construction phase is the cost for land leases, purchases, and rights of way required to construct and operate the repository.

3.2 Operations

The operations phase includes both the emplacement and caretaker periods of the repository life cycle.

In order to estimate the cost of operating the repository, it has been assumed that before completion of construction the DOE will select a repository operating contractor who will be responsible for all aspects of operating the repository. It has further been assumed that the operating contractor will subcontract the underground mining and maintenance activities but will retain direct responsibility for underground emplacement and selective removal operations.

The only waste removal costs included in the estimates are those associated with the performance confirmation program. It is assumed that beginning 5 yr after the initiation of emplacement, one container per month will be retrieved during the emplacement and caretaker periods to confirm the integrity of the waste package.

Operation costs for the repository are based on the following:

- waste receipt--receiving spent fuel assemblies and high-level waste as shown on the waste-acceptance schedule included in Appendix D;

- waste preparation--preparing spent fuel and high-level waste, such as consolidating and packaging incoming material and repackaging material retrieved for performance confirmation;

- waste emplacement--loading the waste package on the transporter, transporting it to the emplacement area, placing the waste package into a previously prepared borehole, and inserting the shield plug in the borehole;

- performance confirmation--conducting tests, experiments, and analyses to evaluate the accuracy and adequacy of the information used to determine with reasonable assurance that the performance objectives for the period after permanent closure are met;

- support--supporting waste operations, such as treating site-generated waste;

- administration--providing payroll, personnel, document control, and all general plant management functions;

- service--maintaining and repairing the repository facilities and equipment;

- mining--removing rock from the working faces by blasting or using a tunnel boring machine, conveying the tuff to the surface, installing rock support features, drilling boreholes, and placing the liner in the borehole;

- surface tuff storage--stacking and grading excavated tuff;

- underground maintenance--maintaining the integrity of the ground support systems and the ventilation flow paths for both the underground development and underground emplacement areas; and

- utilities--providing communications and distribution of power.

3.2.1 Emplacement Period

Operating and maintenance costs during the emplacement period include developing the remaining underground emplacement areas and accesses not developed during the construction phase; preparing and emplacing a total of 62,000 MTU of spent fuel, 7,360 MTU of defense high-level waste (DHLW), and 640 MTU of West Valley high-level waste

(WVHLW); and supporting and maintaining both surface and underground facilities. The cost of transporting radioactive waste to the repository has not been included.

3.2.2 Caretaker Period

For design purposes the option to retrieve waste will be maintained for 50 yr after initiation of waste emplacement as stated in 10 CFR 60.111(b)(1) (NRC, 1986). The time between the end of the emplacement period and the initiation of closure activities is called the caretaker period.

Operating and maintenance costs for the caretaker period are estimated assuming that only those buildings, or parts of buildings, required to support the performance confirmation program and the associated maintenance activities will be kept fully operable. Included among the buildings that will provide this support are the administration and computer buildings, fire stations, warehouses, maintenance shops, security headquarters, performance confirmation support facilities, and ancillary shaft collar facilities. The remainder of the surface facilities, including buildings, unused portions of the buildings listed above, and all equipment and systems not required for the protection of life and property, will be deactivated and will be minimally maintained. During the caretaker period, the highway into the site will be fully maintained, but the railroad will be only minimally maintained.

Also included in both the emplacement and caretaker periods are costs to cover consultants, offsite activities associated with the performance confirmation program, and the cost of subsidized busing for employees from the Las Vegas area.

3.3 Closure and Decommissioning

Implementation costs for decommissioning include backfilling and sealing the underground emplacement area, razing all of the surface facilities, and installing truncated granite pyramids and records

caches to mark the repository boundaries as required by 40 CFR 191 (EPA, 1985).

The cost of closure of the underground facilities has been estimated based on the assumption that the underground rooms and drifts will be backfilled and that all access ramps and shafts will be backfilled and sealed. The cost to decommission the surface facilities is based on the assumption that decommissioning will include decontamination of those buildings that have been radioactively contaminated during repository operations and dismantlement of the surface buildings to 2 ft below grade. The site will then be contoured and returned to a natural state.

3.4 Life-Cycle Schedule

A schedule for the design, construction, and life-cycle activities of the repository for vertical emplacement (Figure 3-1) shows that the 1998 repository startup date mandated by the Nuclear Waste Policy Act is met by waste receipt beginning in January 1998. The schedule for horizontal emplacement is essentially the same as for vertical emplacement except that backfill and demolition require 4 yr instead of the 10 yr shown on Figure 3-1.

This schedule is predicated upon timely execution of the design phases shown and upon construction authorization being granted in mid-1993. A delay in construction authorization, for whatever reason, would result in a corresponding delay in the startup date. A major uncertainty in this schedule is the amount of time allocated for the licensing procedure.

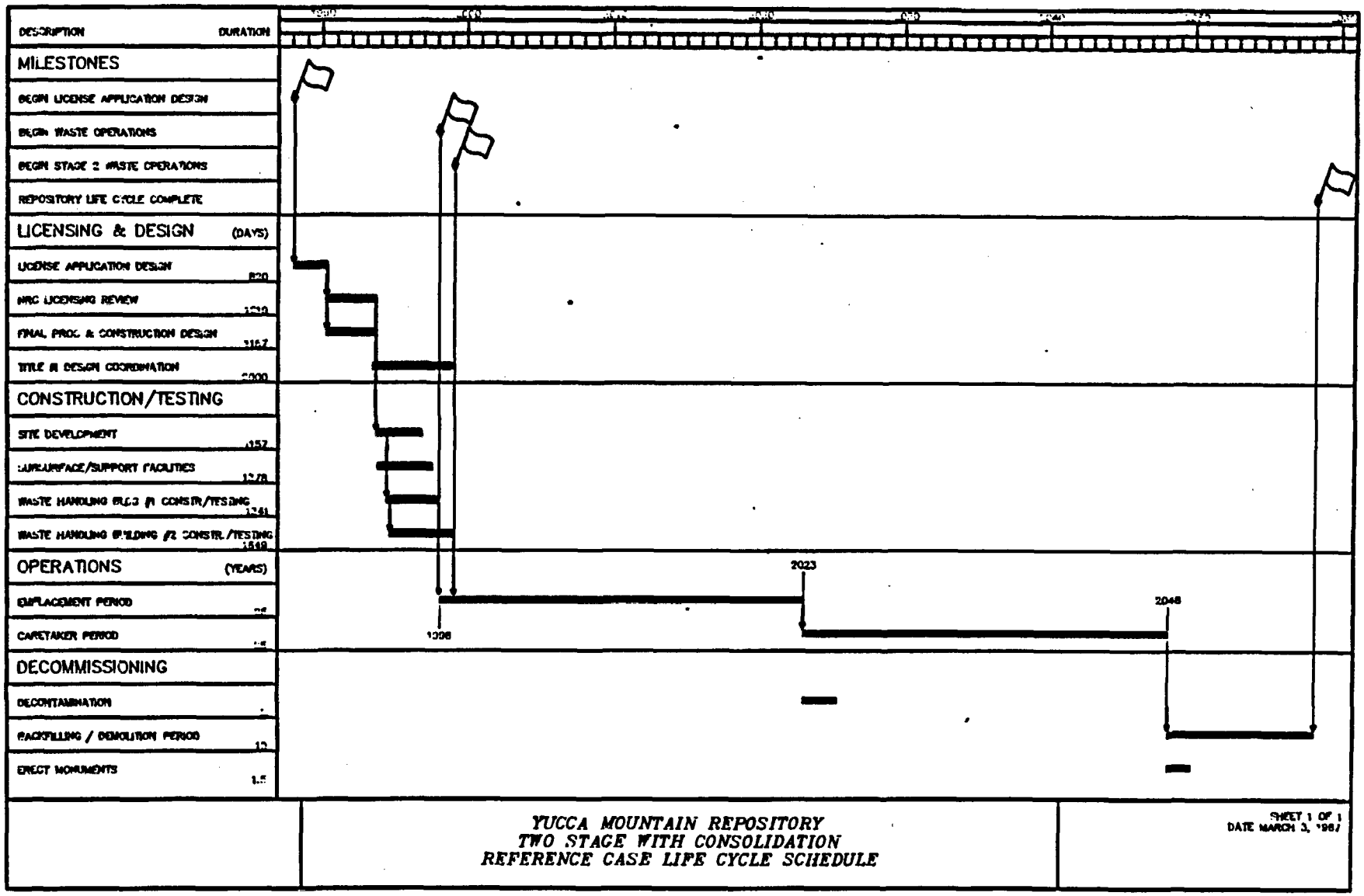

Figure 3-1. Schedule Showing Design, Construction, and Life-Cycle Activities of the Repository

4.0 METHODOLOGY

The overall structure and contents of the cost estimate are determined by the project code of accounts described in Section 4.1 and the project schedule outlined in Section 3.4. The cost components for each account include labor, materials, equipment, taxes, and contingencies, as described in Section 4.2. The procedures by which the various cost components are prepared for each cost account are presented in Section 4.3.

4.1 Code of Accounts

The code of accounts is the organizational framework by which estimated costs have been provided for specific functions and facilities within the mined geologic disposal system. The code of accounts as used in this estimate is a subset of the more detailed, generic code of accounts prepared by DOE (1986) for use on all geologic repository estimates.

The cost detail provided in this estimate is commensurate with the design detail in the "Site Characterization Plan-Conceptual Design Report" (SNL, 1987). The level of detail in the estimate varies for the different phases of the repository's life, the engineering and construction phase being the most detailed.

Table 4-1 summarizes the major cost accounts. A cross reference between the design activity structure (DAS) and the code of accounts is included in Appendix A. A detailed description of the items in each cost account is provided in Appendix B.

4.2 Cost Components and Calculations

Each cost account comprises a combination of labor, materials, and equipment plus suitable factors to account for indirect costs, contingency, taxes, and contractor fees.

TABLE 4-1

A SUMMARY OF MAJOR COST ACCOUNTS

Cost Account	Account Description
00000	MANAGEMENT AND INTEGRATION
01000	Support Contractor
02000	Architect/Engineer
03000	Construction Management
04000	Consultants
05000	Performance Confirmation Program
07000	Repository Land Aquisition
10000	SITE PREPARATION
11000	Employee Transportation
12000	Onsite
13000	Offsite
14000	Monuments
20000	SURFACE FACILITIES
21000	Waste-Handling Facilities
21100	Waste-Handling Building 1
21200	Waste-Handling Building 2
21500	Other Waste-Handling Facilities
22000	Balance of Plant
23000	Surface Shaft Facilities
30000	SHAFTS/RAMPS--UNDERGROUND
30010	Men-and-Materials Shaft
30020	Waste-Handling Ramp
30030	Excavated Tuff Ramp
30080	Emplacement Exhaust Shaft
30100	Exploratory Shaft-1 Modifications
30110	Exploratory Shaft-2 Modifications
40000	SUBSURFACE EXCAVATIONS
41000	Development
42000	Emplacement/Retrieval Operations
43000	Backfill
50000	UNDERGROUND SERVICE SYSTEMS
51000	Support System Facilities
52000	Utilities
53000	Monitoring
60000	WASTE PACKAGE FABRICATION
61000	Spent Fuel Containers
62000	DHLW Containers
63000	Other Waste

The differences between surface and underground construction and operations require a different estimating approach for each area. Tables 4-2 through 4-5 define the primary cost components and describe the basis for data used to estimate the cost of surface and underground facilities for the major phases in the repository's life. The relevant formulas that apply to each cost component are also included.

In addition to the primary components of labor, materials, and equipment, costs have been allocated to each account to cover contractor fees, taxes, and contingency, as seen in Table 4-6.

4.3 Management and Integration Costs

The cost account code includes a series of accounts (00000 level) for contractor costs, architect/engineer (A/E) fees, and construction management. The basis and method for estimating the cost of these activities are described as follows.

4.3.1 Architect/Engineering Costs

Engineering costs are assumed to be proportional to the cost of construction. Table 4-7 lists the percentages applied to each cost account to estimate the A/E cost and engineering contingency. Account 02000 (Appendix A) contains the estimated cost for all A/E services for

- license application design (LAD),
- final procurement and construction design (FPCD), and
- Title III engineering.

Surface Facility Architect/Engineer Cost

The total A/E cost for the surface is the sum of the A/E costs calculated for each of the surface cost accounts.

TABLE 4-2

LABOR COSTS

Cost Component	Project Phase	Surface Cost Estimate	Underground Cost Estimate
LABOR	CONSTRUCTION	Direct Labor (DL) Direct labor includes all craft labor through the general foremen engaged in the permanent installation of direct material and capital equipment. The average construction unit rate of $27.50/hr is based on craft agreements at the NTS and on a crew mix distribution developed from current estimating standards. The rates used comply with the Davis-Bacon wage rates (DOL, 1986) for the area and include all applicable additives and allowances. No additional NTS burden costs are included.	Direct Labor (DL) Underground labor during the construction phase is composed of a direct portion that accounts for all nonsupervisory construction personnel allocated to specific facilities or activities and an indirect portion that accounts for the remaining staff. Indirect labor components are described under indirect costs. The average underground labor rate is $25.90/hr and is based on the current tunnel worker craft agreement at the Nevada Test Site. The rate complies with the Davis-Bacon wage rates (DOL, 1986) for the area and includes fringe benefits, payroll taxes, insurance, and subsistence allowance. No additional NTS burden costs are included.
	OPERATIONS	The staffing requirements for the entire life of the surface facility have been developed and include operations, maintenance, quality assurance, administrative services, and supervision. An average annual salary of $50,000 has been developed and applied to the staffing requirements in each year. This salary includes fringe benefits, taxes, and insurance additives. The salary has been developed from actual wage information for the Las Vegas area (U.S. Civil Service Commission, 1984).	Labor costs for ongoing mining and development are treated the same as construction phase labor described above. Labor costs for underground waste-handling operations are assigned to specific accounts based on estimated crew sizes and operating schedules. Labor rates for the operations staff are assumed to be the same as the average craft labor rate of $25.90/hr.
	DECOMMISSIONING	Same as construction phase	Underground labor during the decommissioning and closure phase will be composed primarily of construction crews and is treated the same.

TABLE 4-3

MATERIAL COSTS

Cost Component	Project Phase	Surface Cost Estimate	Underground Cost Estimate
MATERIAL	CONSTRUCTION	Direct Material (DM) Direct material includes the cost of those goods that are normally purchased in bulk quantities (e.g., concrete, structural steel, pipe) and become a part of the permanent installation. The quantities have been developed in detail from conceptual drawings where the level of design has permitted. For those areas where detailed design information is not available, a parametric approach has been used to estimate quantities. Material and equipment pricing is based on historical estimating information, vendor and subcontractor contacts for budgetary quotations, vendor catalogues, and national pricing bulletins.	Direct Material (DM) Direct materials consist of all installed bulk materials or consumable items used to excavate and line the drifts and shafts and to equip the subsurface facilities. Where possible, the material quantities are obtained directly from conceptual drawings. For general excavation and lining, the material quantities are determined on a per ton basis and extended accordingly. Unit costs for materials are based on telephone quotes from vendors and industry cost-reference guides. Electricity and fuel costs are treated as material costs.
	OPERATIONS	Operating Supplies The costs of operating supplies, including fuels, lubricants, waste treatment materials, consumables, decontamination materials, and personnel protection equipment, have been estimated at 5% of the operating labor costs discussed above. The only major utility cost, electric power, is based on an estimate of the annual plant usage and an average rate per kilowatt hour for the Nevada Test Site. Maintenance Material Depending on the period, 0.1 to 2% of the total cost of construction has been allowed for spare and repair parts, equipment replacement, and small tools.	Same as construction phase
	DECOMMISSIONING	Same as Construction Phase	Same as construction phase

TABLE 4-4

EQUIPMENT COSTS

Cost Component	Project Phase	Surface Cost Estimate	Underground Cost Estimate
EQUIPMENT	CONSTRUCTION	Capital Equipment (EQ) This category includes major equipment that is normally identified by an equipment number. Quantities have been developed in the same manner as direct material. Initial cost of mobile equipment has also been included. Costs for commercially available equipment are obtained from industry cost-reference guides and vendor budget quotes. Cost for the fuel consolidation equipment is based on the Townes et al. (1984) fuel consolidation equipment.	Capital Equipment (EQ) Capital equipment for the underground facilities includes all permanent shaft equipment and the initial purchase of all mining, drilling, and special waste handling equipment used underground. Costs for commercially available equipment are obtained from industry cost-reference guides and vendor budget quotes. Equipment operating costs during construction are the same as during operations phase. Costs for specialized drilling and waste handling equipment are based on estimates prepared by SML, LATA, and manufacturers.
	OPERATIONS	Included as operating supplies and maintenance materials	Equipment Usage (EQ) Equipment usage costs are accrued on an operating-hour basis to cover the cost of continued equipment replacement throughout the operating phases of the repository's life. Economic life estimates for underground equipment are based on mining industry historical records. No credit is taken for salvage value of any underground equipment. Electricity and fuel costs are also included.
	DECOMMISSIONING	Included as indirect costs	Treatment of equipment costs during decommissioning and closure phase is identical to operations phase.

TABLE 4-5

INDIRECT COSTS

Cost Component	Project Phase	Surface Cost Estimate	Underground Cost Estimate
INDIRECT COSTS	CONSTRUCTION	Indirect Costs (IC) Indirect costs cover labor and material costs that cannot be identified with specific direct operations and that are either support services or apply to several direct operations for which a logical allocation to each separate operation cannot readily be made. Indirect costs include temporary construction facilities; miscellaneous construction equipment; tools; and consumable material, overhead, and profit. Indirect costs for construction of the surface facility have been estimated at 100% of the direct labor costs. Formula: Indirect Cost (IC) = 1.0 x DL	Indirect Costs (IC) Indirect costs for underground construction are used to account for unallocated labor and material costs that are not attributable to a single account. Indirect labor costs provide for direct supervision, technical support (geologists, engineers, surveyors), safety and skill training, and quality control. An estimate of 33% of direct labor is used for indirect labor. Indirect materials are estimated at 3% of direct materials to account for miscellaneous consumables, small tools, and personal safety equipment. The underground mining and waste-handling operations will most likely be performed by separate contractors. For the purpose of this estimate, no distinction is made, and a single value, 15%, is applied to the direct and indirect construction and operating costs to cover contractor overhead, fees, and profits. Formula: Indirect Labor (IL) = 0.33 x DL Indirect Material (IM) = 0.03 x DM Contractor Cost (CC) = 0.15 (IL + IM + DL + DM + EQ + ST + QA) Indirect Cost (IC) = IL + IM + CC Note: ST = Sales Tax QA = Quality Assurance
	OPERATIONS	Included as operating supplies and maintenance materials	Same as construction phase
	DECOMMISSIONING	Same as construction phase except indirect costs for demolition ranging from 75 to 100% of the direct labor costs Formula: Indirect Cost (IC) = .75 to 1.0 x DL	Same as construction phase

TABLE 4-6

OTHER COST COMPONENTS

Cost Component	Project Phase	Surface Cost Estimate	Underground Cost Estimate
STATE SALES TAX	ALL	A sales tax of 3.75% is applied to the cost of all direct and indirect materials and equipment. Each account includes a portion of sales tax proportional to the materials and equipment costs within the account. The sales tax is applicable throughout the repository's life. Formula: Sales Tax (ST) = 0.0375 x (DM + IM + EQ)	Same as surface cost estimate Formula: Sales Tax (ST) = 0.0375 x (DM + IM + EQ)
CONTIN-GENCY	ALL	The rationale for a contingency allowance is applicable to both surface and underground cost estimates. A contingency cost is present in all cost accounts to cover the inherent uncertainties in the quantity estimates and cost data. The conceptual design uses some concepts and equipment for which no historical cost information is available. The contingency allowance does not account for changes in scope or design criteria, changes in repository location, changes in licensing requirements, or cost escalation. The amount of contingency applied to any one account for each phase ranges from 20 to 40% depending on an engineering judgment of the relative complexity of the facilities or operations involved. Table 4-7 is a listing of the range of contingency values applied to major cost accounts for each phase of the repository's life. Formula: Contingency = % Contingency x (DL + DM + IC + EQ + ST)	Formula: Contingency = % Contingency x (DL + DM + IC + EQ + ST + QA)
QA/QC IMPACT	ALL	Cost information used for estimating the construction and operation of the surface facilities is based on historical data (which contains QA/QC) from other nuclear industry construction and thus reflects a level of quality control appropriate for the repository.	The underground development and operation costs are based on mining industry experience. To account for the impact on cost of the additional quality control and quality assurance programs likely to be present, an allowance of 5% of the total direct plus indirect costs has been added to each account for all phases. Formula: QA/QC Impact (QA) = 0.05 x (DL + DM + EQ + IL + IM)

TABLE 4-7

PRECENTAGES USED FOR ESTIMATING ARCHITECT/ENGINEERING COST AND CONTINGENCY

Cost Account	Account Description	Architect/Engineering Contingency				
		Construction		Operations	Closure/Decommissioning	
00000	MANAGEMENT AND INTEGRATION	Management and integration costs are estimated as a percentage of the costs reported for all other accounts. The values against which the percentages are applied already include a contingency. The effective contingency contained in the management and integration costs ranges from 25 to 40%.				
01000	Support Contractor					
02000	Architect/Engineer					
03000	Construction Management					
04000	Consultants					
05000	Performance Confirmation Program					
07000	Repository Land Aquisition					
10000	SITE PREPARATION					
11000	Employee Transportation	NA	NA	20-40%	NA	NA
12000	Onsite	5-15%	20-30%	20%	NA	35%
13000	Offsite	10-15%	20-30%	20%	NA	NA
14000	Monuments	NA	NA	NA	10%	25%
20000	SURFACE FACILITIES					
21000	Waste Handling Facilities	15-25%	30-40%	40%	NA	35%
21100	Waste-Handling Building 1	25%	40%	40%	NA	35%
21200	Waste-Handling Building 2	25%	40%	40%	NA	35%
22000	Balance of Plant	10-15%	25-30%	30%	NA	35%
23000	Surface Shaft Facilities	15-20%	30-35%	30%	NA	35%
30000	SHAFTS/RAMPS--UNDERGROUND	10-15%	25-30%	25-30%	3-4.5%	25-30%
40000	SUBSURFACE EXCAVATIONS					
41000	Development					
41010	Common facility excavation	15%	30%	NA	NA	NA
41020	Spent fuel facility excavation	10-20%	25-35%	25-35%	NA	NA
41030	DHLW facility excavation	20%	35%	35%	NA	NA
42000	Emplacement/Retrieval Operations					
42010	Spent fuel emplacement	20%	35%	35%	NA	NA
42020	DHLW emplacement	20%	35%	35%	NA	NA
42040	Waste retrieval	NA	NA	40%		NA
43000	Backfill	NA	NA	NA	7.5%	40%
50000	UNDERGROUND SERVICE SYSTEMS					
51000	Support System Facilites	10-15%	25-30%	25-30%	3-4.5%	25-30%
52000	Utilities	10-15%	25-30%	25-30%	3-4.5%	25-30%
53000	Monitoring	20%	35%	35%	6%	35%
60000	WASTE PACKAGE FABRICATION	Engineering costs for disposal containers are not included in this estimate, because they are assumed to be incurred before license application design.		20%	NA	NA
61000	Spent Fuel Containers			20%	NA	NA
62000	DHLW Containers			20%	NA	NA
63000	Other Waste					

NA Not applicable.

Costs are calculated as follows:

Engineering Cost (EC) = (direct construction cost + indirect cost) x (engineering %)

Engineering Quality Assurance (EQA) = EC x 5%

Engineering Contingency (ECON) = (EC + EQA) x (contingency %)

Total Accounting Engineering Cost = EC + EQA + ECON

Subsurface Facility Architect/Engineering Cost

Calculations for the subsurface facility A/E costs follow the same general procedure described above with the exception that 10% of the subsurface operation phase costs is included with the construction cost. This adjustment reflects the fact that only a fraction of the total underground facility is completed during the construction phase.

4.3.2 Support Contractor Cost

The cost for this function, estimated at 25% of the A/E cost and included in Account 01000, is for that portion of the support contractor staff that

- manages and coordinates the architect/engineer and construction manager activities;
- prepares integrated repository design reports;
- develops and establishes a baseline for functional criteria, standards, analytical methods, assumptions, and interface requirements required to design repository surface facilities, shafts, subsurface excavations, and underground service systems;
- assembles and maintains data to support design;

- evaluates repository design options; and

- interacts with other OCRWM program participants, (e.g., participates in the repository coordination group).

4.3.3 Construction Management Cost

Construction management duties include but are not limited to

- state and local permitting,
- coordination of contractors,
- scheduling,
- quality assurance (major role),
- record keeping, and
- material testing.

The cost for this function is estimated at 7% of the total construction cost and is reported under Account 03000 (Appendix A).

4.3.4 Other Management Costs

Cost allowances are provided for outside consultants, offsite container testing for the performance confirmation program, and for acquisition of land.

Outside consultant costs are factored from the cost for the total repository operations staff (ROS) at a rate of $0.055/ROS man-hour (DOE, 1986). During operations, $1 million/yr is allowed for offsite testing of containers as part of performance confirmation, and $1 million is included for land acquisition costs to establish the needed offsite roads and rail rights of way. The entire repository facility is situated on government-owned land. No costs are allocated for land acquisition.

5.0 STAFFING

5.1 Introduction

5.1.1 Purpose and Scope

This chapter estimates the labor force needed to construct, operate, and decommission the repository and discusses the methods used to develop these estimates.

The procedures for estimating labor are different for the surface and subsurface activities because of the inherent differences in the construction and operating processes. Consequently, these procedures are explained separately in Section 5.2 for clarity. Tables 5-1 and 5-2 contain the staffing estimates for both configurations.

5.1.2 General Approach

At least four different methods are used to estimate the work force: detail takeoffs, parametric, historical, and a combination of these methods. More than one of these methods, as discussed in Section 5.2.1, has been used to estimate the work force needed for most facilities.

Contingency factors have been applied to the estimated work force to account for the uncertainty normally associated with preliminary design estimates and are listed in Table 4-7. These contingency factors have been applied sequentially; thus, the work force has not been estimated to be "plus or minus" the base estimate but consists of the base estimate plus the workers added for contingency.

The schedule assumed for repository construction is consistent with the Mission Plan (DOE, 1985) and has a major effect on the estimates of the peak work force. There is not, however, a linear relationship between the total worker effort (man-years) and schedule. As a general

rule, the longer the schedule, the higher the number of man-years becomes. On the other hand, if the schedule is too compressed, efficiency is reduced and the number of man-years begins to increase again. Most projects have an efficiency relationship between schedule and man-years of effort, which allows some flexibility. The figures on application of manpower in this report have not been optimized. Optimization of manpower should not be attempted until the design is more detailed and complete.

5.2 Methods

5.2.1 Surface Work Force

5.2.1.1 Construction

The work force required to build the surface facilities is determined by dividing the total labor hours by the number of hours worked by one person in a year [e.g., total labor hours/(250 shifts/yr x 8-hr/person/shift)].

The methods used to determine the labor hours vary depending on the amount of design detail available at the time the estimates are made. The unit-hour (the number of hours required to install a unit of material) is the basis for all of the estimating methods for construction. These unit-hours have been developed from actual data accumulated for many years from the construction of a wide variety of projects, including data from the Waste Isolation Pilot Plant (WIPP) project. The methods used to estimate the work force for the surface facilities follow.

Detail Takeoff* Method

Where the design has been supported by adequate detail, estimators have calculated the quantity of construction materials. Based on historical construction data, a unit-hour needed to accomplish the task

*"Takeoff" is the term used by estimators to itemize the individual components of buildings "taken off" an engineering drawing to estimate the quantities of construction materials.

is then applied to the unit quantity to determine the total craft labor hours required to install the unit.

Parametric Method

A parametric approach has been used when very few design details are available but when the facility is similar to one for which actual data are available. When using this approach, for example, the common estimating parameter of a building is typically square or cubic feet. The unit-hour is then applied to the parameter selected to estimate the hours of craft labor required for installation. An example would be the application of principles cited in Cox and Horsley (1983).

Historical Method

Historically, an estimator develops an information data base by compiling cost information from various types of construction projects accumulated over the years. The cost of a given construction activity is then reduced to the cost per unit and to the amount of labor required to perform the unit of this activity. Thus, the estimator can determine the labor force requirement.

5.2.1.2 Operations

The work force for repository operations has been estimated by breaking down site operations into functions. Functional categories representing known operations have been estimated based on the architect/engineers' (A/E) experience with similar operations in completed facilities. In the case of waste-handling buildings, flow diagrams have been prepared to show operational steps in more detail, including time allocations for each step.

5.2.1.3 Decommissioning

The method used to estimate the staff needed for decommissioning is the same as has been used for construction.

5.2.2 Subsurface Work Force

5.2.2.1 Construction

The design of the subsurface facility determines the methods and equipment needed to construct the various underground facilities. Equipment and labor productivity have been obtained using conventional mining industry methods of estimating cycle times for drilling, blasting, haulage, and ground support for a typical excavation. These productivities are then used to estimate the number of crews and thus the staffing requirements.

In addition to the direct labor force, personnel are needed for miscellaneous support and supervisory and technical positions. Based on experience and engineering judgment, a value of 33% of the direct labor force accounts for supervision, geologists, staff engineers, surveyors, and skill and safety training personnel.

5.2.2.2 Operations

A large part of the subsurface operations phase is the continuation of the same excavation activities started in the construction phase; therefore, the same methods are used to estimate staffing requirements. A second but very fundamental function in this phase is waste emplacement.

Because historical data are not available, the costs and work force requirements for waste emplacement have been estimated using engineering judgment. Estimates have been made of the number of transporters and size and number of crews needed to transport and emplace the waste. Additional support personnel are required during emplacement to control and monitor the operations; provide quality control; provide health and safety monitoring; and maintain equipment, ventilation systems, and drifts.

5.2.2.3 Decommissioning

During decommissioning, selective removal for performance confirmation is discontinued. Salvageable equipment will be removed from the underground facilities and shafts; then, the entire underground facility will be backfilled and sealed. Staffing for total backfilling of the underground facility has been estimated based on the amount of rock to be replaced and the continued operation of the necessary support facilities. Staffing for removal of equipment has been determined from previous experience with dismantling similar mine facilities.

5.3 Estimates of Repository Workers

Tables 5-1 and 5-2 summarize the average annual number of repository workers for the vertical and horizontal emplacement configurations, respectively, but do not consider allowances for vacation, sick leave, and other absenteeism. Figures 5-1 and 5-2 graphically represent the data in Tables 5-1 and 5-2. Appendix E provides staffing information at the next level of detail.

TABLE 5-1

REPOSITORY WORKERS
Average Annual Number of Workers--Vertical Emplacement Method

APPLICABLE COST ACCOUNTS	DESCRIPTION	CONSTRUCTION 1993	1994	1995	1996	1997	EMPLACEMENT 1998	1999	2000	2001	2002	2003	2004	2005-2016	2017	2018	2019	2020	2021	2022
	SURFACE:																			
10000	SITE PREPARATION AND MAINTENANCE	170	120	180	130	0	3	3	3	3	3	3	3	3	3	3	3	3	3	1
21000	WASTE HANDLING FACILITIES	0	155	795	930	575	315	210	255	268	268	268	268	268	268	268	268	268	268	150
22000, 23013 and 23083	BALANCE OF PLANT	0	130	370	260	210	290	390	470	510	510	510	510	510	510	510	510	510	510	280
ALL ACCOUNTS	CONTINGENCY	35	125	465	480	295	202	197	292	264	264	264	264	264	264	264	264	264	264	169
	SUBTOTAL SURFACE	205	530	1810	1800	1080	810	800	1020	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	600
	SUBSURFACE:																			
23000 except 23013 and 23083 plus 30000	SHAFTS AND RAMPS	56	108	64	70	24	12	12	12	12	12	12	12	12	12	12	12	12	12	12
43000 and 41000 except 41025, 41035 and 41045	EXCAVATION/BACKFILL	30	51	124	128	116	121	121	121	121	121	121	121	109	94	26	26	20	20	20
41025, 41035 and 41045	EMPLACEMENT HOLE DRILLING AND LINING	0	0	0	29	33	41	41	41	41	68	68	68	68	68	68	68	0	0	0
42000	EMPLACEMENT/RETRIEVAL OPERATIONS	0	0	0	0	1	8	8	8	8	8	13	13	14	14	14	14	14	14	14
50000	SUPPORT SERVICES	80	118	149	179	190	230	230	230	230	230	230	230	231	231	231	231	219	219	219
ALL ACCOUNTS	CONTINGENCY	43	75	90	110	97	118	118	118	118	128	130	130	128	125	108	108	78	78	78
	SUBTOTAL SUBSURFACE	209	352	427	516	461	530	530	530	530	567	574	574	562	544	459	459	343	343	343
	REPOSITORY TOTAL	414	882	2237	2316	1541	1340	1330	1550	1575	1612	1619	1619	1607	1589	1504	1504	1388	1388	943

TABLE 5-1

REPOSITORY WORKERS
Average Annual Number of Workers--Vertical Emplacement Method
(Concluded)

APPLICABLE COST ACCOUNTS	DESCRIPTION	CARETAKER 2023	CARETAKER 2024	CARETAKER 2025-2047	BACKFILL/DECOMMISSIONING 2048	2049	2050	2051	2052	2053	2054	2055	2056	2057
	SURFACE:													
10000	SITE PREPARATION AND MAINTENANCE	1	1	1	72	78	12	26						
21000	WASTE HANDLING FACILITIES	12	12	12	70	131	85							
22000,23013 and 23083	BALANCE OF PLANT	64	64	64	32	56	56	19	19	19	19	19	19	19
ALL ACCOUNTS	CONTINGENCY	23	23	23	51	85	62	15	6	6	6	6	6	6
	SUBTOTAL SURFACE	100	100	100	225	350	215	60	25	25	25	25	25	25
	SUBSURFACE:													
23000 except 23013 and 23083 plus 30000	SHAFTS AND RAMPS	9	9	9	10	10	10	10	10	10	10	10	10	0
43000 and 41000 except 41025, 41035 and 41045	EXCAVATION/BACKFILL	12	12	12	60	60	60	60	60	60	62	63	75	41
41025, 41035 and 41045	EMPLACEMENT HOLE DRILLING AND LINING	0	0	0	0	0	0	0	0	0	0	0	0	0
42000	EMPLACEMENT/RETRIEVAL OPERATIONS	0	0	0	0	0	0	0	0	0	0	0	0	0
50000	SUPPORT SERVICES	59	59	59	86	86	86	86	86	86	86	86	86	27
ALL ACCOUNTS	CONTINGENCY	23	23	23	50	50	50	50	50	50	51	51	56	24
	SUBTOTAL SUBSURFACE	103	103	103	206	206	206	206	206	206	209	210	227	92
	REPOSITORY TOTAL	203	203	203	431	556	421	266	231	231	234	235	252	117

TABLE 5-2

REPOSITORY WORKERS
Average Annual Number of Workers--Horizontal Emplacement Method

APPLICABLE COST ACCOUNTS	DESCRIPTION	CONSTRUCTION 1993	1994	1995	1996	1997	1998	EMPLACEMENT 1999	2000	2001	2002	2003	2004	2005-2016	2017	2018	2019	2020	2021	2022
	SURFACE:																			
10000	SITE PREPARATION AND MAINTENANCE	170	120	180	130	0	3	3	3	3	3	3	3	3	3	3	3	3	3	1
21000	WASTE HANDLING FACILITIES	0	155	795	930	575	315	210	255	268	268	268	268	268	268	268	268	268	268	150
22000,23013 and 23083	BALANCE OF PLANT	0	130	330	260	210	290	390	470	510	510	510	510	510	510	510	510	510	510	280
ALL ACCOUNTS	CONTINGENCY	35	125	455	480	295	202	197	292	264	264	264	264	264	264	264	264	264	264	169
	SUBTOTAL SURFACE	205	530	1760	1800	1080	810	800	1020	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	600
	SUBSURFACE:																			
23000 except 23013 and 23083 plus 30000	SHAFTS AND RAMPS	56	104	64	70	24	12	12	12	12	12	12	12	12	12	12	12	12	12	12
43000 and 41000 except 41025, 41035 and 41045	EXCAVATION/BACKFILL	27	48	85	90	80	58	58	58	58	58	58	58	46	32	19	19	13	13	13
41025, 41035 and 41045	EMPLACEMENT HOLE DRILLING AND LINING	0	0	0	35	36	52	52	52	52	78	78	78	78	78	78	78	0	0	0
42000	EMPLACEMENT/RETRIEVAL OPERATIONS	0	0	0	0	1	7	7	7	7	7	12	12	14	14	14	14	14	14	14
50000	SUPPORT SERVICES	60	93	123	149	156	154	154	154	154	154	154	154	154	154	154	154	148	148	148
ALL ACCOUNTS	CONTINGENCY	37	67	73	94	79	84	84	84	84	93	95	95	93	89	86	86	55	55	55
	SUBTOTAL SUBSURFACE	180	312	345	438	376	367	367	367	367	402	409	409	397	379	363	363	242	242	242
	REPOSITORY TOTAL	385	842	2105	2238	1456	1177	1167	1387	1412	1447	1454	1454	1442	1424	1408	1408	1287	1287	842

TABLE 5-2

REPOSITORY WORKERS
Average Annual Number of Workers--Horizontal Emplacement Method
(Concluded)

APPLICABLE COST ACCOUNTS	DESCRIPTION	CARETAKER 2023	CARETAKER 2024	CARETAKER 2025-2047	BACKFILL AND DECOMMISSIONING 2048	2049	2050	2051	2052	2053	2054	2055	2056	2057
	SURFACE:													
10000	SITE PREPARATION AND MAINTENANCE	1	1	1	72	78	12	26						
21000	WASTE HANDLING FACILITIES	12	12	12	70	131	85							
22000,23013 and 23083	BALANCE OF PLANT	64	64	64	32	56	56	19						
ALL ACCOUNTS	CONTINGENCY	23	23	23	51	85	62	15						
	SUBTOTAL SURFACE	100	100	100	225	350	215	60	0	0	0	0	0	0
	SUBSURFACE:													
23000 except 23013 and 23083 plus 30000	SHAFTS AND RAMPS	9	9	9	10	10	10	0						
43000 and 41000 except 41025, 41035 and 41045	EXCAVATION/BACKFILL	8	8	8	60	60	80	41						
41025, 41035 and 41045	EMPLACEMENT HOLE DRILLING AND LINING	0	0	0	0	0	0	0						
42000	EMPLACEMENT/RETRIEVAL OPERATIONS	2	2	2	0	0	0	0						
50000	SUPPORT SERVICES	54	54	54	64	64	64	24						
ALL ACCOUNTS	CONTINGENCY	22	22	22	44	44	52	24						
	SUBTOTAL SUBSURFACE	95	95	95	178	178	206	89	0	0	0	0	0	0
	REPOSITORY TOTAL	195	195	195	403	528	421	149	0	0	0	0	0	0

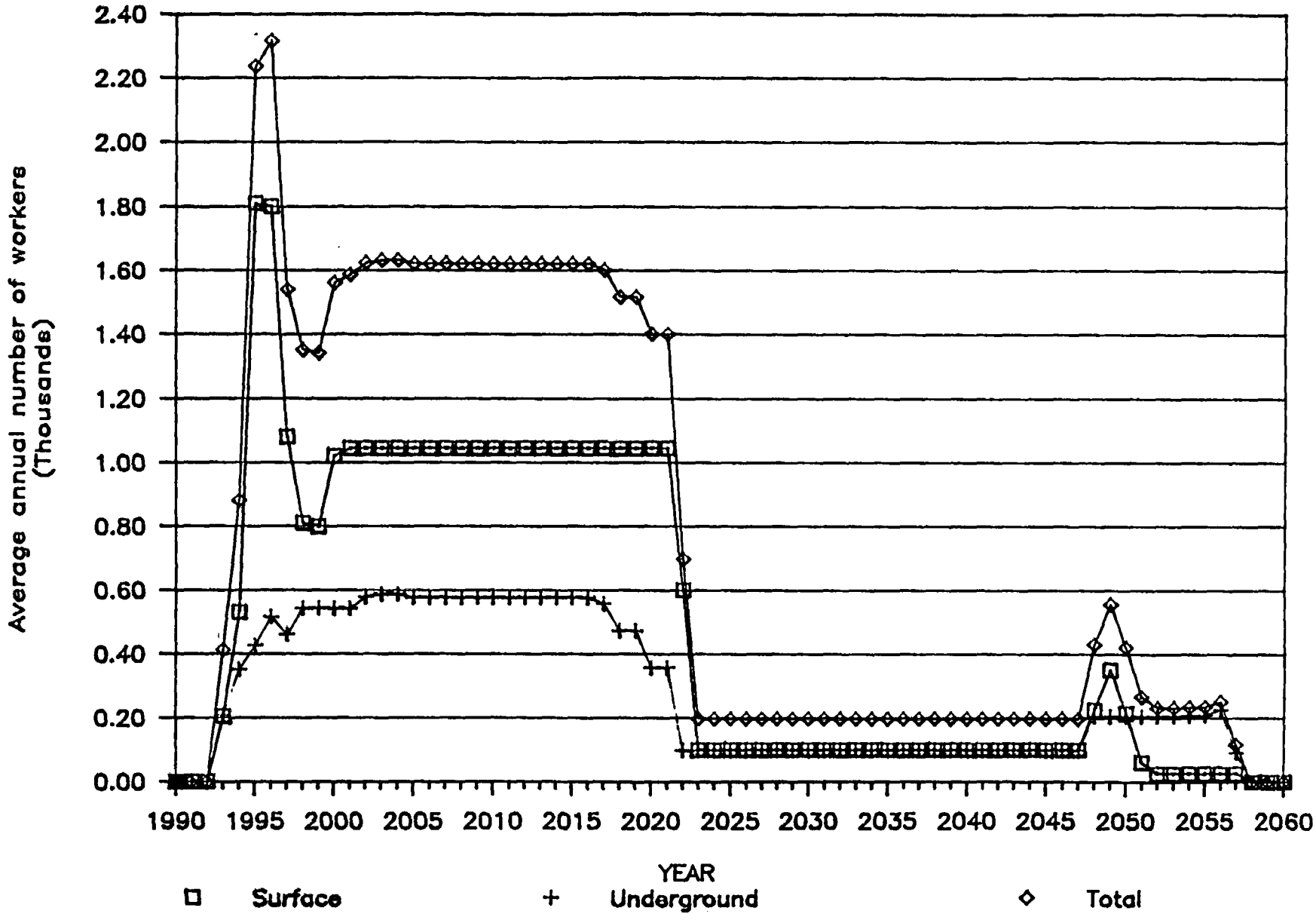

Figure 5-1. Repository Workers--Vertical Emplacement

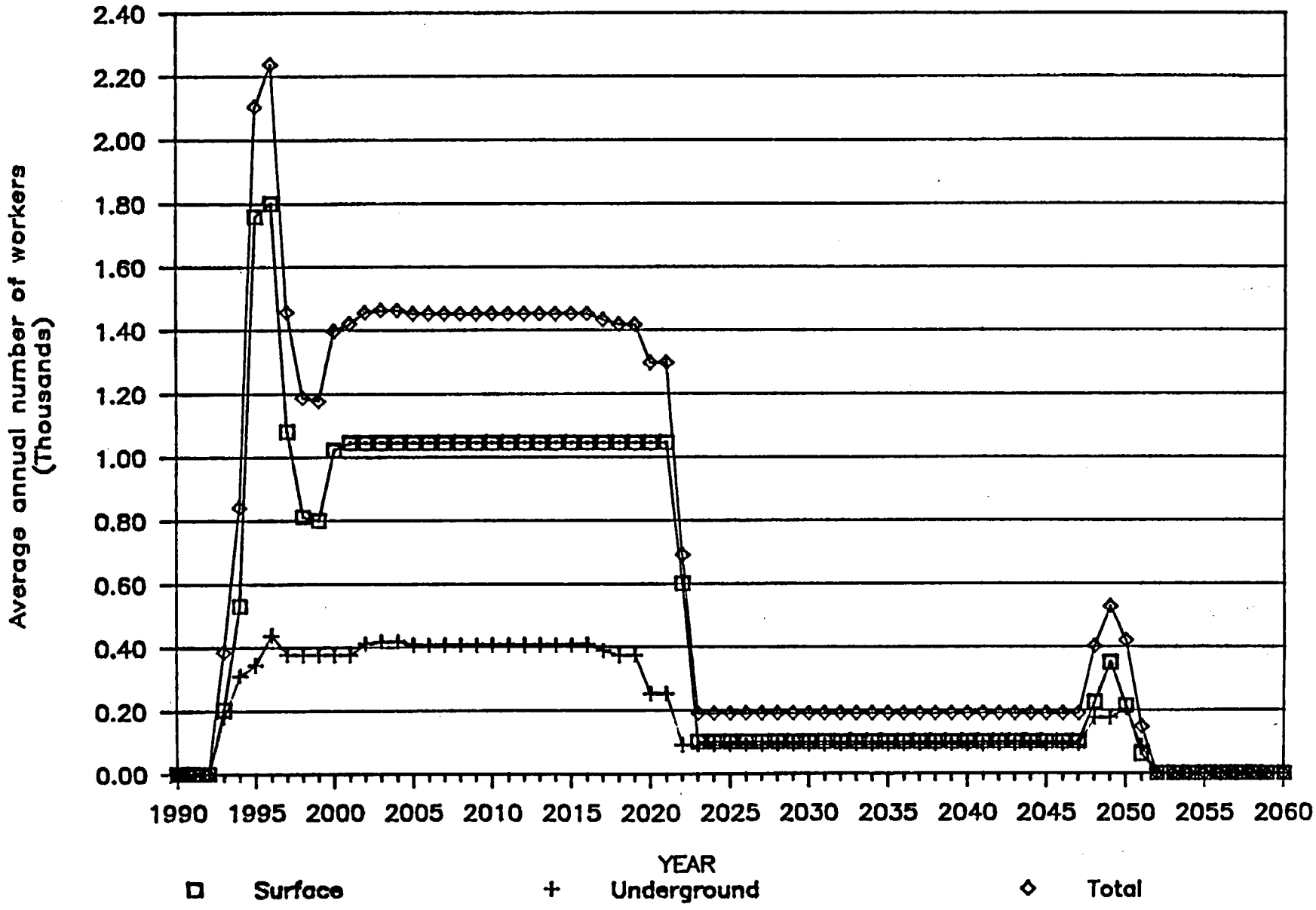

Figure 5-2. Repository Workers--Horizontal Emplacement

6.0 REFERENCES

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APPENDIX A

COST DETAILS

APPENDIX A

Cost Details

Tables A-1 and A-2 list the total costs by life-cycle phase for all applicable cost accounts for vertical and horizontal emplacement, respectively.

The structure and format of the cost code of accounts follow cost estimating guidelines set forth by DOE (1986). The WBS/DAS column refers to the design activities structure (DOE, 1984).

Costs are reported for the level of detail at which they were estimated. In subaccounts that are left blank, the functions or facilities are included in an account at a higher level, or the accounts do not apply to the current tuff repository design. Accounts that do not apply to a particular phase of the current repository design are designated by "xxxxxx."

TABLE A-1

Printed: 13-Mar-87
Data Date: 24-Nov-86

TUFF REPOSITORY LIFE CYCLE COST--VERTICAL EMPLACEMENT OPTION
(Millions of 1986 dollars)

WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO & DEC.	TOTAL
4.1		MANAGEMENT AND INTEGRATION	$346.04	$22.54	$26.54	$49.08	$13.35	$6.46	$19.81	$414.93
	1000	SUPPORT CONTRACTOR	$54.23				$2.67	$0.84	$3.51	$57.74
	1010	Surface	$40.52					$0.84	$0.84	$41.36
	1020	Subsurface	$13.71				$2.67		$2.67	$16.38
	2000	ARCHITECT-ENGINEER	$216.89	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$10.68	$3.37	$14.05	$230.94
	2010	Surface	$162.07	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		$3.37	$3.37	$165.44
	2020	Subsurface	$54.82	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$10.68		$10.68	$65.50
	3000	CONSTRUCTION MANAGEMENT	$73.92					$2.25	$2.25	$76.17
	3010	Surface	$53.30	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		$2.25	$2.25	$55.55
	3020	Subsurface	$20.62							$20.62
4.1.0.6	4000	CONSULTANTS'		$3.54	$0.54	$4.08				$4.08
	5000	PERFORMANCE CONFIRMATION PROGRAM		$19.00	$26.00	$45.00				$45.00
8.3	7000	REPOSITORY LAND AQUISITION	$1.00	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$1.00
4.3.1	10000	SITE PREPARATION	$167.40	$97.70	$16.25	$113.95	$0.27	$37.57	$37.84	$319.19
	11000	EMPLOYEE TRANSPORTATION		$90.41	$13.82	$104.23				$104.23
4.3.1.2	12000	ON-SITE	$29.77	$7.29	$2.43	$9.72	$0.27	$4.82	$5.09	$44.58
4.3.1.2.1	12010	Roads	$4.40							$4.40
4.3.1.2.2	12020	Rail	$2.76							$2.76
4.3.1.2.3	12030	Communications	$0.38							$0.38
4.3.1.2.4	12040	Clearing	$1.87	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			$1.87
4.3.1.2.5	12050	Grading	$3.96	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			$3.96
4.3.1.2.6	12060	Landscaping	$0.21							$0.21
4.3.1.2.7	12070	Drainage Control	$0.82							$0.82
4.3.1.2.8	12080	Fencing	$1.09							$1.09
4.3.1.2.9	12090	Utilities	$14.21							$14.21
	12091	Potable Water								
	12092	Industrial Water								
	12093	Sewage								
	12094	Effluent (Water Treatment)								
	12095	Electrical								
	12096	Steam								
	12097	Compressed Air								
	12098	Fuel Distribution System								
	12099	Gas Storage and Dist. System (LP-Natural)								
4.3.1.2.11	12100	Other	$0.07							$0.07
	12101	Heliport	$0.07							$0.07
	12102	(Specify)								
4.3.1.3	13000	OFF-SITE	$137.63							$137.63
4.3.1.3.1	13010	Roads	$17.31							$17.31
	13011	New Construction	$10.78							$10.78
	13012	Improvements		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			
	13013	Bridges	$6.53							$6.53
	13014	Tunnels								
4.3.1.3.2	13020	Rail	$116.04							$116.04
	13021	New Construction	$116.04							$116.04
	13022	Improvements		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			
	13023	Bridges								
	13024	Tunnels								
4.3.1.3.3	13030	Communications								
4.3.1.3.4	13040	Drainage								

TABLE A-1 (Continued)

Printed: 13-Mar-87
Data Date: 24-Nov-86

TUFF REPOSITORY LIFE CYCLE COST--VERTICAL EMPLACEMENT OPTION
(Millions of 1986 dollars)

WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
4.3.1.3.5	13050	Utilities	$4.28							$4.28
	13051	Water Supply								
	13053	Electrical								
	13054	Gas/Fuel/Oil/Coal								
4.3.1.3.6	13060	Other								
	14000	MONUMENTS	XXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$32.75	$32.75	$32.75
4.3.2	20000	SURFACE FACILITIES:	$617.92	$2,205.10	$226.92	$2,432.02	$37.54	$40.58	$78.12	$3,126.06
4.3.2.1	21000	WASTE HANDLING FACILITY	$487.96	$1,204.89	$36.72	$1,241.61	XXXXXXXXXXX	$33.58	$33.58	$1,763.15
	21100	Waste Handling Building 1:	$101.56				XXXXXXXXXXX	$7.83	$7.83	$109.39
4.3.2.1.2	21102	Building/Structures	$54.31				XXXXXXXXXXX			$54.31
4.3.2.1.3	21103	Hot Cell	$10.78				XXXXXXXXXXX			$10.78
4.3.2.1.4	21104	Utilities	$8.42				XXXXXXXXXXX			$8.42
4.3.2.1.5	21105	HVAC	$5.28				XXXXXXXXXXX			$5.28
4.3.2.1.6	21106	Handling/Packaging Equipment	$19.69				XXXXXXXXXXX			$19.69
4.3.2.1.7	21107	Support Facilities	$3.08				XXXXXXXXXXX			$3.08
	21200	Waste Handling Building 2:	$342.58				XXXXXXXXXXX	$21.67	$21.67	$364.25
4.3.2.1.9	21202	Building/Structures	$150.88				XXXXXXXXXXX			$150.88
4.3.2.1.10	21203	Hot Cell	$39.86				XXXXXXXXXXX			$39.86
4.3.2.1.11	21204	Utilities	$20.33				XXXXXXXXXXX			$20.33
4.3.2.1.12	21205	HVAC	$12.21				XXXXXXXXXXX			$12.21
4.3.2.1.13	21206	Handling/Packaging Equipment	$111.77				XXXXXXXXXXX			$111.77
4.3.2.1.14	21207	Support Facilities	$7.53				XXXXXXXXXXX			$7.53
	21500	Other	$43.82				XXXXXXXXXXX	$4.08	$4.08	$47.90
4.3.2.1.15	21501	Site-Generated Radwaste Treatment Facility	$19.75				XXXXXXXXXXX	$1.71	$1.71	$21.46
	21502	Vehicle Wash Facility	$0.88				XXXXXXXXXXX	$0.07	$0.07	$0.95
	21503	Decontamination Building	$3.28				XXXXXXXXXXX	$0.24	$0.24	$3.52
	21504		$19.91				XXXXXXXXXXX	$2.06	$2.06	$21.97
4.3.2.1.16	21505	Radwaste Storage					XXXXXXXXXXX			
4.3.2.2	22000	BALANCE OF PLANT	$85.67	$977.43	$176.98	$1,154.41	$29.01	$4.43	$33.44	$1,273.52
4.3.2.2.1	22010	Health/Medical Facilities	$2.88					$0.18	$0.18	$3.06
4.3.2.2.2	22020	Fire Protection Facilities	$1.43					$0.14	$0.14	$1.57
4.3.2.2.3	22030	Security Facilites	$3.26					$0.23	$0.23	$3.49
4.3.2.2.4	22040	Maintenance Facilities	$6.57					$0.64	$0.64	$7.21
4.3.2.2.5	22050	Administration/Personnel Facilities	$11.53					$1.05	$1.05	$12.58
4.4.0.1.4	22060	Training/Mockup Facility	$3.32					$0.29	$0.29	$3.61
4.3.2.2.7	22070	Warehouse and Receiving	$11.76					$0.57	$0.57	$12.33
4.3.2.2.8	22080	Visitors Center Facility	$0.71					$0.07	$0.07	$0.78
4.3.2.2.9	22090	Backup Power Generation Facility	$5.64					$0.15	$0.15	$5.79
4.3.2.2.10	22100	Change Room Facility	$1.85					$0.20	$0.20	$2.05
4.3.2.2.11	22110	Explosive Storage Facility	$0.12					$0.02	$0.02	$0.14
4.3.2.2.12	22120	Compressed Air and Steam Facility								
4.3.2.2.13	22130	Cooling Tower and Chilled Water Facility	$0.93				$12.60	$0.02	$12.62	$13.55
4.3.2.2.14	22140	Excavated Material Storage and Handling Facility	$6.20					$0.27	$0.27	$6.47
	22141	Surface Excavated Material Storage/Handling	$6.20					$0.27	$0.27	$6.47
	22142	Offsite Excavated Material Disposal								
4.3.2.2.15	22150	Fuel Storage Facility								
4.3.2.2.16	22160	Chemical Storage Facility								
4.3.2.2.6	22170	Lab and Testing Facilities								
4.3.2.2.18	22180	Potable Water Facility								
4.3.2.2.19	22190	Sewage Treatment Facility	$1.56					$0.15	$0.15	$1.71

TABLE A-1 (Continued)

Printed: 13-Mar-87
Data Date: 24-Nov-86

TUFF REPOSITORY LIFE CYCLE COST--VERTICAL EMPLACEMENT OPTION
(Millions of 1986 dollars)

WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
4.3.2.2.20	22200	Backfill Facility								
4.3.2.2.21	22210	Packing Facility								
4.3.2.2.17	22220	Control and Monitoring Facility	$19.22					$0.33	$0.33	$19.55
	22221	Facilities								
	22222	Computer Equipment								
	22230	Standard Equipment	$6.42							$6.42
	22240	Other	$2.27					$0.12	$0.12	$2.39
	22241	Solid Waste								
	22242	Batch Plant	$2.27					$0.12	$0.12	$2.39
	22243	(Specify)								
	23000	SURFACE SHAFT FACILITIES	$44.29	$22.78	$13.22	$36.00	$8.53	$2.57	$11.10	$91.39
	23010	Men and Materials Facility	$12.80	$21.87	$12.23	$34.10	$8.20	$0.64	$8.84	$55.74
	23011	Headframe	$5.95	$21.87	$12.23	$34.10	$8.20		$8.20	$48.25
	23012	Hoist House	$0.6[illegible]					$0.09	$0.09	$0.71
	23013	Ventilation Building	$6.23					$0.55	$0.55	$6.78
	23014	Heating/Cooling Building								
	23015	Other								
	23020	Waste Facility								
	23021	Headframe								
	23022	Hoist House								
	23023	Ventilation Building								
	23024	Heating/Cooling Building								
	23025	Other								
	23030	Excavated Material Handling Facility								
	23031	Headframe								
	23032	Hoist House								
	23033	Ventilation Building								
	23034	Heating/Cooling Building								
	23035	Other								
	23040	Developement Intake Facility								
	23043	Ventilation Building								
	23044	Heating/Cooling Building								
	23045	Other								
	23050	Confinement Intake Facility - 1								
	23053	Ventilation Building								
	23054	Heating/Cooling Building								
	23055	Other								
	23060	Confinement Intake Facility - 2								
	23063	Ventilation Building								
	23064	Heating/Cooling Building								
	23065	Other								
	23070	Developement Exhaust Facility								
	23073	Ventilation Building								
	23074	Heating/Cooling Building								
	23075	Other								
	23080	Confinement Exhaust Facility - 1	$29.49	$0.31	$0.34	$0.65	$0.12	$1.93	$2.05	$32.18
	23083	Ventilation Building	$29.02					$1.93	$1.93	$30.95
	23084	Heating/Cooling Building								
	23085	Other	$0.47	$0.31	$0.34	$0.65	$0.12		$0.12	$1.23
	23090	Confinement Exhaust Facility - 2								
	23093	Ventilation Building								

TABLE A-1 (Continued)

Printed: 13-Mar-87
Data Date: 24-Nov-86

TUFF REPOSITORY LIFE CYCLE COST--VERTICAL EMPLACEMENT OPTION
(Millions of 1986 dollars)

WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
	23094	Heating/Cooling Building								
	23095	Other								
	23100	Exploratory Shaft Facility - 1	$1.95	$0.30	$0.33	$0.63	$0.11		$0.11	$2.69
	23101	Headframe								
	23102	Hoist House								
	23103	Ventilation Building								
	23104	Heating/Cooling Building								
	23105	Other	$1.95	$0.30	$0.33	$0.63	$0.11		$0.11	$2.69
	23110	Exploratory Shaft Facility - 2	$0.06	$0.30	$0.33	$0.63	$0.10		$0.10	$0.78
	23111	Headframe								
	23112	Hoist House								
	23113	Ventilation Building								
	23114	Heating/Cooling Building								
	23115	Other	$0.06	$0.30	$0.33	$0.63	$0.10		$0.10	$0.78
	23120	Other Facility								
	23121	Headframe								
	23122	Hoist House								
	23123	Ventilation Building								
	23124	Heating/Cooling Building								
	23125	Other								
4.3.3	30000	SHAFTS/RAMPS - UNDERGROUND	$61.61	$13.80	$14.74	$28.34	$3.00	XXXXXXXXXXX	$3.00	$92.95
4.3.3.1	30010	Men and Materials Access (Shaft)	$21.89	$6.25	$5.69	$10.03	$1.48	XXXXXXXXXXX	$1.48	$34.30
4.3.3.1.2	30012	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.1.3	30013	Lining						XXXXXXXXXXX		
4.3.3.1.4	30014	Fixtures						XXXXXXXXXXX		
	30015	Shaft Stations						XXXXXXXXXXX		
	30016	Other (Specify)						XXXXXXXXXXX		
4.3.3.2	30020	Waste Handling Access (Waste Ramp)	$8.50					XXXXXXXXXXX		$8.50
4.3.3.2.2	30022	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.2.3	30023	Lining						XXXXXXXXXXX		
4.3.3.2.4	30024	Fixtures						XXXXXXXXXXX		
	30025	Shaft Stations						XXXXXXXXXXX		
	30026	Other (Specify)						XXXXXXXXXXX		
4.3.3.3	30030	Excavated Material Handling Access (Tuff Ramp)	$6.54					XXXXXXXXXXX		$6.54
4.3.3.3.2	30032	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.3.3	30033	Lining						XXXXXXXXXXX		
4.3.3.3.4	30034	Fixtures						XXXXXXXXXXX		
	30035	Shaft Stations						XXXXXXXXXXX		
	30036	Other (Specify)						XXXXXXXXXXX		
	30040	Development Intake Access (Shaft)						XXXXXXXXXXX		
4.3.3.4.2	30042	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.4.3	30043	Lining						XXXXXXXXXXX		
4.3.3.4.4	30044	Fixtures						XXXXXXXXXXX		
	30045	Shaft Stations						XXXXXXXXXXX		
	30046	Other (Specify)						XXXXXXXXXXX		
	30050	Confinement Intake Access - 1 (Shaft)						XXXXXXXXXXX		
4.3.3.4.2	30052	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.4.3	30053	Lining						XXXXXXXXXXX		
4.3.3.4.4	30054	Fixtures						XXXXXXXXXXX		
	30055	Shaft Stations						XXXXXXXXXXX		

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TUFF REPOSITORY LIFE CYCLE COST--VERTICAL EMPLACEMENT OPTION
(Millions of 1986 dollars)

WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
	30056	Other (Specify)						XXXXXXXXXXX		
	30060	Confinement Intake Access - 2 (Shaft)						XXXXXXXXXXX		
4.3.3.4.2	30062	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.4.3	30063	Lining						XXXXXXXXXXX		
4.3.3.4.4	30064	Fixtures						XXXXXXXXXXX		
	30065	Shaft Stations						XXXXXXXXXXX		
4.3.3.5	30066	Other (Specify)						XXXXXXXXXXX		
	30070	Development Exhaust Access (Shaft)						XXXXXXXXXXX		
4.3.3.5.2	30072	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.5.3	30073	Lining						XXXXXXXXXXX		
4.3.3.5.4	30074	Fixtures						XXXXXXXXXXX		
	30075	Shaft Stations						XXXXXXXXXXX		
	30076	Other (Specify)						XXXXXXXXXXX		
	30080	Confinement Exhaust Access - 1 (Shaft)	$21.46	$4.26	$4.62	$8.88	$0.80	XXXXXXXXXXX	$0.80	$31.13
4.3.3.5.2	30082	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.5.3	30083	Lining						XXXXXXXXXXX		
4.3.3.5.4	30084	Fixtures						XXXXXXXXXXX		
	30085	Shaft Stations						XXXXXXXXXXX		
	30086	Other (Specify)						XXXXXXXXXXX		
	30090	Confinement Exhaust Access - 2 (Shaft)						XXXXXXXXXXX		
4.3.3.5.2	30092	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.5.3	30093	Lining						XXXXXXXXXXX		
4.3.3.5.4	30094	Fixtures						XXXXXXXXXXX		
	30095	Shaft Stations						XXXXXXXXXXX		
	30096	Other (Specify)						XXXXXXXXXXX		
	30100	Exploratory Shaft - 1	$2.86	$2.05	$2.22	$4.26	$0.38	XXXXXXXXXXX	$0.38	$7.50
4.3.3.5.3	30103	Lining						XXXXXXXXXXX		
4.3.3.5.4	30104	Fixtures						XXXXXXXXXXX		
	30105	Shaft Stations						XXXXXXXXXXX		
	30106	Other (Specify)	$2.86	$2.05	$2.22	$4.26	$0.38	XXXXXXXXXXX	$0.38	$7.50
	30110	Exploratory Shaft - 2	$0.38	$2.05	$2.22	$4.26	$0.34	XXXXXXXXXXX	$0.34	$4.98
4.3.3.5.3	30113	Lining						XXXXXXXXXXX		
4.3.3.5.4	30114	Fixtures						XXXXXXXXXXX		
	30115	Shaft Stations						XXXXXXXXXXX		
	30116	Other (Specify)	$0.38	$2.05	$2.22	$4.26	$0.34	XXXXXXXXXXX	$0.34	$4.98
	30120	Other						XXXXXXXXXXX		
	30122	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	30123	Lining						XXXXXXXXXXX		
	30124	Fixtures						XXXXXXXXXXX		
	30125	Shaft Stations						XXXXXXXXXXX		
	30126	Other (Specify)						XXXXXXXXXXX		
4.3.4	40000	SUBSURFACE EXCAVATIONS	$136.01	$795.92	$41.72	$837.64	$100.55	XXXXXXXXXXX	$100.55	$1,074.20
4.3.4.1	41000	DEVELOPMENT	$116.32	$613.42	$39.54	$652.96	$12.81	XXXXXXXXXXX	$12.81	$782.10
	41010	Common Facility (Shaft Pillar) Excavation	$14.56		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$14.56
	41011	Main Drifts	$5.31		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$5.31
	41012	Ventilation Drifts	$4.62		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$4.62
	41013	Support Facilities	$4.20		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$4.20
	41014	Training Areas	$0.22		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.22
	41015	Performance Confirmation	$0.20		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.20
	41020	Spent Fuel Facility Excavation	$73.00	$412.05	XXXXXXXXXXX	$412.05	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$485.05

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WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
	41021	Main Drifts	$9.70	$13.58	XXXXXXXXXXX	$13.58	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$23.28
	41022	Access Drifts	$11.57	$44.58	XXXXXXXXXXX	$44.58	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$56.15
	41023	Ventilation Drifts	$10.73	$21.22	XXXXXXXXXXX	$21.22	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$31.95
	41024	Emplacement Drifts	$22.42	$164.28	XXXXXXXXXXX	$164.28	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$186.71
	41025	Emplacement Borehole Drilling/Lining	$18.58	$168.39	XXXXXXXXXXX	$168.39	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$186.97
	41030	DHLW Facility Excavation	$5.18	$99.85	XXXXXXXXXXX	$99.85	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$105.03
	41031	Main Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41032	Access Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41033	Ventilation Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41034	Emplacement Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41035	Emplacement Borehole Drilling/Lining	$5.18	$99.85	XXXXXXXXXXX	$99.85	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$105.03
	41040	Other Waste Facility Excavation	$3.25	$9.58	XXXXXXXXXXX	$9.58	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$12.83
	41041	Main Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41042	Access Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41043	Ventilation Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41044	Emplacement Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41045	Emplacement Borehole Drilling/Lining	$3.25	$9.58	XXXXXXXXXXX	$9.58	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$12.83
	41050	Re-excavation						XXXXXXXXXXX		
	41051	Main Drifts						XXXXXXXXXXX		
	41052	Access Drifts						XXXXXXXXXXX		
	41053	Ventilation Drifts						XXXXXXXXXXX		
	41054	Other						XXXXXXXXXXX		
	41060	Excavated Material Handling	$11.86	$29.08		$29.08		XXXXXXXXXXX		$40.94
	41070	General Maintenance	$8.48	$62.86	$39.54	$102.40	$12.81	XXXXXXXXXXX	$12.81	$123.69
4.3.4.2	42000	EMPLACEMENT/RETRIEVAL OPERATIONS	$19.69	$182.49	$2.18	$184.67	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$204.36
	42010	Spent Fuel Waste Transport and Emplacement	$9.97	$109.29		$109.29	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$119.26
	42011	Underground Transport					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42012	Emplacement					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42013	Borehole Closure (shield plug/backfill)	XXXXXXXXXXXXX				XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42020	DHLW Transport and Emplacement	$5.98	$65.36		$65.36	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$71.34
	42021	Underground Transport					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42022	Emplacement					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42023	Borehole Closure (shield plug/backfill)	XXXXXXXXXXXXX				XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42030	Other Waste Transport and Emplacement	$3.73	$6.26		$6.26	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$9.99
	42031	Underground Transport					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42032	Emplacement					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42033	Borehole Closure (shield plug/backfill)	XXXXXXXXXXXXX				XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42040	Waste Retrieval		$1.59	$2.18	$3.77	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$3.77
4.3.4.3	43000	BACKFILL	XXXXXXXXXXXXX				$87.74	XXXXXXXXXXX	$87.74	$87.74
	43010	Men and Materials Access (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$4.70	XXXXXXXXXXX	$4.70	$4.70
	43020	Waste Handling Access (Shaft or Ramp)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$2.87	XXXXXXXXXXX	$2.87	$2.87
	43030	Muck Handling Access (Shaft or Ramp)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$1.60	XXXXXXXXXXX	$1.60	$1.60
	43040	Development Intake Access (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43050	Confinement Intake Access - 1 (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43060	Confinement Intake Access - 2 (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43070	Development Exhaust Access (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43080	Confinement Exhaust Access - 1 (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.57	XXXXXXXXXXX	$0.57	$0.57
	43090	Confinement Exhaust Access - 2 (Shaft)	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43100	Exploratory Shaft - 1	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.55	XXXXXXXXXXX	$0.55	$0.55
	43110	Exploratory Shaft - 2	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.12	XXXXXXXXXXX	$0.12	$0.12
	43120	Other Shaft	XXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		

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TUFF REPOSITORY LIFE CYCLE COST--VERTICAL EMPLACEMENT OPTION
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WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING & CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
	43300	Development Areas	XXXXXXXXXXXX				$77.34	XXXXXXXXXXX	$77.34	$77.34
	43301	Common Areas	XXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43302	Spent Fuel Panels	XXXXXXXXXXXX					XXXXXXXXXXX		
	43303	DHLW Panels	XXXXXXXXXXXX					XXXXXXXXXXX		
	43304	Other Waste Panels	XXXXXXXXXXXX					XXXXXXXXXXX		
4.3.5	50000	UNDERGROUND SERVICE SYSTEMS	$88.49	$572.53	$171.74	$744.27	$131.63	XXXXXXXXXXX	$131.63	$964.39
4.3.5.1	51000	SUPPORT SYSTEM FACILITIES	$68.66	$450.76	$101.59	$552.35	$67.27	XXXXXXXXXXX	$67.27	$688.29
4.3.5.1.1	51010	Material Support, Receiving/warehousing	$12.29	$41.07	$18.01	$59.08	$11.05	XXXXXXXXXXX	$11.05	$82.42
	51011	Facilities	$7.97	$41.07	$18.01	$59.08	$11.05	XXXXXXXXXXX	$11.05	$78.10
	51012	Initial Inventory	$4.32					XXXXXXXXXXX		$4.32
4.3.5.1.2	51020	Equipment Fuel Facility						XXXXXXXXXXX		
4.3.5.1.3	51030	Maintenance Facility	$33.26	$282.94	$27.80	$310.75	$18.05	XXXXXXXXXXX	$18.05	$362.06
	51031	Development Area	$32.30	$186.84	$20.37	$207.21	$18.05	XXXXXXXXXXX	$18.05	$257.56
	51032	Emplacement Area	$0.96	$96.10	$7.44	$103.54		XXXXXXXXXXX		$104.50
4.3.5.1.4	51040	Emergency Medical/Rescue Chamber	$3.05	$14.58	$1.59	$16.17	$5.46	XXXXXXXXXXX	$5.46	$24.68
4.3.5.1.5	51050	Ventilation System (Waste Emplacement)	$0.94	$22.00	$8.17	$30.17	$19.73	XXXXXXXXXXX	$19.73	$50.84
4.3.5.1.6	51060	Ventilation System (Mine Development)	$6.63	$34.60		$34.60		XXXXXXXXXXX		$41.24
4.3.5.1.7	51070	Mine Water Control System	$1.12	$6.94	$7.52	$14.46	$2.60	XXXXXXXXXXX	$2.60	$18.18
4.3.5.1.8	51080	Fire Protection/Control	$0.46	$0.83	$0.56	$1.40	$0.31	XXXXXXXXXXX	$0.31	$2.17
4.3.5.1.9	51090	Operations Support Facility	$1.44	$3.91	$1.65	$5.56	$1.43	XXXXXXXXXXX	$1.43	$8.43
4.3.5.1.10	51100	Contamination Control System	$7.79	$25.26	$16.12	$41.38	$8.63	XXXXXXXXXXX	$8.63	$57.80
4.3.5.1.11	51110	Control Room Facility	$1.69	$18.62	$20.17	$38.79		XXXXXXXXXXX		$40.48
4.3.5.2	52000	UTILITIES	$8.92	$25.93	$21.86	$47.80	$50.64	XXXXXXXXXXX	$50.64	$107.36
4.3.5.2.1	52010	Electrical	$7.19	$18.38	$8.19	$26.57	$10.06	XXXXXXXXXXX	$10.06	$43.83
4.3.5.2.2	52020	Communications	$0.19	$1.24	$1.78	$3.01	$0.32	XXXXXXXXXXX	$0.32	$3.52
4.3.5.2.3	52030	Compressed Air						XXXXXXXXXXX		
4.3.5.2.4	52040	Chilled Water	$1.08	$4.95	$11.89	$16.85	$40.26	XXXXXXXXXXX	$40.26	$58.18
4.3.5.2.5	52050	Water	$0.46	$1.36		$1.36		XXXXXXXXXXX		$1.83
4.3.5.2.6	52060	Other (Specify)						XXXXXXXXXXX		
4.3.5.3	53000	MONITORING	$10.90	$95.84	$48.28	$144.12	$13.72	XXXXXXXXXXX	$13.72	$168.74
4.3.5.3.1	53010	Radiological Monitoring						XXXXXXXXXXX		
4.3.5.3.2	53020	Occupational Monitoring						XXXXXXXXXXX		
4.3.5.3.3	53030	Performance Confirmation Monitoring						XXXXXXXXXXX		
2.4	60000	WASTE PACKAGE FABRICATION	XXXXXXXXXXXX	$599.04	$4.32	$603.36	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$603.36
	61000	SPENT FUEL	XXXXXXXXXXXX	$350.96		$350.96	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$350.96
	61010	Intact PWR	XXXXXXXXXXXX	$46.07		$46.07	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$46.07
	61020	Intact BWR	XXXXXXXXXXXX	$41.90		$41.90	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$41.90
	61030	Consolidated PWR	XXXXXXXXXXXX	$168.69		$168.69	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$168.69
	61040	Consolidated BWR	XXXXXXXXXXXX	$94.30		$94.30	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$94.30
	62000	DHLW	XXXXXXXXXXXX	$127.71		$127.71	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$127.71
	63000	OTHER WASTE	XXXXXXXXXXXX	$120.37	$4.32	$124.69	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$124.69
	63010	Spent Fuel Hardware	XXXXXXXXXXXX	$12.40		$12.40	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$12.40
	63020	High Activity (Remote-Handled)	XXXXXXXXXXXX	$3.16	$4.32	$7.48	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$7.48
	63030	WVHLW and CHLW	XXXXXXXXXXXX	$2.69		$2.69	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$2.69
	63040	Contact-Handled	XXXXXXXXXXXX	$102.12		$102.12	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$102.12
	99999	TOTAL REPOSITORY	$1,417.47	$4,306.43	$502.22	$4,808.65	$286.34	$84.61	$370.95	$6,597.07

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4.1	0000	MANAGEMENT AND INTEGRATION	$329.19	$22.12	$26.52	$48.64	$4.67	$6.46	$11.13	$388.96
	1000	SUPPORT CONTRACTOR	$51.57				$0.93	$0.84	$1.77	$53.34
	1010	Surface	$39.94					$0.84	$0.84	$40.78
	1020	Subsurface	$11.63				$0.93		$0.93	$12.56
	2000	ARCHITECT-ENGINEER	$206.26	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$3.74	$3.37	$7.11	$213.36
	2010	Surface	$189.75	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		$3.37	$3.37	$163.12
	2020	Subsurface	$46.51	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$3.74		$3.74	$50.24
	3000	CONSTRUCTION MANAGEMENT	$70.37					$2.25	$2.25	$72.62
	3010	Surface	$52.57	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		$2.25	$2.25	$54.82
	3020	Subsurface	$17.80							$17.80
4.1.0.6	4000	CONSULTANTS		$3.12	$0.52	$3.64				$3.64
	5000	PERFORMANCE CONFIRMATION PROGRAM		$19.00	$26.00	$45.00				$45.00
8.3	7000	REPOSITORY LAND AQUISITION	$1.00	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$1.00
4.3.1	10000	SITE PREPARATION	$167.40	$88.20	$15.71	$103.91	$0.06	$37.57	$37.63	$308.94
	11000	EMPLOYEE TRANSPORTATION		$80.91	$13.28	$94.19				$94.19
4.3.1.2	12000	ON-SITE	$29.77	$7.29	$2.43	$9.72	$0.06	$4.82	$4.88	$44.37
4.3.1.2.1	12010	Roads	$4.40							$4.40
4.3.1.2.2	12020	Rail	$2.76							$2.76
4.3.1.2.3	12030	Communications	$0.38							$0.38
4.3.1.2.4	12040	Clearing	$1.87	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			$1.87
4.3.1.2.5	12050	Grading	$3.96	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			$3.96
4.3.1.2.6	12060	Landscaping	$0.21							$0.21
4.3.1.2.7	12070	Drainage Control	$0.82							$0.82
4.3.1.2.8	12080	Fencing	$1.09							$1.09
4.3.1.2.9	12090	Utilities	$14.21							$14.21
	12091	Potable Water								
	12092	Industrial Water								
	12093	Sewage								
	12094	Effluent (Water Treatment)								
	12095	Electrical								
	12096	Steam								
	12097	Compressed Air								
	12098	Fuel Distribution System								
	12099	Gas Storage and Dist. System (LP-Natural)								
4.3.1.2.11	12100	Other	$0.07							$0.07
	12101	Heliport	$0.07							$0.07
	12102	(Specify)								
4.3.1.3	13000	OFF-SITE	$137.63							$137.63
4.3.1.3.1	13010	Roads	$17.31							$17.31
	13011	New Construction	$10.78							$10.78
	13012	Improvements		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			
	13013	Bridges	$6.53							$6.53
	13014	Tunnels								
4.3.1.3.2	13020	Rail	$116.04							$116.04
	13021	New Construction	$116.04							$116.04
	13022	Improvements		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX			
	13023	Bridges								
	13024	Tunnels								
4.3.1.3.3	13030	Communications								
4.3.1.3.4	13040	Drainage								

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WBS/DAS CODE	COST CODE	COST ACCOUNT TITLE	ENGINEERING CONSTRUCTION	EMPLACEMENT OPERATIONS	CARETAKER OPERATIONS	SUBTOTAL OPERATIONS	CLOSURE	DECOMMIS-SIONING	SUBTOTAL CLO. & DEC.	TOTAL
4.3.1.3.5	13050	Utilities	$4.28							$4.28
	13051	Water Supply								
	13053	Electrical								
	13054	Gas/Fuel/Oil/Coal								
4.3.1.3.6	13060	Other								
	14000	MONUMENTS	XXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$32.75	$32.75	$32.75
4.3.2	20000	SURFACE FACILITIES:	$607.54	$2,205.10	$226.92	$2,432.02	$6.50	$40.58	$47.08	$3,086.64
4.3.2.1	21000	WASTE HANDLING FACILITY	$487.96	$1,204.89	$36.72	$1,241.61	XXXXXXXXXXX	$33.58	$33.58	$1,763.15
	21100	Waste Handling Building 1:	$101.56				XXXXXXXXXXX	$7.83	$7.83	$109.39
4.3.2.1.2	21102	Building/Structures	$54.31				XXXXXXXXXXX			$54.31
4.3.2.1.3	21103	Hot Cell	$10.78				XXXXXXXXXXX			$10.78
4.3.2.1.4	21104	Utilities	$8.42				XXXXXXXXXXX			$8.42
4.3.2.1.5	21105	HVAC	$5.28				XXXXXXXXXXX			$5.28
4.3.2.1.6	21106	Handling/Packaging Equipment	$19.69				XXXXXXXXXXX			$19.69
4.3.2.1.7	21107	Support Facilities	$3.08				XXXXXXXXXXX			$3.08
	21200	Waste Handling Building 2:	$342.58				XXXXXXXXXXX	$21.67	$21.67	$364.25
4.3.2.1.9	21202	Building/Structures	$150.88				XXXXXXXXXXX			$150.88
4.3.2.1.10	21203	Hot Cell	$39.86				XXXXXXXXXXX			$39.86
4.3.2.1.11	21204	Utilities	$20.33				XXXXXXXXXXX			$20.33
4.3.2.1.12	21205	HVAC	$12.21				XXXXXXXXXXX			$12.21
4.3.2.1.13	21206	Handling/Packaging Equipment	$111.77				XXXXXXXXXXX			$111.77
4.3.2.1.14	21207	Support Facilities	$7.53				XXXXXXXXXXX			$7.53
	21500	Other	$43.82				XXXXXXXXXXX	$4.08	$4.08	$47.90
4.3.2.1.15	21501	Site-Generated Radwaste Treatment Facility	$19.75				XXXXXXXXXXX	$1.71	$1.71	$21.46
	21502	Vehicle Wash Facility	$0.88				XXXXXXXXXXX	$0.07	$0.07	$0.95
	21503	Decontamination Building	$3.28				XXXXXXXXXXX	$0.24	$0.24	$3.52
	21504		$19.01				XXXXXXXXXXX	$2.06	$2.06	$21.97
4.3.2.1.16	21505	Radwaste Storage					XXXXXXXXXXX			
4.3.2.2	22000	BALANCE OF PLANT	$84.41	$977.43	$176.98	$1,154.41	$3.65	$4.43	$8.08	$1,246.90
4.3.2.2.1	22010	Health/Medical Facilities	$2.88					$0.18	$0.18	$3.06
4.3.2.2.2	22020	Fire Protection Facilities	$1.43					$0.14	$0.14	$1.57
4.3.2.2.3	22030	Security Facilites	$3.26					$0.23	$0.23	$3.49
4.3.2.2.4	22040	Maintenance Facilities	$6.57					$0.64	$0.64	$7.21
4.3.2.2.5	22050	Administration/Personnel Facilities	$11.53					$1.05	$1.05	$12.58
4.4.0.1.4	22060	Training/Mockup Facility	$3.32					$0.29	$0.29	$3.61
4.3.2.2.7	22070	Warehouse and Receiving	$11.76					$0.57	$0.57	$12.33
4.3.2.2.8	22080	Visitors Center Facility	$0.71					$0.07	$0.07	$0.78
4.3.2.2.9	22090	Backup Power Generation Facility	$5.64					$0.15	$0.15	$5.79
4.3.2.2.10	22100	Change Room Facility	$1.52					$0.20	$0.20	$1.72
4.3.2.2.11	22110	Explosive Storage Facility	$0.12					$0.02	$0.02	$0.14
4.3.2.2.12	22120	Compressed Air and Steam Facility								
4.3.2.2.13	22130	Cooling Tower and Chilled Water Facility						$0.02	$0.02	$0.02
4.3.2.2.14	22140	Excavated Material Storage and Handling Facility	$6.20					$0.27	$0.27	$6.47
	22141	Surface Excavated Material Storage/Handling	$6.20					$0.27	$0.27	$6.47
	22142	Offsite Excavated Material Disposal								
4.3.2.2.15	22150	Fuel Storage Facility								
4.3.2.2.16	22160	Chemical Storage Facility								
4.3.2.2.6	22170	Lab and Testing Facilities								
4.3.2.2.18	22180	Potable Water Facility								
4.3.2.2.19	22190	Sewage Treatment Facility	$1.56					$0.15	$0.15	$1.71

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4.3.2.2.20	22200	Backfill Facility								
4.3.2.2.21	22210	Packing Facility								
4.3.2.2.17	22220	Control and Monitoring Facility	$19.22					$0.33	$0.33	$19.55
	22221	Facilities								
	22222	Computer Equipment								
	22230	Standard Equipment	$6.42							$6.42
	22240	Other	$2.27					$0.12	$0.12	$2.39
	22241	Solid Waste								
	22242	Batch Plant	$2.27					$0.12	$0.12	$2.39
	22243	(Specify)								
	23000	SURFACE SHAFT FACILITIES	$35.17	$22.78	$13.22	$36.00	$2.85	$2.57	$5.42	$76.59
	23010	Man and Materials Facility	$10.79	$21.87	$12.23	$34.10	$2.73	$0.64	$3.37	$48.26
	23011	Headframe	$5.95	$21.87	$12.23	$34.10	$2.73		$2.73	$42.78
	23012	Hoist House	$0.62					$0.09	$0.09	$0.71
	23013	Ventilation Building	$4.22					$0.55	$0.55	$4.77
	23014	Heating/Cooling Building								
	23015	Other								
	23020	Waste Facility								
	23021	Headframe								
	23022	Hoist House								
	23023	Ventilation Building								
	23024	Heating/Cooling Building								
	23025	Other								
	23030	Excavated Material Handling Facility								
	23031	Headframe								
	23032	Hoist House								
	23033	Ventilation Building								
	23034	Heating/Cooling Building								
	23035	Other								
	23040	Developement Intake Facility								
	23043	Ventilation Building								
	23044	Heating/Cooling Building								
	23045	Other								
	23050	Confinement Intake Facility - 1								
	23053	Ventilation Building								
	23054	Heating/Cooling Building								
	23055	Other								
	23060	Confinement Intake Facility - 2								
	23063	Ventilation Building								
	23064	Heating/Cooling Building								
	23065	Other								
	23070	Developement Exhaust Facility								
	23073	Ventilation Building								
	23074	Heating/Cooling Building								
	23075	Other								
	23080	Confinement Exhaust Facility - 1	$22.38	$0.31	$0.34	$0.65	$0.04	$1.93	$1.97	$25.00
	23083	Ventilation Building	$21.91					$1.93	$1.93	$23.84
	23084	Heating/Cooling Building								
	23085	Other	$0.47	$0.31	$0.34	$0.65	$0.04		$0.04	$1.16
	23090	Confinement Exhaust Facility - 2								
	23093	Ventilation Building								

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	23094	Heating/Cooling Building								
	23095	Other								
	23100	Exploratory Shaft Facility - 1	$1.95	$0.30	$0.33	$0.63	$0.04		$0.04	$2.61
	23101	Headframe								
	23102	Hoist House								
	23103	Ventilation Building								
	23104	Heating/Cooling Building								
	23105	Other	$1.95	$0.30	$0.33	$0.63	$0.04		$0.04	$2.61
	23110	Exploratory Shaft Facility - 2	$0.06	$0.30	$0.33	$0.63	$0.04		$0.04	$0.72
	23111	Headframe								
	23112	Hoist House								
	23113	Ventilation Building								
	23114	Heating/Cooling Building								
	23115	Other	$0.06	$0.30	$0.33	$0.63	$0.04		$0.04	$0.72
	23120	Other Facility								
	23121	Headframe								
	23122	Hoist House								
	23123	Ventilation Building								
	23124	Heating/Cooling Building								
	23125	Other								
4.3.3	30000	SHAFTS/RAMPS - UNDERGROUND	$60.08	$13.60	$14.74	$28.34	$0.69	XXXXXXXXXXX	$0.69	$89.10
4.3.3.1	30010	Men and Materials Access (Shaft)	$21.89	$5.25	$5.69	$10.93	$0.16	XXXXXXXXXXX	$0.16	$32.98
4.3.3.1.2	30012	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.1.3	30013	Lining						XXXXXXXXXXX		
4.3.3.1.4	30014	Fixtures						XXXXXXXXXXX		
	30015	Shaft Stations						XXXXXXXXXXX		
	30016	Other (Specify)						XXXXXXXXXXX		
4.3.3.2	30020	Waste Handling Access (Waste Ramp)	$7.90					XXXXXXXXXXX		$7.90
4.3.3.2.2	30022	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.2.3	30023	Lining						XXXXXXXXXXX		
4.3.3.2.4	30024	Fixtures						XXXXXXXXXXX		
	30025	Shaft Stations						XXXXXXXXXXX		
	30026	Other (Specify)						XXXXXXXXXXX		
4.3.3.3	30030	Excavated Material Handling Access (Tuff Ramp)	$5.61					XXXXXXXXXXX		$5.61
4.3.3.3.2	30032	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.3.3	30033	Lining						XXXXXXXXXXX		
4.3.3.3.4	30034	Fixtures						XXXXXXXXXXX		
	30035	Shaft Stations						XXXXXXXXXXX		
	30036	Other (Specify)						XXXXXXXXXXX		
	30040	Development Intake Access (Shaft)						XXXXXXXXXXX		
4.3.3.4.2	30042	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.4.3	30043	Lining						XXXXXXXXXXX		
4.3.3.4.4	30044	Fixtures						XXXXXXXXXXX		
	30045	Shaft Stations						XXXXXXXXXXX		
	30046	Other (Specify)						XXXXXXXXXXX		
	30050	Confinement Intake Access - 1 (Shaft)						XXXXXXXXXXX		
4.3.3.4.2	30052	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.4.3	30053	Lining						XXXXXXXXXXX		
4.3.3.4.4	30054	Fixtures						XXXXXXXXXXX		
	30055	Shaft Stations						XXXXXXXXXXX		

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	30058	Other (Specify)						XXXXXXXXXXX		
	30060	Confinement Intake Access - 2 (Shaft)						XXXXXXXXXXX		
4.3.3.4.2	30062	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.4.3	30063	Lining						XXXXXXXXXXX		
4.3.3.4.4	30064	Fixtures						XXXXXXXXXXX		
	30065	Shaft Stations						XXXXXXXXXXX		
4.3.3.5	30066	Other (Specify)						XXXXXXXXXXX		
	30070	Development Exhaust Access (Shaft)						XXXXXXXXXXX		
4.3.3.5.2	30072	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.5.3	30073	Lining						XXXXXXXXXXX		
4.3.3.5.4	30074	Fixtures						XXXXXXXXXXX		
	30075	Shaft Stations						XXXXXXXXXXX		
	30076	Other (Specify)						XXXXXXXXXXX		
	30080	Confinement Exhaust Access - 1 (Shaft)	$21.46	$4.26	$4.62	$8.88	$0.27	XXXXXXXXXXX	$0.27	$30.60
4.3.3.5.2	30082	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.5.3	30083	Lining						XXXXXXXXXXX		
4.3.3.5.4	30084	Fixtures						XXXXXXXXXXX		
	30085	Shaft Stations						XXXXXXXXXXX		
	30086	Other (Specify)						XXXXXXXXXXX		
	30090	Confinement Exhaust Access - 2 (Shaft)						XXXXXXXXXXX		
4.3.3.5.2	30092	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
4.3.3.5.3	30093	Lining						XXXXXXXXXXX		
4.3.3.5.4	30094	Fixtures						XXXXXXXXXXX		
	30095	Shaft Stations						XXXXXXXXXXX		
	30096	Other (Specify)						XXXXXXXXXXX		
	30100	Exploratory Shaft - 1	$2.86	$2.05	$2.22	$4.26	$0.13	XXXXXXXXXXX	$0.13	$7.25
4.3.3.5.3	30103	Lining						XXXXXXXXXXX		
4.3.3.5.4	30104	Fixtures						XXXXXXXXXXX		
	30105	Shaft Stations						XXXXXXXXXXX		
	30106	Other (Specify)	$2.86	$2.05	$2.22	$4.26	$0.13	XXXXXXXXXXX	$0.13	$7.25
	30110	Exploratory Shaft - 2	$0.38	$2.05	$2.22	$4.26	$0.13	XXXXXXXXXXX	$0.13	$4.77
4.3.3.5.3	30113	Lining						XXXXXXXXXXX		
4.3.3.5.4	30114	Fixtures						XXXXXXXXXXX		
	30115	Shaft Stations						XXXXXXXXXXX		
	30116	Other (Specify)	$0.38	$2.05	$2.22	$4.26	$0.13	XXXXXXXXXXX	$0.13	$4.77
	30120	Other						XXXXXXXXXXX		
	30122	Excavation		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	30123	Lining						XXXXXXXXXXX		
	30124	Fixtures						XXXXXXXXXXX		
	30125	Shaft Stations						XXXXXXXXXXX		
	30126	Other (Specify)						XXXXXXXXXXX		
4.3.4	40000	SUBSURFACE EXCAVATIONS	$109.54	$606.26	$38.88	$645.15	$46.32	XXXXXXXXXXX	$46.32	$801.01
4.3.4.1	41000	DEVELOPMENT	$88.95	$422.56	$24.81	$447.37	$4.27	XXXXXXXXXXX	$4.27	$540.59
	41010	Common Facility (Shaft Pillar) Excavation	$13.77		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$13.77
	41011	Main Drifts	$5.04		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$5.04
	41012	Ventilation Drifts	$4.46		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$4.46
	41013	Support Facilities	$3.74		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$3.74
	41014	Training Areas	$0.27		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.27
	41015	Performance Confirmation	$0.27		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.27
	41020	Spent Fuel Facility Excavation	$49.90	$280.14	XXXXXXXXXXX	$280.14	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$330.03

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	41021	Main Drifts	$8.97	$13.07	XXXXXXXXXXX	$13.07	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$22.05
	41022	Access Drifts	$13.36	$44.58	XXXXXXXXXXX	$44.58	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$57.94
	41023	Ventilation Drifts	$8.27	$11.03	XXXXXXXXXXX	$11.03	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$19.30
	41024	Emplacement Drifts	$5.63	$26.39	XXXXXXXXXXX	$26.39	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$32.02
	41025	Emplacement Borehole Drilling/Lining	$13.67	$185.06	XXXXXXXXXXX	$185.06	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$198.73
	41030	DHLW Facility Excavation	$3.31	$74.28	XXXXXXXXXXX	$74.28	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$77.59
	41031	Main Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41032	Access Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41033	Ventilation Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41034	Emplacement Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41035	Emplacement Borehole Drilling/Lining	$3.31	$74.28	XXXXXXXXXXX	$74.28	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$77.59
	41040	Other Waste Facility Excavation	$1.74		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$1.74
	41041	Main Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41042	Access Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41043	Ventilation Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41044	Emplacement Drifts			XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	41045	Emplacement Borehole Drilling/Lining	$1.74		XXXXXXXXXXX		XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$1.74
	41050	Re-excavation						XXXXXXXXXXX		
	41051	Main Drifts						XXXXXXXXXXX		
	41052	Access Drifts						XXXXXXXXXXX		
	41053	Ventilation Drifts						XXXXXXXXXXX		
	41054	Other						XXXXXXXXXXX		
	41060	Excavated Material Handling	$11.75	$27.88		$27.88		XXXXXXXXXXX		$39.63
	41070	General Maintenance	$8.48	$40.26	$24.81	$65.08	$4.27	XXXXXXXXXXX	$4.27	$77.82
4.3.4.2	42000	EMPLACEMENT/RETRIEVAL OPERATIONS	$20.60	$183.70	$14.07	$197.78	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$218.37
	42010	Spent Fuel Waste Transport and Emplacement	$12.67	$108.88		$108.88	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$121.54
	42011	Underground Transport					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42012	Emplacement					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42013	Borehole Closure (shield plug/backfill)	XXXXXXXXXXX				XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42020	DHLW Transport and Emplacement	$7.14	$60.71		$60.71	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$67.84
	42021	Underground Transport					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42022	Emplacement					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42023	Borehole Closure (shield plug/backfill)	XXXXXXXXXXX				XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42030	Other Waste Transport and Emplacement	$0.79	$3.84		$3.84	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$4.63
	42031	Underground Transport					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42032	Emplacement					XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42033	Borehole Closure (shield plug/backfill)	XXXXXXXXXXX				XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
	42040	Waste Retrieval		$10.28	$14.07	$24.35	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$24.35
4.3.4.3	43000	BACKFILL	XXXXXXXXXXX				$42.05	XXXXXXXXXXX	$42.05	$42.05
	43010	Men and Materials Access (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$4.70	XXXXXXXXXXX	$4.70	$4.70
	43020	Waste Handling Access (Shaft or Ramp)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$2.68	XXXXXXXXXXX	$2.68	$2.68
	43030	Muck Handling Access (Shaft or Ramp)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$1.83	XXXXXXXXXXX	$1.83	$1.83
	43040	Development Intake Access (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43050	Confinement Intake Access - 1 (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43060	Confinement Intake Access - 2 (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43070	Development Exhaust Access (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43080	Confinement Exhaust Access - 1 (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.57	XXXXXXXXXXX	$0.57	$0.57
	43090	Confinement Exhaust Access - 2 (Shaft)	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43100	Exploratory Shaft - 1	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.55	XXXXXXXXXXX	$0.55	$0.55
	43110	Exploratory Shaft - 2	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$0.11	XXXXXXXXXXX	$0.11	$0.11
	43120	Other Shaft	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		

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	43300	Development Areas	XXXXXXXXXXX				$31.62	XXXXXXXXXXX	$31.62	$31.62
	43301	Common Areas	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX		XXXXXXXXXXX		
	43302	Spent Fuel Panels	XXXXXXXXXXX					XXXXXXXXXXX		
	43303	DHLW Panels	XXXXXXXXXXX					XXXXXXXXXXX		
	43304	Other Waste Panels	XXXXXXXXXXX					XXXXXXXXXXX		
4.3.5	50000	UNDERGROUND SERVICE SYSTEMS	$76.28	$400.89	$152.36	$553.25	$26.97	XXXXXXXXXXX	$26.97	$656.51
4.3.5.1	51000	SUPPORT SYSTEM FACILITIES	$57.63	$284.07	$94.11	$378.18	$16.21	XXXXXXXXXXX	$16.21	$451.93
4.3.5.1.1	51010	Material Support, Receiving/warehousing	$12.03	$41.07	$18.01	$59.08	$3.68	XXXXXXXXXXX	$3.68	$74.79
	51011	Facilities	$7.97	$41.07	$18.01	$59.08	$3.68	XXXXXXXXXXX	$3.68	$70.73
	51012	Initial Inventory	$4.06					XXXXXXXXXXX		$4.06
4.3.5.1.2	51020	Equipment Fuel Facility						XXXXXXXXXXX		
4.3.5.1.3	51030	Maintenance Facility	$25.83	$148.79	$24.87	$173.67	$6.02	XXXXXXXXXXX	$6.02	$205.51
	51031	Development Area	$24.87	$76.92	$17.40	$94.32	$6.02	XXXXXXXXXXX	$6.02	$125.20
	51032	Emplacement Area	$0.96	$71.87	$7.47	$79.35		XXXXXXXXXXX		$80.31
4.3.5.1.4	51040	Emergency Medical/Rescue Chamber	$3.05	$14.58	$1.59	$16.17	$2.19	XXXXXXXXXXX	$2.19	$21.40
4.3.5.1.5	51050	Ventilation System (Waste Emplacement)	$0.38	$5.20	$3.62	$8.82		XXXXXXXXXXX		$9.21
4.3.5.1.6	51060	Ventilation System (Mine Development)	$3.75	$18.85		$18.85		XXXXXXXXXXX		$22.60
4.3.5.1.7	51070	Mine Water Control System	$1.12	$6.94	$7.52	$14.46	$0.87	XXXXXXXXXXX	$0.87	$16.45
4.3.5.1.8	51080	Fire Protection/Control	$0.46	$0.83	$0.56	$1.40	$0.10	XXXXXXXXXXX	$0.10	$1.96
4.3.5.1.9	51090	Operations Support Facility	$1.44	$3.91	$1.65	$5.56	$0.48	XXXXXXXXXXX	$0.48	$7.48
4.3.5.1.10	51100	Contamination Control System	$7.79	$25.26	$16.12	$41.38	$2.88	XXXXXXXXXXX	$2.88	$52.04
4.3.5.1.11	51110	Control Room Facility	$1.69	$18.62	$20.17	$38.79		XXXXXXXXXXX		$40.48
4.3.5.2	52000	UTILITIES	$7.84	$20.98	$9.97	$30.95	$3.68	XXXXXXXXXXX	$3.68	$42.48
4.3.5.2.1	52010	Electrical	$7.19	$18.38	$8.19	$26.57	$3.57	XXXXXXXXXXX	$3.57	$37.33
4.3.5.2.2	52020	Communications	$0.19	$1.24	$1.78	$3.01	$0.11	XXXXXXXXXXX	$0.11	$3.32
4.3.5.2.3	52030	Compressed Air						XXXXXXXXXXX		
4.3.5.2.4	52040	Chilled Water						XXXXXXXXXXX		
4.3.5.2.5	52050	Water	$0.46	$1.36		$1.36		XXXXXXXXXXX		$1.83
4.3.5.2.6	52060	Other (Specify)						XXXXXXXXXXX		
4.3.5.3	53000	MONITORING	$10.90	$95.84	$48.28	$144.12	$7.08	XXXXXXXXXXX	$7.08	$162.10
4.3.5.3.1	53010	Radiological Monitoring						XXXXXXXXXXX		
4.3.5.3.2	53020	Occupational Monitoring						XXXXXXXXXXX		
4.3.5.3.3	53030	Performance Confirmation Monitoring						XXXXXXXXXXX		
2.4	60000	WASTE PACKAGE FABRICATION	XXXXXXXXXXX	$599.04	$4.32	$603.36	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$603.36
	61000	SPENT FUEL	XXXXXXXXXXX	$350.96		$350.96	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$350.96
	61010	Intact PWR	XXXXXXXXXXX	$46.07		$46.07	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$46.07
	61020	Intact BWR	XXXXXXXXXXX	$41.90		$41.90	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$41.90
	61030	Consolidated PWR	XXXXXXXXXXX	$168.69		$168.69	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$168.69
	61040	Consolidated BWR	XXXXXXXXXXX	$94.30		$94.30	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$94.30
	62000	DHLW	XXXXXXXXXXX	$127.71		$127.71	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$127.71
	63000	OTHER WASTE	XXXXXXXXXXX	$120.37	$4.32	$124.69	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$124.69
	63010	Spent Fuel Hardware	XXXXXXXXXXX	$12.40		$12.40	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$12.40
	63020	High Activity (Remote-Handled)	XXXXXXXXXXX	$3.16	$4.32	$7.48	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$7.48
	63030	WVHLW and CHLW	XXXXXXXXXXX	$2.69		$2.69	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$2.69
	63040	Contact-Handled	XXXXXXXXXXX	$102.12		$102.12	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	$102.12
	99999	TOTAL REPOSITORY	$1,350.05	$3,935.21	$479.45	$4,414.66	$85.21	$84.61	$169.82	$5,934.52

APPENDIX B

COST CODE OF ACCOUNTS

APPENDIX B

Cost Code of Accounts

The cost estimate code of accounts is presented in this appendix. A thorough understanding of this accounting structure, which is a subset of a generic code of accounts developed by the Department of Energy, Office of Civilian Radioactive Waste Management, Office of Geologic Repositories (DOE/OCRWM-OGR) to provide adequate detail for comparative analysis, will facilitate estimate consistency among the projects.

Cost Structure

The cost estimate for the repository includes a cost breakdown by design elements, subelements, and by life-cycle phases (engineering, construction, emplacement operations, caretaker operations, and closure and decommissioning).

A five-digit code has been specified for each cost account or sub-account. These codes are based on a four-level cost hierarchy. Beginning at the left code Levels 1, 2, and 4 have one digit (0 through 9) while Level 3 has two digits (00 through 99). These codes provide keys for sorting and identifying the estimates. The costs are subtotaled at each level beginning with the fourth level and then are rolled up for the entire cost hierarchy.

Costs, included in this report, are figured for the greatest level of detail in the conceptual design. Engineering costs, in the architect/engineer (A/E) account under the construction costs column, include license application design (LAD), final procurement and construction design (FPCD), and Title III costs. Operations costs are as detailed as possible for each phase. Closure and decommissioning costs include underground and surface facility accounts, respectively. Costs for facility operations (such as shaft or surface facility maintenance) are included as necessary during closure and decommissioning.

The cost accounts and subaccounts are shown in Table A-1 and are defined below.

Definition of Accounts

Definitions of repository cost accounts have been developed and agreed to by all of the projects. The projects have based the definitions on descriptions of the design activity structure (DAS) elements and the preliminary definitions developed by NNWSI. The definitions developed by NNWSI have been modified significantly to provide additional detail that includes cost elements not in the DAS (management and integration, land acquisition, and waste container) and detail that applies generically. The following definitions include cost codes and titles that when adopted will allow all cost estimates to be compiled consistently.

00000 MANAGEMENT AND INTEGRATION

Costs include the accounts for management, design, and integration activities.

01000 SUPPORT CONTRACTOR

This account includes costs for the DOE support contractor who manages and integrates services to support repository development during the engineering, construction, and decommissioning phases. These services are similar to those currently provided by Battelle, Rockwell, and Sandia. The costs correspond only to Element 1.4 of the work breakdown structure (WBS), Management and Integration Costs [see OGR Work Breakdown Structure and Dictionary--Development and Evaluation Phase (DOE, 1984)]. The support contractor costs do not include costs for systems (e.g., systems engineering), waste package, siting, regulatory and institutional (e.g., licensing), exploratory shaft, test facilities, land acquisition, or project management activities.

The costs include only that portion of the support contractor staff that

- manages and coordinates the A/E and construction manager activities;
- prepares integrated repository design reports;
- develops and establishes a baseline for functional criteria, standards, analytical methods, assumptions, and interface requirements required to design repository surface facilities, shafts, subsurface excavations, and underground service systems;
- assembles and maintains data to support design;
- evaluates repository design options; and
- interacts with other OCRWM program participants (e.g., participates in the repository coordination group).

Costs are divided into surface and subsurface components.

01010 <u>Surface</u>

Costs are for support contractor activities associated with the surface facilities.

01020 <u>Subsurface</u>

Costs are for support contractor activities associated with the subsurface facilities.

02000 ARCHITECT/ENGINEER

Costs are for A/E activities (design) during the LAD as well as during the final design and construction periods and include appropriate quality assurance program costs for the design activities. Additional costs to support closure are also included here. Separate accounts are for surface and underground design activities.

02010 Surface

Costs are for the design activities associated with the surface facilities.

02020 Subsurface

Costs are for the design activities associated with the subsurface facilities.

03000 CONSTRUCTION MANAGEMENT

Costs are for management activities during construction, closure, and decommissioning periods as required. Costs include a quality assurance program as part of the construction management activities.

03010 Surface

Costs are for construction management activities for surface facilities.

03020 Subsurface

Costs are for construction management activities for subsurface facilities.

04000 CONSULTANTS

Costs for consultants required to support all phases of the repository life cycle are included in this account. Such consultants provide expertise in areas where a full-time staff is not necessary.

05000 PERFORMANCE CONFIRMATION PROGRAM

Costs for offsite activities in the performance confirmation program are included in this account. These costs include such items as laboratory studies of waste package components. Costs for onsite performance confirmation are a subaccount of the facility where the activities are conducted, e.g., waste-handling building 1 (WHB-1), 21107; waste-handling building 2 (WHB-2), 21207; stand-alone performance confirmation building, 21504; and underground, 42040 and 53030.

07000 REPOSITORY LAND ACQUISITION

Costs for land leases, purchases, mineral rights, and rights of way required to construct and operate the repository are included in this account.

10000 SITE PREPARATION

Costs for all improvements to the site and surrounding area, as well as development of access and utility corridors, are included for the entire life cycle of the repository, including design and construction, operations (maintenance and upkeep), and closure and decommissioning. Costs for purchased surface equipment (rolling stock, locomotives, trucks, buses, and plows) are not included here but are costed in 22230.

11000 EMPLOYEE TRANSPORTATION

This account contains the cost of subsidized transportation by bus for employees from Las Vegas, Nevada, to the site. Costs are for the operating phase only.

12000 ONSITE

The costs in this account provide for site improvements within the boundaries of the central surface facilities (fenced areas). This area includes the central facilities and any subsurface support facilities located on the surface at the Yucca Mountain site. Costs for access to the site and other improvements within the larger area outside the central area are included in the offsite accounts (13000). The onsite area is generally considered to be the area west of the Fortymile Wash. Onsite cost accounts include site improvements and utilities. Utilities and service systems for individual buildings out to 5 ft from those structures are included in the respective balance-of-plant account.

12010 Roads

The costs of constructing onsite roadways include grading, subbase, pavement, curbs, guardrails, walkways, signs, and signals. Roadways for service vehicles, transportation of waste, and personnel are also included, along with parking areas, yards, and paved storage areas for both loaded and unloaded waste casks for storage or transport.

12020 Rail

The cost of the onsite railroad includes roadbed, ties, rail sections, turnouts, signal systems, and crossings required at the repository. Costs also include yards for both loaded and unloaded storage or transport waste casks. Locomotives and rolling stock are included in the standard equipment account (22230).

12030 Communications

Site telephone, switchboard, and radio system costs are in this account. Conduit costs are under the accounts for the respective buildings, and site cables and duct banks are included in site utilities (12090). Subsurface communications are included in Account 52020.

12040 Clearing

The initial clearing of land and mass excavation to support construction, including removal of debris, make up this cost. Also included is the cost of clearing the shaft areas.

12050 Grading

Only construction costs for grading the site, including all cut and fill, are in this account. Costs for structural excavation and backfill are not included here but are included in the costs for each waste-handling or balance-of-plant structure. Hauling costs for excavated material and backfill are included as applicable.

12060 Landscaping

This account includes costs for initial landscaping, trash receptacles, retaining walls, planters, flagpoles, and signs.

12070 Drainage Control

The cost of a drainage system for the site includes materials for catch basins, ditches, and erosion control features which collect and retain waste water. The cost of systems to pump mine water from the emplacement exhaust shaft collar to effluent facilities is covered here. Water treatment facilities for sewage and effluent are in Account 12090. Roadbed drainage and culverts are costed in road and railroad accounts for both onsite and offsite features.

12080 Fencing

Costs for onsite security fencing and gates and the cost to install fencing for the surface facility boundaries, central areas, restricted areas, and storage yards are included here. Surveillance systems, intrusion detection systems, and other security barriers are included in 22030.

12090 Utilities

Costs for site utility systems are included here. System construction costs, listed below, are included as they apply to surface facilities.

Electrical. Construction costs are for electrical service to site surface facilities, including substations, wire, signal and telephone cable, duct banks, onsite power lines, motor control centers, transformers, and outside lighting.

Water. Costs to construct water distribution systems that provide the facilities on the site with potable and fire-protection water supplies are included as well as the piping and storage tanks for the water.

Fuel Supply. Construction costs for fuel storage and distribution systems are included in this category. Also included is the cost of tanks, piping, and pumps for diesel fuel and unleaded gasoline to supply diesel generators; pumps to supply water for fighting fires; waste transporters; and other vehicles.

Sewage collection. Construction costs are for the entire sanitary sewer collection grid, 5 ft from each building to the sewage treatment facility.

12100 Other

Costs are for other site improvements (miscellaneous) not included in the above accounts.

12101 Heliport

Costs for a heliport to provide air transport for visitors or emergencies include landing lights, windsock, and a waiting shelter.

13000 OFFSITE

Included in these accounts are costs to extend public utilities and their access from existing systems to the repository central facilities boundary. Costs for utilities systems within the inner control area are included in the 12000 accounts. Costs for construction are included in the following accounts.

13010 Roads

The costs to construct access roads from U.S. Highway 95 to the repository include grading, drainage, subbase, pavement, curbs, guardrail, right-of-way fencing, and signs.

13013 Bridges

Costs to construct and maintain bridges along the repository highway access route include all excavation, formwork, concrete, structural steel, and finish costs.

13020 Rail

Costs to construct rail access include roadbed, ties, rail sections, turnouts, signal systems, right-of-way fencing, and crossings required to provide the rail connection from Dike Siding near Las Vegas, Nevada, to the repository gate.

13050 Utilities

Construction costs to run electrical transmission lines up to the main plant substation are included here. This account also includes the water supply pump station, wells, chlorination unit, and main water supply piping to the onsite facilities.

14000 MONUMENTS

The cost of permanent markers installed at the 5-km periphery of the repository as well as the central records cache monument grouping is included here.

20000 SURFACE FACILITIES

Costs to construct, operate, and decommission the surface facilities are in these accounts. The cost accounts below are divided into the site waste-handling, balance-of-plant, and surface shaft facilities. The cost of each facility includes excavation and backfill, structures, utilities systems, personnel, materials, and equipment. Costs are included for all utilities and site work up to 5 ft from the building or structure. Upkeep and renovation costs are in addition to normal operations.

21000 WASTE-HANDLING FACILITIES

Costs for surface radioactive waste-handling facilities and operations are included in these accounts. Process operations include waste handling from initial waste receipt and inspection to transfer of waste to the underground via the waste ramp. Waste-handling activities on the surface to confirm performance also take place in these facilities. Although the costs of assembling waste containers and processing wastes are included in these accounts, the fabrication of the waste container components appears in the 60000 accounts.

21100 Waste-Handling Building 1

Costs for WHB-1 are included in this account. During Stage 1, this facility processes intact spent fuel assemblies and will process DHLW and WVHLW during Stage 2. The facility unloads, inspects, stores, and packages the intact spent fuel rods with a throughput of 400 MTU/yr. Numerous subaccounts detail the costs for WHB-1. Operations costs are included in Account 21000.

21102 Building/Structures

This account includes the civil, structural, and architectural features of the building. Costs for excavation, foundations, concrete work, carpentry, and finish are included. The facility includes receiving bays, unloading areas, hot cells (shield doors and windows are included in the following account), transfer corridors, and other control and support areas.

21103 Hot Cell

Costs are for the purchase and installation of special hot cell shielding features including shield doors, shield windows, penetrations, and transfer drawers. Hot cell equipment costs are not included in this account but are included in 21106.

21104 Utilities

Costs for electricity, water, compressed air, fire protection, instrumentation and control as well as decontamination and other systems in WHB-1 are included. Also included are electrical components (wiring, cable, cable trays, conduit, boxes, feeder/breakers, panelboards, and lighting fixtures), communications components, fire protection and detection systems, plumbing fixtures, and control components. Upkeep and renovation costs are included in the operations costs.

21105 HVAC

Costs to construct heating, ventilating, and air conditioning (HVAC) systems are included in this account for WHB-1 as are the purchase and installation of components including heaters, ducts, humidifiers, insulation, air-handling units, filtration units, vents, stacks, chillers, and cooling towers.

21106 Handling/Packaging Equipment

The cost of equipment in the hot cell (nuclear) that processes spent fuel and other waste is included in this account. Costs include purchase, installation, and testing of equipment. Process equipment for handling waste (spent fuel, DHLW, WVHLW, and onsite generated wastes) includes electromechanical manipulators, survey instruments, cranes, transfer carts, yokes, closed-circuit television (CCTV) systems, welders, leak test stations, storage racks, master-slave manipulators, grapples, transfer casks, decontamination tanks, and cutters and rework stations. Equipment costs are included for the following functions: spent fuel canisterization, process storage, spent fuel packaging, and HLW packaging.

21107 Support Facilities

Costs for equipping nonprocess support facilities that are separate from process areas in WHB-1 are included in this account. The building and structural costs are included in 21102; utilities are included in 21104. All non-nuclear equipment not identified in the 21100 accounts above is included here.

21200 <u>Waste-Handling Building 2</u>

Costs for WHB-2 are included in this account. During Stage 2, this facility processes spent fuel assemblies (unloads, inspects, stores, disassembles, consolidates, and packages wastes) with a

throughput of 3,000 MTU/yr. Numerous subaccounts are provided to detail the costs for WHB-2. Operations costs are included in Account 21000.

21202 Building/Structures

This account includes the civil, structural, and architectural features of the building. Costs for excavation, foundations, concrete work, carpentry, and finish are included. The facility includes receiving bays, unloading areas, hot cells (shield doors and windows are included in the following account), transfer corridors, and other control and support areas.

21203 Hot Cell

Costs are for the purchase and installation of special hot cell shielding features including shield doors, shield windows, penetrations, and transfer drawers. Hot cell equipment costs are not included in this account but are included in 21206.

21204 Utilities

Costs for electricity, water, compressed air, fire protection, instrumentation and control as well as decontamination and other systems in WHB-2 are included. Electrical components (wiring, cable, cable trays, conduit, boxes, feeder/breakers, panelboards, and lighting fixtures), communications components (phones, intercoms, switchboards, and CCTV), fire protection and detection systems (alarms, sprinklers, emergency power generators, suppression systems, extinguishers, and hoses), plumbing fixtures (piping, appliances, pumps, valves, lavatories, restroom, and showroom), and control components are examples of the items purchased and installed. Upkeep and renovation costs are included in the operations costs.

21205 HVAC

Costs to construct HVAC systems are included in this account for WHB-2 as are the purchase and installation of boilers, heaters, ducts, humidifiers, insulation, air-handling units, filtration units, vents, stacks, chillers, and cooling towers.

21206 Handling/Packaging Equipment

The cost of equipment in the hot cell (nuclear) that processes spent fuel and other waste is included in this account. Construction and operations costs include purchase, installation, and testing of equipment. Process equipment to handle waste (spent fuel, hardware, or other site-generated wastes) includes electromechanical manipulators, survey instruments, cranes, transfer carts, yokes, CCTV systems, welders, leak test stations, storage racks, master-slave manipulators, grapples, transfer casks, decontamination tanks, disassembly and consolidation equipment, and cutters and rework stations. Equipment costs are for the consolidation of spent fuel, process storage, and spent fuel packaging.

21207 Support Facilities

Costs for equipping the nonprocess support facilities that are separate from process areas in WHB-2 are included in this account. The building and structural costs have already been included in 21202 and utilities have been included in 21204. Construction costs are for applicable areas, including inspection areas, receiving bays, lag storage areas--other than yard or in process cell--and other support areas in this building that have not been separated as balance-of-plant facilities, such as food service, administration, or training.

21500 Other

Costs for operating stand-alone facilities that service waste-handling functions either from WHB-1 or WHB-2 are included in this account.

21501 Site-Generated Radwaste Treatment Facility

The cost of a stand-alone radwaste facility is included in this account. Operating costs to collect and process site-generated solid, liquid, and gaseous radwaste, including the purchase and installation of collection tanks, pumps, evaporators, compactors, and HEPA filters, are in Account 21000. Waste packaging drums, boxes, and media are costed in Account 63040.

21502 Vehicle Wash Facility

Costs are for a stand-alone facility to remove road dirt from casks and carriers (railroad and truck). These costs include water-processing and monitoring systems.

21503 Decontamination Building

Costs are for a stand-alone facility to store and decontaminate suspect waste casks.

21504 Performance Confirmation (Diagnostic) Facility

Construction costs for a stand-alone diagnostic facility to examine waste packages are included in this account. Specialized preparation, sampling, and testing equipment to support the performance confirmation program are included. (Analysis is performed offsite.)

22000 BALANCE OF PLANT

In general, balance-of-plant buildings have structural steel frames and insulated metal siding and roofing. In the current design, columns are supported on reinforced-concrete spread footings. The ground floor is typically a concrete slab on grade, and elevated floors are metal deck with concrete topping supported by steel beams and girders. Rooms are partitioned by metal studs with gypsum board on each side. Ceilings are suspended acoustic panels.

The cost of operating and maintaining the balance-of-plant buildings includes labor, operating supplies, maintenance materials, electrical power, and local taxes.

22010 Health/Medical Facilities

The medical center, industrial safety offices, and health physics headquarters are included in this account. These facilities include x-ray, clinical, monitoring, mine rescue, counting, and survey equipment.

22020 Fire Protection Facilities

The fire station, fire control center, dormitory, and communications center are included in this account. These facilities include fire fighting (no vehicles), monitoring, and communications equipment.

22030 Security Facilities

The security facilities include the main security center, gatehouses, surveillance, intrusion and detection systems, command center, and miscellaneous special equipment.

22040 Maintenance Facilities

Costs for maintenance shops, motor pools, garages, and repair and service facilities are included. In addition, special equipment such as machines and power tools are included.

22050 Administration/Personnel Facilities

These facilities house executive, DOE, NRC, human resources, accounting, payroll, legal, records, public relations, transportation operations (logistics), waste operations (logistics), facilities' operations, quality assurance, and engineering departments. DOE and NRC staff costs are not considered in this estimate, but the design of the facility will be adequate to accommodate these workers. Food service facilities (lunchroom, kitchen, cafeteria, and vending area) are also included in this account.

22060 Training/Mockup Facility

Costs are included in this account for stand-alone training facilities. These facilities include classroom and lecture space (auditorium) as well as required mockup or simulator areas. Special equipment includes audio-visual systems, mockup equipment, and simulators.

22070 Warehouse and Receiving

Costs are for warehousing and storing supplies and spare equipment. Explosives magazines are not costed in this account but are found in 22110.

22080 Visitors' Center Facility

Costs for the visitors' center include display rooms, auditorium, and meeting rooms as appropriate.

22090 Backup Power Generation Facility

The costs of a stand-alone facility to provide backup power include structures, diesel generators, control equipment, and other special equipment in the facility.

22100 Change Room Facility

Costs for the change house for underground personnel are included in this account. This facility includes waiting areas, shower and change areas (men and women), and personal equipment storage.

22110 Explosives Storage Facility

Costs for material and construction of the surface explosives magazines (powder and cap) are included in this subaccount. The cost of the explosives is not included here but is found in excavation cost accounts as appropriate.

22130 Cooling Tower and Chilled-Water Facility

This account includes costs for cooling towers and a chilled-water plant to cool emplacement drifts during operations. Cooling facilities are not necessary for the horizontal emplacement design.

22141 Surface Excavated Material Storage/Handling

Costs are to construct the structures, towers, and conveyors required to transfer excavated material from the tuff ramp portal to the storage pile.

22190 Sewage Treatment Facility

Costs for the sewage collection system and treatment plant are included in this account.

22220 Control and Monitoring Facility

Costs for a central facility that monitors repository operations include facilities for monitoring equipment and computer systems, as required, and costs for environmental monitoring, including weather stations.

22230 Standard Equipment

Surface mobile equipment required to operate the repository are included here: trucks, buses, locomotives, ambulances, fire-fighting vehicles, security vehicles, and cranes.

22240 Other

This account details other balance-of-plant facilities not accommodated in the above accounts.

22242 Batch Plant

Costs to purchase and install a concrete batch plant for use during operation periods are included.

23000 SURFACE SHAFT FACILITIES

This account covers the cost of surface facilities that support the underground access shafts and ramps. Such facilities include hoist houses, headframes, ventilation structures, and miscellaneous buildings. The structure of the 23000 account provides separate accounts for 12 shafts, of which only 4 are applicable to the current design. Costs for construction and operations are combined during the construction phase. Costs reported during the emplacement, caretaker, and closure and decommissioning phases are for operating and maintenance only.

23010 Men-and-Materials Facility

The facilities at the collar of the men-and-materials shaft include the headframe, hoist and hoisthouse, ventilation fans, and the duct structure.

23011 Headframe

The capital cost of the permanant headframe, hoists, ropes, conveyances, and electrical switchgear is contained in this account. Operating costs for all phases include the hoistman, hoist mechanics, and costs to maintain and repair hoist equipment.

23012 Hoist House

This account covers the costs to construct and decommission buildings that house the hoists and electrical switchgear.

23013 Ventilation Building

This account includes the cost to construct and decommission the main development ventilation fans, ducts, and building.

23014 Heating/Cooling Building

Minimal heating and no cooling are required for the incoming air for development. Because the necessary equipment is contained in the ventilation building (23013), no separate facility is required.

Accounts 23020, 23030, 23040, 23050, 23060, and 23070 do not apply to the current design.

23080 Confinement Exhaust Facility (Emplacement)

The primary structure at the collar of the emplacement exhaust shaft is the ventilation building housing the high-efficiency particulate air (HEPA) filter system and the main fans.

23083 Ventilation Building

This account covers the costs to construct and decommission the HEPA filter and fan system. No heating or cooling is required.

23085 Other (Inspection Hoist)

The cost of an inspection hoist and hoist operating cost for routine shaft inspections are covered in this account.

23100 Exploratory Shaft Facility 1 (ES-1)

Following completion of all site characterization testing, the two exploratory shafts will be stripped of fixtures and used as air intakes for the emplacement area ventilation system. The remaining surface facility will consist of a hoist to inspect the shaft and for emergency egress.

23105 Other (Inspection Hoist)

This account covers the cost to install and maintain a hoist that is used to routinely inspect the shaft or for emergency for the life of the repository.

23110 Exploratory Shaft Facility 2 (ES-2)

ES-2 will serve solely as a ventilation intake shaft following the completion of site characterization activities. Shaft inspections will be performed routinely, using the portable hoist stationed at ES-1.

23115 Other (Inspection Hoist)

This account covers the cost to install and maintain a hoist that is used to routinely inspect the shaft or for emergency for the life of the repository.

30000 SHAFTS/RAMPS--UNDERGROUND

This account covers the costs to construct all underground repository accesses except the exploratory shafts that are part of site characterization. The cost of converting the exploratory shafts to ventilation duty is contained here as are the costs of maintaining the shaft linings and fixtures. The cost of maintaining the ramps is contained in Account 41070, General Maintenance. Surface features (ventilation or hoist-house facilities) are included in the 23000 accounts. Shaft utility systems (communications, ventilation, water, power, and control) are found in the 50000 accounts. The cost account structure provides separate accounts for up to 12 accesses of which only 6 are applicable to the current design.

30010 Men-and-Materials Access (Shaft)

The costs in this account reflect the costs to construct, operate, and maintain the men-and-materials shaft. The code of accounts includes Accounts 30011 to 30016 for excavating, lining, and outfitting the shaft, and although these accounts are not used, the cost components they represent are included at the higher account level.

30020 Waste-Handling Access (Waste Ramp)

This account covers the cost to excavate and line the waste ramp. Subaccounts that pertain to sinking a shaft are not used, but the equivalent elements that correspond to ramp construction are included here in the cost of the ramp.

30030 Excavated Material-Handling Access (Tuff Ramp)

The cost to construct the tuff ramp is in this account. The cost to install, operate, and maintain the belt conveyor systems within

the tuff ramp is included in Account 41060, Excavated Material Handling. See Account 30020 for additional description of this account.

Accounts 30040, 30050, 30060, 30070, 30090, and 30120 do not apply to the current underground design.

30080 Confinement Exhaust Access 1 (Emplacement Exhaust Shaft)

The costs to sink, line, and equip the emplacement exhaust shaft are included in this account. As described in Account 30010, the additional detail provided in the cost account structure is not used.

30100 Exploratory Shaft 1 (ES-1)

This account covers the cost of modifying the 12-ft-diameter shaft (ES-1) for use by the repository as an air intake ventilation shaft for the emplacement areas. ES-1 is modified by removing the hoisting facilities and headframe and all in-shaft guides and fixtures. The account also includes the cost of routine inspections and maintenance (installing the hoist at the collar for inspection and emergency).

30110 Exploratory Shaft 2 (ES-2)

ES-2 is intended to be a ventilation and escape shaft during the site characterization program and will require little or no modification. This account contains the costs associated with maintenance and inspection of the shaft throughout the life of the repository.

40000 SUBSURFACE EXCAVATIONS

The costs listed in this account represent the total cost of

- all excavation beyond the shafts and ramps,
- emplacement borehole drilling and lining,
- excavated materials handling (muck handling),
- backfill and closure activities,
- general maintenance of drifts and ramps, and
- underground waste transport and emplacement.

41000 DEVELOPMENT

Development costs include all drift excavation, muck-handling, and borehole preparation. Separate accounts are provided for the preparation of boreholes for the individual waste types (e.g., spent fuel, WVHLW, and DHLW). Costs to develop the underground facilities are treated as construction costs if incurred before start-up, January 1998. Costs to develop the underground facilities after start-up are considered operating costs.

41010 Common Facility Excavation

Common facilities refer to underground shops, offices, warehouse areas, interconnecting ventilation and access drifts, and dedicated training and performance confirmation areas. This account covers only the excavation and lining costs of the listed facilities. Costs for equipping, staffing, and operating the common facilities appear in the 50000 accounts. All common facilities are excavated during the construction phase.

41011 Main Drifts

This account covers the cost of excavating and lining the three main drifts from the point where the ramps meet the repository horizon (elevation 3,100 ft) to the southwest corner of the exploratoy shaft test facility.

41012 Ventilation Drifts

This account contains the costs to excavate miscellaneous crosscuts and ventilation drifts that serve the development and emplacement shops and offices. Also included is the cost to excavate the perimeter ventilation drift from the base of the waste ramp to the emplacement exhaust shaft.

41013 Support Facilities

Costs in this account cover the excavation, lining, and floor preparation of the development and emplacement shops, control rooms, warehouses, and offices. Costs for furnishings, equipment, and operations are covered in Account 51000.

41014 Training Areas

An operator training area has been set aside near the base of the ramps. This account covers the cost of excavating the training drifts and rooms.

41015 Performance Confirmation Area

This account covers the cost to excavate a dedicated area for general testing and for monitoring container performance and rock interactions.

41020 Spent Fuel Facility Excavation

The cost to develop the waste emplacement panels is contained in this account. Spent fuel, DHLW, and other wastes are commingled within the same panels. All mining costs are treated as spent fuel facility costs. However, the cost of the boreholes depends on the number of boreholes needed for each type of waste. Panel development begins during the initial construction period and continues through the emplacement period. Mining operations are

completed approximately 3 yr before the end of emplacement operations. Emplacement borehole preparations are completed 2 yr before last emplacement. The cost components of a typical panel are described in the following subaccounts. Costs for mining support operations and permanent utilities (piping, vent ducts, cable, lighting) are included in Account 50000.

41021 Main Drifts

Three parallel main drifts (waste, service, and tuff mains) are mined ahead of the advancing emplacement panel. The costs in this account are to excavate and line the mains and the connecting crosscuts.

41022 Access Drifts

Access to the emplacement drifts is provided by parallel panel access drifts that bound the emplacement panels. The costs in this account are to excavate and line the panel access drifts.

41023 Ventilation Drifts

This account covers the costs to excavate and line the perimeter ventilation drift and, in the case of the vertical emplacement design, the midpanel drift. These drifts are driven with the advancing panels.

41024 Emplacement Drifts

The cost to excavate all emplacement drifts is contained in this account. Because spent fuel and DHLW are commingled within the same drifts, no distinction is made between emplacement drifts used for different waste types. However, borehole preparation costs for each waste type are accrued separately.

41025 Emplacement Borehole Drilling/Lining (Spent Fuel)

Costs to excavate and prepare spent fuel boreholes are in this account and include drilling, removal of excavated material, and lining the boreholes. Costs to install borehole lining assemblies are also included. Cover doors, permanent radiation shields, or plugs are not included here but are included in the waste emplacement accounts (42000).

41030 DHLW Facility Excavation

The cost of facilities developed strictly for emplacement of defense wastes are contained in this account. DHLW containers are commingled in an alternating pattern with spent fuel in the same drift. Therefore, no attempt is made to allocate the cost of drifts to separate waste types.

Accounts 41031, 41032, 41033, and 41034 are not used.

41035 Emplacement Borehole Drilling/Lining (DHLW)

This account covers the borehole drilling and lining costs for DHLW containers. See Account 41025 for a detailed description of this account.

41040 Other Waste Facility Excavation

Other wastes include WVHLW and spent fuel hardware. Because these waste forms produce little or no heat, they too are commingled with spent fuel containers in the same emplacement drifts.

Accounts 41041, 41042, 41043, and 41044 are not used.

41045 Emplacement Borehole Drilling/Lining (WVHLW and Hardware)

This account represents the borehole drilling and lining costs for WVHLW and hardware containers. See Account 41025 for a detailed description of this account.

Account 41050, Reexcavation, is not applicable to the current repository design.

41060 Excavated Material Handling

Development muck-handling costs, which include conveyance from the collection point (near the development face) to the top of the tuff ramp, are contained in this account. Costs are included to install and operate feeder breakers, conveyors (permanent and temporary), and underground loading areas. Operations costs include lubrication, maintenance, repair, ownership costs, and conveyor relocation and extension. Haulage of excavated material from development faces to collection points is included in the development accounts, while surface haulage is included in Account 22140.

41070 General Maintenance

Costs for general maintenance of common, spent fuel, DHLW, and other areas underground are included in this account. Maintenance includes road grading, ground support rehabilitation, trash removal, general repair of utilities, upkeep of special facilities, and removal of temporary facilities and ventilation ducts. Maintenance of both the development and active emplacement areas is included.

42000 EMPLACEMENT/RETRIEVAL OPERATIONS

All costs for waste handled underground are contained in this account. The primary cost components involve transport and emplacement of waste, borehole shielding, and plug installation. Separate accounts are provided for spent fuel, DHLW, and other high-level waste. The initial cost of the subsurface waste-handling equipment fleet is allocated to separate accounts according to the total number of containers of each waste type.

An additional level of detail separating transport costs from emplacement costs is available in the cost account structure but is not used in this cost estimate.

42010 Spent Fuel Transport and Emplacement

The total costs to handle spent fuel underground include

- purchase and operation of the waste transporters (transport and emplacement);
- installation, operation, and removal of borehole shielding closure;
- permanent shield plugs and borehole covers;
- miscellaneous in-hole hardware (e.g., container dollies for horizontal emplacement); and
- transporter/borehole alignment systems.

It is assumed that the waste-handling equipment fleet is purchased during the initial construction phase and used for dry-run tests before start-up of waste processing.

Accounts 42011, 42012, and 42013 are not used.

42020 DHLW Transport and Emplacement

The costs to handle DHLW underground are contained in this account. See Account 42010 for a detailed description of this account.

Accounts 42021, 42022, and 42023 are not used.

42030 Other Waste Transport and Emplacement

The cost to emplace WVHLW and spent fuel hardware is included in this account. See Account 42010 for a detailed description of this account.

Accounts 42031, 42032, and 42033 are not used.

42040 Waste Retrieval

Selective removal of waste packages to support the performance confirmation program is costed in this account. Selective removal begins 5 yr after the first emplacement and continues to the end of the caretaker phase. For estimating purposes, it is assumed that one container per month is retrieved using normal emplacement equipment. Each container is transported to the surface for testing, analysis, and repackaging for re-emplacement in the same hole from which it was taken. No off-normal or total retrieval scenarios have been considered.

43000 BACKFILL

Repository backfill costs are applied during the closure period only. The costs include preparation and handling of backfill and transport of the crushed tuff (muck) from the stockpile to the backfill areas. It is assumed that all subsurface drifts, ramps, and shafts are backfilled using a combination of belt conveyors and pneumatic stowage methods. Other costs include installation of bulkheads and seals and removal of the belt conveyor systems as backfilling progresses. Separate accounts are provided for the shafts and ramps and for the emplacement panels.

43010 Men-and-Materials Shaft

This account covers the cost of removing all fixtures and utilities from the men-and-materials shaft and backfilling with crushed tuff. Costs are included for multiple concrete seal plugs.

43020 Waste-Handling Access (Waste Ramp)

The cost of backfilling and sealing the waste ramp are contained in this account. Costs are included to remove portal structures and utilities and install concrete seals.

43030 Muck-Handling Access (Tuff Ramp)

Cost components described in Account 43020 apply to backfilling the tuff ramp. The tuff ramp is filled last because it contains the main conveyors that handle all backfill.

Accounts 43040, 43050, 43060, 43070, 43090, and 43120 do not apply to the current underground design.

43080 Confinement Exhaust Access 1 (Emplacement Exhaust Shaft)

The cost components described in Account 43010 apply to backfilling the emplacement exhaust shaft.

43100 Exploratory Shaft 1 (ES-1)

43110 Exploratory Shaft 2 (ES-2)

The cost components described in Account 43010 apply to backfilling both exploratory shafts.

43300 Development Areas

The cost to pneumatically backfill all emplacement drifts, access drifts, ventilation drifts, and common underground support facilities is contained in this account. Accounts 43001 through 43304 are not used. The cost to remove ducts, piping, and salvageable equipment is carried in Account 41070, General Maintenance. No credit is taken for any salvage value.

50000 UNDERGROUND SERVICE SYSTEMS

The costs for subsurface support and utilities systems (from the top of the shafts or ramps to the waste emplacement or development areas) are contained in this account. Costs to equip and operate these facilities are also included. All costs accrued before 1998 are included in the construction accounts, while costs for the following 50 yr are operations costs. Service system costs are also accrued during the closure period.

51000 SUPPORT SYSTEM FACILITIES

Support system facilities are the underground shops, offices, warehouse areas, ventilation systems, and monitoring and control rooms that operate throughout the life of the repository. The cost of excavating these facilities is in Account 41010.

51010 Material Support, Receiving/Warehousing

The primary subsurface warehouse is located near the men-and-materials shaft station. This account covers the cost to initially stock and then operate the facility throughout the life of the repository.

51011 Facilities

This account contains the cost to equip the warehouse with shelves and fixtures and then operate it for the life of the repository.

51012 Initial Inventory

This account covers the one-time cost of furnishing the underground warehouse with an inventory of parts and supplies. All inventory replacement costs are covered as material costs for the respective activity or as parts cost for equipment.

51020 Equipment Fuel Facility

Costs for this facility are contained in Account 51030, Maintenance Facility.

51030 Maintenance Facility

Separate facilities to maintain equipment for development (mining) and waste-handling are included. This account covers both the cost to equip the shop facilities and to operate them for the duration of the operations phase. When all mining and drilling operations are completed, the maintenance facilities will be consolidated into a single shop.

51031 Development Area

The cost of the shop for the development area includes a fuel storage area, shop tools, maintenance vehicles, and the operating staff of mechanics and technicians. This shop remains active throughout the life of the repository. All mining equipment is serviced and repaired in the development shop.

51032 Emplacement Area

This account covers the cost of a separate facility where preventive maintenance of the waste transporter is performed and other waste emplacement support machinery (e.g., shielding, closures, forklifts) is completely maintained. This facility also includes an equipment decontamination (washdown) area. These shops operate during the emplacement and caretaker phases only.

51040 Emergency Medical/Rescue Chamber

This account includes the cost of first-aid equipment, medical supplies, interior construction, and utility installation costs for a subsurface medical facility. Operating costs include

medical technicians, maintenance of equipment, and upkeep of the underground medical center.

51050 Ventilation System (Waste Emplacement)

Separate ventilation systems are used to isolate air used to ventilate the development areas from air used to ventilate emplacement areas. This account covers the installation and maintenance cost of air doors, air locks, regulators, and bulkheads that maintain separation of the ventilation systems. The cost of the main exhausting fans appears in Account 23083. This account includes the purchase, installation, and operating costs of portable heat exchangers used to cool emplacement drifts for inspections for vertical emplacement only. The costs of the chilled-water distribution system appear in Account 52040, while the surface chiller costs are contained in Account 22130.

51060 Ventilation System (Mine Development)

This account covers the cost of all temporary fans, ducts, and air stoppings used in the process of developing the emplacement panels. The costs to install permanent air doors between the tuff main and the service main are also included. The cost of the main system fans at the collar of the men-and-materials shaft are contained in Account 23013.

51070 Mine Water Control System

The costs to install and operate water pumping stations at the base of the emplacement exhaust shaft and the men-and-materials shaft are included in this account.

51080 Fire Protection/Control

This account covers the cost of foam fire-suppression systems at equipment refueling stations, underground fire-fighting vehicles, and maintenance of fire control equipment.

51090 Operations Support Facility

The costs for underground offices and visitor reception areas, lunch areas, shaft station waiting rooms, restrooms, and workstations (engineering and supervision) are provided here. Construction costs include interior construction, installation of utilities, and equipment. Operations costs include mobile equipment, consumables, and upkeep.

51100 Contamination Control System

The cost of a system for radiological emergencies includes a self-contained personnel and equipment decontamination facility plus a portable system for remote use. Costs are included for radiological technicians and to operate equipment. Monitoring and alarm system costs are included in Account 53010.

51110 Control Room Facility

Costs in this account are to construct the interior of the control room facilities and to operate the climate-controlled offices and workspace for monitoring the development and waste-handling operations. A computer system, and communications and data transmission equipment are housed in this area. The cost of the equipment, however, is included in the monitoring account costs (53000). Operation costs include subsurface control room staff and facility upkeep.

52000 UTILITIES

This account covers the costs to install and operate permanent utility systems from the shaft collar and ramp portals to the emplacement panels.

52010 Electrical

The cost to install and maintain the electrical distribution network is covered in this account. Other items included are the

underground lighting and installation of the transformers and switchgear. The cost of electrical power is treated as a material cost and allocated to the accounts where power is consumed, except for lighting which is included in this account.

52020 Communications

The cost of an underground telephone system, including installation and maintenance, is provided in this account.

52030 Compressed Air

A central compressed-air plant is not used in the current design thus, no costs are reported. Compressed air will be used for various underground activities but will be provided by portable electric compressors moved and located as needed. The cost of providing the compressed air is included under equipment and material costs for a specific task. Temporary pipe costs are included with the excavation cost.

52040 Chilled Water

The cost of installing and maintaining underground piping to distribute chilled water is included in this account. The cost of a surface chilled-water plant is in Account 22130, Cooling Tower and Chilled-Water Facility.

Heat exchangers for use in cooling emplacement drifts are included in the costs reported for the emplacement ventilation system (51050). A chilled-water system is required only for the vertical emplacement option.

52050 Water

Permanent and temporary service water piping is installed and maintained throughout the mining and drilling operations.

53000 MONITORING

These accounts provide costs associated with monitoring various health, safety, and performance objectives. Costs are included for the development, operations, and closure of the underground facilities.

53010 Radiological Monitoring

Costs are included to purchase, install, operate (staffing), and maintain equipment required to monitor radiation levels underground. Sensors, control wiring, data collection and transmission equipment, and alarms are included in this account.

53020 Occupational Monitoring

Costs are included to purchase, install, operate (staffing), and maintain equipment required to monitor working conditions underground (heat, humidity, pressure differentials, airflow, dust, and gas concentrations). Sensors, control wiring, data collection and transmission equipment, and alarms are included in this account.

53030 Performance Confirmation Monitoring

Costs are included to purchase, install, staff, and maintain equipment and instrumentation required to monitor host rock mechanics (e.g., stresses, temperature, deformation, and acoustic emissions), waste packages, hydrological conditions, and geophysical conditions. Sensors, control wiring, as well as data collection and transmission equipment are included.

60000 WASTE PACKAGE FABRICATION*

These cost accounts include the cost to fabricate waste container parts, quality assurance (NQA-1), materials, and delivery (placing

*Waste package fabrication in this context is synonymous with the use of container in Table D-3.

on pallets, shipping, and handling) charges. Costs to assemble the waste container are not included here but are included in the 21000 accounts. All costs are operations costs and are accrued during the emplacement and caretaker periods. Additional waste container components for repackaging during performance confirmation are also included.

61000 SPENT FUEL

The cost of containers for spent fuel is included in this account. Several subaccounts detail the waste container costs by waste form.

61010 Intact PWR

The cost of containers for PWR intact spent fuel assemblies is included here.

61020 Intact BWR

The cost of containers for BWR intact spent fuel assemblies is included here.

61030 Consolidated PWR

The cost of containers for PWR consolidated spent fuel is included here.

61030 Consolidated BWR

The cost of containers for BWR consolidated spent fuel is included here.

62000 DHLW

The cost of DHLW containers is included here.

63000 OTHER WASTE

Costs for other containers are included in this account and are broken down by waste type.

63010 Spent Fuel Hardware

Costs for package components (drums, canister, containers) for spent fuel hardware (consolidated waste) are included in this account.

63020 High Activity (Remote-Handled)

Costs are for drums, canisters, and containers for remote-handled waste, such as site-generated spent resins, filters, and sludges.

63030 WVHLW and CHLW

Costs for waste package components for WVHLW and CHLW are included in this account.

63040 Contact-Handled

Costs are included to purchase standard drums or boxes in which to compact or solidify site-generated contact-handled wastes (trans-uranic or low-level waste). Costs include solidification materials as required. The costs to dispose site-generated waste offsite are also included here.

99999 Total Repository Costs

This account represents the sum of all costs for each phase.

APPENDIX C

FACILITIES DATA SHEETS

TABLE C-1

SURFACE FACILITIES DATA FOR VERTICAL OR HORIZONTAL EMPLACEMENT

Cost Account	Building	Functional Areas		Type of Construction	Principal Dimensions (ft)	Total Floor Area (ft^2)	Building Volume ($1,000\ ft^3$)
21100	WHB-1	• Receiving/shipping bays • Unloading/containerization hot cell • Operating gallery • Remote maintenance cell • Decontamination area • Surface storage vault	• Personnel annex - Control room - Change room - Laboratories - Health physics - Offices	High bay structural steel frame receiving and shipping area; multi-level reinforced-concrete hot cells; a steel frame/insulated siding personnel annex	315 x 360	129,000	3,863
21200	WHB-2	• Receiving/shipping bays • Cask area • Unloading hot cell • Consolidation hot cells • Waste packaging hot cells • Operating gallery • Remote maintenance cell • Decontamination area	• Surface storage vault • Personnel annex - Control room - Change room - Laboratories - Health physics - Offices	High bay structural steel frame receiving and shipping area; multi-level reinforced-concrete hot cells; a steel frame/insulated siding personnel annex	492 x 484	321,000	10,477
21501	Site-generated radioactive waste treatment facility	• Liquid radioactive waste-treatment area • Waste solidification for loading and unloading • Solid radioactive waste treatment area	• Loading/unloading area • Office and laundry area • Health physics	Two-story reinforced-concrete construction with a high bay structural steel frame area	128 x 208	30,850	770
21502	Vehicle wash facility	• Drive-through vehicle wash area	• Mechanical room	Single-story structural steel frame with concrete block wall	40 x 100	4,000	80
21503	Decontamination building	• Vehicle and cask decontamination bay • Small component and tool decontamination room	• Health physics • Mechanical/electrical room • Offices	High bay structural steel frame with insulated metal siding	60 x 90	6,600	324
21504	Performance confirmation (diagnostic) facility	• Unloading bay • Hot cell • Machining chamber • Mechanical/electrical room	• Operating gallery • Lab area • Change room • Offices	Structural steel frame with insulated metal siding; a multilevel interior reinforced-concrete hot cell	125 x 190	27,300	1,020
22010	Health physics building	• Storage for contamination detection equipment		Single-story structural steel frame with insulated metal siding	20 x 20	400	5
22010	Medical facilities	• Examination rooms • X-ray • Medical labs	• Offices • Waiting room • Ambulance garage	Single-story structural steel frame with insulated metal siding	40 x 175	8,200	90

TABLE C-1

SURFACE FACILITIES DATA FOR VERTICAL OR HORIZONTAL EMPLACEMENT
(continued)

Cost Account	Building	Functional Areas		Type of Construction	Principal Dimensions (ft)	Total Floor Area (ft^2)	Building Volume ($1,000\ ft^3$)
22020	Fire protection facilities	• Apparatus room • Communications room • Firemen's quarters	• Offices • Equipment storage • Lockers and showers • Lunchroom	Single-story structural steel frame with insulated metal siding	85 x 100	7,600	105
22030	Security Station 1	• Waiting room • Offices • Badge distribution • Communications center	• Records storage • Security administration • Lockers/showers	Two-story structural steel frame with insulated metal siding	50 x 80	8,000	110
22030	Security Station 2	• Security check station • Health physics • Offices		Single-story structural steel frame with insulated metal siding	65 x 80	3,000	41
22030	Security Station 3	• Health physics • Offices		Single-story structural steel frame with insulated metal siding	40 x 60	2,400	34
22030	Security station at men-and-materials shaft	• Security check station		Single-story structural steel frame with insulated metal siding	20 x 20	400	5
22040	Shops	• Shop areas for each craft • Mechanical/electrical room		Single-story structural steel frame with insulated metal siding	120 x 200	24,000	384
22040	Motor pool and facility service station	• Dispatch office • Carwash area	• Fuel storage • Paved parking	Single-story structural steel frame with insulated metal siding	30 x 40	1,200	19.2
22040	Waste operations area garage	• Transporter storage • Parts storage	• Change room • Offices	Single-story structural steel frame with insulated metal siding	50 x 150	7,500	135
22050	Administration building	• Offices • Laboratories • Training rooms	• Data analysis • Operations monitoring	Two-story structural steel frame with insulated metal siding	100 x 220	44,000	561
22050	Food service facility	• Kitchen • Storage space	• Serving area • Lunchroom	Single-story structural steel frame with insulated metal siding	60 x 180	11,000	181
22050	Training auditorium	• Area with 50-seat capacity		Single-story structural steel frame with insulated metal siding	25 x 40	1,000	18

TABLE C-1

SURFACE FACILITIES DATA FOR VERTICAL OR HORIZONTAL EMPLACEMENT
(concluded)

Cost Account	Building	Functional Areas		Type of Construction	Principal Dimensions (ft)	Total Floor Area (ft^2)	Building Volume ($1,000\ ft^3$)
22060	Training/mock-up building	• High bay mock-up room • Classrooms	• Offices	Single-story structural steel frame with insulated metal siding	72 x 120	9,840	432
22070	Warehouse and receiving	• Storage space • Receiving/shipping dock	• Offices	Single-story (clear height 23 ft) structural steel frame with insulated metal siding	200 x 285	57,000	1,602
22080	Visitors' center	• Display room • Auditorium	• Meeting rooms	Single-story structural steel frame with insulated metal siding	50 x 80	4,000	60
22090	Main substation and standby generator building	• Electrical switchgear • Standby generators		Single-story structural steel frame with insulated metal siding	40 x 90	3,600	50
22090	Standby generator at men-and-materials shaft	• Electrical switchgear • Standby generators		Single-story structural steel frame with insulated metal siding	30 x 60	1,800	22
22100	Change room facility	• Shower and change rooms • First aid/mine rescue	• Training area • Offices	Single-story structural steel frame with insulated metal siding	80 x 100	8,000*	148
22220	Control and monitoring facility	• Computer room • Offices	• Mechanical room	Single-story reinforced-concrete structure	60 x 65	4,000	65
23012	Hoist house (men-and-materials shaft)	• Hoist control center		Single-story structural steel frame with insulated metal siding	50 x 50	2,760	71
23013	Ventilation building (development)	• Supply ventilation fans		Single-story structural steel frame with insulated metal siding	105 x 226	23,700*	617
23083	Ventilation building (confinement exhaust facility)	• HEPA filters, ventilation fans • Offices		Single-story structural steel frame with insulated metal siding	219 x 410	60,130*	1,870

*The size of these facilities is reduced for horizontal emplacement, and although the exact dimensions are not known at this time, an estimated reduction in costs has been included in the estimate.

TABLE C-2

SUBSURFACE SUPPORT FACILITY DATA FOR VERTICAL AND HORIZONTAL EMPLACEMENT

Cost Account		Facility Name	Functional Areas		Excavation and Lining Method	Total Floor Area Vertical (ft)	Total Floor Area Horizontal (ft)
DEVELOPMENT SERVICE FACILITIES							
41013 51031	Excavate Equip	Maintenance facility, development area	• General shop • Preventive maintenance and lubrication • Refueling bay • Drill machine repair area • Hydraulic shop • Machine shop • Tire shop • Welding and fabrication • Battery shop • Electrical and instrumentation • Maintenance office • Used oil collection and handling area • Lunch room • Ambulance and first aid • Toilets and washup area • Parking	• Underground service facilities will be fully equipped for preventive maintenance and for most repair functions.	Drill and blast Shotcrete lining Poured concrete floor	37,000	25,100

TABLE C-2

SUBSURFACE SUPPORT FACILITY DATA FOR VERTICAL AND HORIZONTAL EMPLACEMENT
(continued)

Cost Account	Facility Name	Functional Areas		Excavation and Lining Method	Total Floor Area Vertical (ft)	Total Floor Area Horizontal (ft)
DECONTAMINATION FACILITY AND EMPLACEMENT SERVICE FACILITIES						
41013 Excavate 51032 Equip	Maintenance facility, emplacement	• General repair • Preventative maintenance and lubrication • Wash bay • Welding and hydraulic shop • Tire shop • Utility and pipe shop • Electrical and instrumentation shop • Used oil collection handling • Ventilation regulator • Lunch room • Maintenance office • Toilets and washroom • Parking	• Underground service facilities are fully equipped for preventive maintenance and for most repair functions.	Drill and blast Shotcrete lining Concrete floor	15,500	15,500
41013 Excavate 51032 Equip	Warehousing, emplacement	• Parts warehousing and handling • Ground support supplies • Ventilation supplies • Utility supplies • Electrical and instrumentation supplies • Engine oil and grease storage • Hand tools • Fire extinguishing equipment and supplies • Warehouse office	• Spare parts and components stocked underground to allow repair of machinery and vehicles stationed permanently in the active emplacement areas	Drill and blast Shotcrete lining Concrete floor	6,300	6,300

TABLE C-2

SUBSURFACE SUPPORT FACILITY DATA FOR VERTICAL AND HORIZONTAL EMPLACEMENT
(continued)

Cost Account		Facility Name	Functional Areas		Excavation and Lining Method	Total Floor Area Vertical (ft)	Total Floor Area Horizontal (ft)
41013 51010	Excavate Equip	Material support, receiving/ warehousing	• Bulk fuel storage area • Bulk oil and grease storage area • General warehouse • Explosives storage • Warehouse office • Sand storage • Pipe shop • Electrical substation and switching	• Spare parts and components will be stocked underground to allow repair or replacement with a minimum of delay in essential operations.	Drill and blast Shotcrete lining Concrete floor, where necessary	15,3000	12,900
41013 51110 53000	Equip Excavate	Underground management support	• Operation managers and control area • Development office • Surveying and engineering of office • Training gear storage	• This facility provides general underground office space for supervision, monitoring, and technical support.	Drill and blast Shotcrete lining Concrete floor	4,000	4,000
41013	Excavate	Support facilities	• Temporary staging for incoming and outgoing materials and supplies		Drill and blast Shotcrete lining Concrete floor	12,050	11,900

TABLE C-2

SUBSURFACE SUPPORT FACILITY DATA FOR VERTICAL AND HORIZONTAL EMPLACEMENT
(concluded)

Cost Account		Facility Name	Functional Areas	Excavation and Lining Method	Total Floor Area Vertical (ft)	Total Floor Area Horizontal (ft)
41013 51100	Excavate Equip	Contamination control facility	• Decontamination central office • Office/communication/ supplies/instruments • Sign in/sign out • Change room/anti-contamination room • Personnel monitoring area • Limited medical treatment • Decontamination equipment and storage • Emergency equipment room	Drill and blast Shotcrete lining Concrete floor	20,550	20,550

TABLE C-3

PHYSICAL DATA FOR THE SUBSURFACE FACILITY

Cost Account	Account Description	Vertical Emplacement: Cross-Section Dimensions (ft)	Vertical Emplacement: Total Length (ft)	Vertical Emplacement: Volume (1,000 ft^3)	Horizontal Emplacement: Cross-Section Dimensions (ft)	Horizontal Emplacement: Total Length (ft)	Horizontal Emplacement: Volume (1,000 ft^3)
30000	SHAFTS/RAMPS--UNDERGROUND						
30010	Man-And-Materials Shaft	20 dia	1,090	433,390	20 dia	1,090	433,390
30020	Waste Ramp	23 dia	6,603	2,746,850	21 dia	6,603	2,284,640
30030	Tuff Ramp	25 dia	4,627	2,271,860	21 dia	4,627	1,600,940
30080	Emplacement Exhaust Shaft	20 dia	1,040	413,510	20 dia	1,040	413,510
30100	Exploratory Shaft 1	12 dia	1,480	244,390	12 dia	1,480	244,390
30110	Exploratory Shaft 2	6 dia	1,020	51,270	6 dia	1,020	51,270
40000	SUBSURFACE EXCAVATIONS						
41010	Common Facility (Shaft Pillar) Excavation						
41011	Main drifts	Variable	5,900	2,478,000	Variable	5,900	2,177,100
41012	Ventilation drifts	Variable	7,285	2,557,040	Variable	7,285	2,557,040
41013	Support facilities	Variable	6,835	2,016,330	Variable	5,930	1,784,930
41014	Training areas	21 x 14	500	129,500	21 x 14	500	129,500
41015	Performance confirmation area	21 x 14	500	129,500	21 x 14	500	129,500
41020	Spent Fuel Facility Excavation (DHLW and Other Wastes)						
41021	Service main	25 x 15	9,120	2,973,120	25 x 15	9,120	2,973,120
41021	Tuff main	25 x 19	9,120	3,885,120	25 x 19	9,120	3,885,120
41021	Waste main	25 dia	9,120	4,447,920	21 dia	9,120	3,155,520
41022	Panel access drifts	21 x 14	85,350	22,104,610	21 x 14	85,346	22,104,610
41023	Perimeter ventilation drift	23 dia	26,555	11,046,880	23 dia	26,555	11,046,880
41023	Midpanel drifts	16 x 14	37,750	7,701,000	NA	0	0
41024	Emplacement drifts	16 x 22	401,479	133,291,030	23 x 13	75,260	19,341,820

NA Not applicable.

APPENDIX D

CONTAINER DATA

TABLE D-1

SUMMARY OF CONTAINER COST ESTIMATES[a]

Description	Weight (lb)	RFQ Bid ($)	Shipping ($)	Packaging/ Handling ($)	Subtotal ($)	NQA-1 ($)	Total ($)
BWR[b], 26" x 15'	2,840	9,100	341	170	9,611	2,403	12,014
PWR[b], 26" x 15'	2,565	8,400	308	154	8,862	2,215	11,077
DHLW[c] and WVHLW[c], 26" x 11'	1,580	5,500	190	95	5,784	1,446	7,230
Hardware container, 26" x 15'	2,060	7,150	247	124	7,521	1,880	9,401

a. The cost of all containers is based upon the following assumptions:
   - welded 304 low-carbon stainless steel,
   - SNL design, and
   - NQA-1 fabrication.

b. PWR and BWR container costs are averaged vendor quotes for a 2,000-unit lot and the dimensions appear in the "Site Characterization Plan-Conceptual Design Report."

c. DHLW, WVHLW, and hardware container costs are extrapolated from the PWR/BWR shell costs.

TABLE D-2

WASTE RECEIPT SCHEDULE FOR SPENT FUEL ASSEMBLIES AND SHIPPING CASK[a]

Year	DHLW/ WVHLW (MTU)	PWR MTU	PWR Assemblies	BWR MTU	BWR Assemblies	SHIPPING CASKS[b] Spent Fuel Rail	Spent Fuel Truck	DHLW Rail	WVHLW Truck
1998	0	240	520	160	873	18	304	0	0
1999	0	240	520	160	873	18	304	0	0
2000	0	240	520	160	873	18	304	0	0
2001	0	540	1,170	360	1,964	41	685	0	0
2002	0	1,080	2,340	720	3,928	83	1,369	0	0
2003	400	1,800	3,901	1,200	6,547	139	2,282	0	194[c]
2004	400	1,800	3,901	1,200	6,547	139	2,282	0	436[c]
2005	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2006	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2007	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2008	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2009	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2010	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2011	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2012	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2013	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2014	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2015	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2016	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2017	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2018	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2019	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2020	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2021	400	1,800	3,901	1,200	6,547	139	2,282	0	800
2022	400	660	1,430	440	2,400	51	837	0	800
TOTAL	8,000	37,200	80,619	24,800	135,304	2,870	47,161	0	15,030

a. Data from O'Brien et al. (in preparation).
b. Assumes 1/2 MTU per DHLW/WVHLW waste container and one container per truck cask.
c. Assumes WVHLW consists of 640 MTU in 310 canisters.
d. Transportation is 70% truck and 30% rail.

TABLE D-3

WASTE EMPLACEMENT SCHEDULE

Year	PWR Containers Intact	PWR Containers Consolidated	BWR Containers Intact	BWR Containers Consolidated	Hardware Containers	DHLW/WVHLW Containers
1998	173	0	145	0	0	0
1999	173	0	145	0	0	0
2000	173	-	145	0	0	0
2001	195	98	164	55	9	0
2002	234	273	196	153	25	0
2003	130	585	109	327	55	194
2004	130	585	109	327	55	436
2005	130	585	109	327	55	800
2006	130	585	109	327	55	800
2007	130	585	109	327	55	800
2008	130	585	109	327	55	800
2009	130	585	109	327	55	800
2010	130	585	109	327	55	800
2011	130	585	109	327	55	800
2012	130	585	109	327	55	800
2013	130	585	109	327	55	800
2014	130	585	109	327	55	800
2015	130	585	109	327	55	800
2016	130	585	109	327	55	800
2017	130	585	109	327	55	800
2018	130	585	109	327	55	800
2019	130	585	109	327	55	800
2020	130	585	109	327	55	800
2021	130	585	109	327	55	800
2022	48	215	40	120	20	800
TOTAL	3,466	11,701	2,906	6,541	1,099	15,030

TABLE D-4

CONTAINER COST ESTIMATE

Waste Type	Number of Containers	Unit Price ($)	Bare Costs ($1000s)	Contingency (20% of $)	Total ($1000s)
WVHLW	310	7,230	2,241	448	2,690
DHLW	14,720	7,230	106,426	21,285	127,711
Intact PWR	3,466	11,077	38,393	7,679	46,071
Consolidated PWR	11,701	12,014	140,576	28,115	168,691
Intact BWR	2,906	12,014	34,913	6,983	41,895
Consolidated BWR	6,541	12,014	78,584	15,717	94,300
BWR Hardware	1,099	9,401	10,332	2,066	12,398
Performance Confirmation (19 yr x 12 mo x 1 container/mo)	228	11,545	2,632	526	3,159
Total Emplacement Phase	40,971		414,096	82,819	496,915
Performance Confirmation During Caretaking (26 yr x 1 container/mo)	312	11,545	3,602	720	4,322
Total	41,283		417,698	83,540	501,237

APPENDIX E

STAFFING DATA

TABLE E-1

SURFACE REPOSITORY WORKERS
(for a representative year--vertical emplacement)

Cost Account	Description	Contingency (%)	Construction 1996	Contingency	Emplacement Operations 2005	Contingency	Caretaker Operations 2025	Contingency	Decommissioning 2049	Contingency
	SITE PREPARATION	20	130	26	3	1	1	0	78	16
	WASTE HANDLING									
21100	WHB-1	40	a		39	16	0	0	a	
21200	WHB-2	40	a		203	81	0	0	a	
21501	Site-generated waste treatment	40	a		9	4	0	0	a	
	Performance confirmation	40	a		17	7	12	5	a	
	Subtotal[b]		930	372	268	107	12	5	131	52
	BALANCE OF PLANT									
22010	Health and medical	30	a		12	4	0	0	a	
22020	Fire protection	30	a		15	5	1	0	a	
22030	Security	30	a		83	25	27	8	a	
22040	Maintenance	30	a		131	40	9	3	a	
22050	Administration	30	a		185	56	23	7	a	
22060	Training	30	a		6	2	0	0	a	
22070	Warehousing and receiving	30	a		17	5	0	0	a	
22080	Visitors' center	30	a		3	1	3	1	a	
22140	Excavated tuff storage	30	a		4	1	0	0	a	
22220	Monitoring	35	a		50	18	0	0	a	
22240	Other (batch plant)	30	a		4	1	0	0	a	
23013	Ventilation building (men-and-materials)	30	a		0		0		a	
23083	Ventilation building (emplacement exhaust)	30	a		0		0		a	
	Subtotal		260	82	510	157	63	19	56	17
	Surface subtotal		1,320	480	781	264	76	24	265	85
	SURFACE TOTAL		1,800		1,045		100		350	

a. Staffing during construction and decommissioning was only calculated at the summary level. See subtotal below.
b. The surface staffing for the vertical emplacement method is the same as for the horizontal emplacement method (see Table E-3) for the selected representative year in each phase except for the last 6 yr of decommissioning.

TABLE E-2

SUBSURFACE REPOSITORY WORKERS
(for a representative year--vertical emplacement)

Cost Account	Description	Contingency	Construction 1996	Contingency	Emplacement Operations 2005	Contingency	Caretaker Operations 2025	Contingency	Decommissioning 2049	Contingency
	SUBSURFACE:									
	SHAFTS AND RAMPS									
23000	Shaft facilities, subsurface	30	14	4	8	2	5	2	8	2
30000	Shafts and ramps, subsurface	30	56	16	4	1	4	1	2	1
	Subtotal		70	20	12	3	9	3	10	3
	EXCAVATION/BACKFILL									
41010	Common facs. mains, ventilation and support	30	16	5	0	0	0	0	0	0
41020	Spent fuel facility excavation	25	90	21	83	21	0	0	0	0
41060	Excavated material handling	30	11	3	5	2	0	0	0	0
41070	General (drift) maintenance	25	11	3	21	5	12	3	13	3
43000	Backfill	40	0	0	0	0	0	0	47	19
	Subtotal		128	32	109	28	12	3	60	22
	EMPLACEMENT HOLE PREPARATION									
41025	SF borehole drilling/lining	35	29	9	38	14	0	0	0	0
41035	DHLW borehole drilling/lining	35	0	0	28	10	0	0	0	0
41045	WVHLW and SF hardware borehole drill/line	35	0	0	2	1	0	0	0	0
	Subtotal		29	9	68	25	0	0	0	0
	EMPLACEMENT									
42010	SF transport and emplacement (T&E)	35	0	0	8	3	0	0	0	0
42020	DHLW T&E	35	0	0	6	2	0	0	0	0
42030	WVHLW and SF hardware T&E	35	0	0	0	0	0	0	0	0
42040	Selected waste recovery	40	0	0	0	0	0	0	0	0
	Subtotal		0	0	14	5	0	0	0	0
	SUPPORT SERVICES									
51010	Material receiving/warehousing	25	21	5	19	5	9	3	14	4
51030	Equipment maintenance facilities	30	81	24	132	40	13	4	20	6
51040	Emergency medical facilities	25	11	3	7	2	1	0	7	2
51050	Ventilation system emplacement area	30	4	1	8	2	3	1	11	3
51060	Ventilation system development area	30	11	3	12	4	0	0	0	0
51070	Water control	25	3	0	1	0	1	0	1	0
51080	Fire protection	25	1	0	0	0	0	0	0	0
51090	Operations support and control facilities	25	1	0	0	0	0	0	0	0
51100	Contamination control facilities	30	11	3	10	3	6	2	9	3
51110	Control room facility	25	11	3	9	2	10	3	0	0
52000	Utilities	25	8	2	6	1	4	1	14	4
53000	Monitoring	30	16	5	27	8	12	3	10	3
	Subtotal		179	49	231	67	59	17	86	25
			406	110	434	128	80	23	156	50
	SUBSURFACE TOTAL		516		562		103		206	

TABLE E-3

SURFACE REPOSITORY WORKERS
(for a representative year--horizontal emplacement)

Cost Account	Description	Contingency	Construction 1996	Contingency	Emplacement Operations 2005	Contingency	Caretaker Operations 2025	Contingency	Decommissioning 2049	Contingency
	SITE PREPARATION	20	130	26	3	1	1	0	78	16
	WASTE HANDLING									
21100	WHB-1	40	a		39	16	0	0	a	
21200	WHB-2	40	a		203	81	0	0	a	
21501	Site-generated waste treatment	40	a		9	4	0	0	a	
	Performance confirmation	40	a		17	7	12	5	a	
	Subtotal[b]		930	372	268	107	12	5	131	52
	BALANCE OF PLANT									
22010	Health and medical	30	a		12	4	0	0	a	
22020	Fire protection	30	a		15	5	1	0	a	
22030	Security	30	a		83	25	27	8	a	
22040	Maintenance	30	a		131	40	9	3	a	
22050	Administration	30	a		185	56	23	7	a	
22060	Training	30	a		6	2	0	0	a	
22070	Warehousing and receiving	30	a		17	5	0	0	a	
22080	Visitors' center	30	a		3	1	3	1	a	
22140	Excavated tuff storage	30	a		4	1	0	0	a	
22220	Monitoring	35	a		50	18	0	0	a	
22240	Other (batch plant)	30	a		4	1	0	0	a	
23013	Ventilation building (men-and-materials)	30	a		0		0		a	
23083	Ventilation building (emplacement exhaust)	30	a		0		0		a	
	Subtotal		260	82	510	157	63	19	56	17
	Surface subtotal		1,320	480	781	264	76	24	265	85
	SURFACE TOTAL		1,800		1,045		100		350	

a. Subaccount staffing data for construction and decommissioning is not available.

b. It is coincidental that the surface staffing for the vertical emplacement method is the same as for the horizontal emplacement method (see Table E-1) for the selected representative year in each phase. Staffing in the other years varies slightly but not to the degree that the subsurface does.

TABLE E-4

SUBSURFACE REPOSITORY WORKERS
(for a representative year--horizontal emplacement)

Cost Account	Description	Contingency	Construction 1996	Contingency	Emplacement Operations 2005	Contingency	Caretaker Operations 2025	Contingency	Decommissioning 2049	Contingency
	SUBSURFACE:									
	SHAFTS AND RAMPS									
23000	Shaft facilities, subsurface	30	13	4	8	2	5	2	8	2
30000	Shafts and ramps, subsurface	30	57	16	4	1	4	1	2	1
	Subtotal		70	20	12	3	9	3	10	3
	EXCAVATION/BACKFILL									
41010	Common face. mains, vent & support	30	15	4	0	0	0	0	0	0
41020	Spent fuel facility excavation	25	53	12	27	7	0	0	0	0
41060	Excavated material handling	30	11	3	6	2	0	0	0	0
41070	General (drift) maintenance	25	11	3	13	3	8	2	13	3
43000	Backfill	40	0	0	0	0	0	0	47	19
	Subtotal		90	22	46	12	8	2	60	22
	EMPLACEMENT HOLE PREPARATION									
41025	SF borehole drilling/lining	35	26	9	52	19	0	0	0	0
41035	DHLW borehole drilling/lining	35	3	1	26	9	0	0	0	0
41045	LVHLW and SF hdwr borehole drill/line	35	6	2	0	0	0	0	0	0
	Subtotal		35	12	78	28	0	0	0	0
	EMPLACEMENT									
42010	SF transport and emplacement (T&E)	35	0	0	7	3	0	0	0	0
42020	DHLW T&E	35	0	0	5	2	0	0	0	0
42030	LVHLW and SF hardware T&E	35	0	0	0	0	0	0	0	0
42040	Selected waste recovery	40	0	0	2	1	2	0	0	0
	Subtotal		0	0	14	6	2	0	0	0
	SUPPORT SERVICES									
51010	Material receiving/warehousing	25	20	5	18	4	9	3	13	3
51030	Equipment maintenance facilities	30	61	18	70	21	11	4	17	6
51040	Emergency medical facilities	25	11	3	7	2	1	0	7	2
51050	Ventilation system emplacement area	30	1	0	2	1	1	0	0	0
51060	Ventilation system development area	30	6	2	6	2	0	0	0	0
51070	Water control	25	3	1	1	0	1	0	1	0
51080	Fire protection	25	1	0	0	0	0	0	0	0
51090	Operations support and control facilities	25	1	0	0	0	0	0	0	0
51100	Contamination control facilities	30	11	3	10	3	6	2	9	3
51110	Control room facility	25	10	2	9	2	10	3	0	0
52000	Utilities	25	8	2	4	1	2	1	4	1
53000	Monitoring	30	16	4	27	8	13	4	13	4
	Subtotal		149	40	154	44	54	17	64	19
	Surface subtotal		344	94	304	93	73	22	134	44
	SUBSURFACE TOTAL		438		397		95		178	

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