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Fiscal Implications of a 1-Mill/kWh Waste Management Fee

R. L. Engel
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December 1982

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
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Richland, Washington 99352

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1.0 SUMMARY

The federal government has the responsibility to provide safe, permanent disposal of radioactive wastes from the commercial nuclear fuel cycle. The government costs for providing this service will be recovered by collecting fees from utilities generating nuclear wastes. In the past, it was assumed that such fees would be collected as waste was delivered to the federal government (DOE-ET-0055). This procedure would result in a several billion dollar outlay of federal funds for site exploration and development and for facility construction prior to the receipt of any revenues from utilities. This year, Congress is considering legislation that proposes collecting a 1-mill/kWh fee from utilities as nuclear generated electricity is produced. This alternative would provide funds to offset the cost of siting and deploying waste management facilities.

This report examines the variations in parameters and uncertainties that can affect future waste management program costs. The activities that were included in the waste management program cost estimate are summarized in Table 1.1. Costs were estimated for both spent fuel and reprocessing waste disposal.

Costs for repository site exploration and development, construction and operation of the first two repositories, and waste transportation of either spent fuel or reprocessing waste to the repository were included in the estimate of program costs. Costs for disposing of either spent fuel or reprocessing wastes in four generic geologic media (domed salt, bedded salt, tuff, and granite) were estimated considering uncertainties in package design, waste preparation, mining cost, repository layout, repository startup date, and waste shipment distance. The range of these costs is then compared with estimated revenues from the proposed 1-mill/kWh fee to determine whether that fee would provide sufficient funds to meet waste management program needs. Figure 1.1 shows the estimated revenues and the range of program cost estimates in 1982 dollars resulting from these variations and uncertainties. The figure shows that the assumed 1-mill/kWh fee provides sufficient revenues to meet program costs for the range of conditions considered.

TABLE 1.1. Activities Included in Waste Management System

Activity Category	Activities Included Spent Fuel Disposal Option	Activities Included Reprocessing Waste Disposal
Repository exploration and development	Site identification Site characterization Test and evaluation facility Technology development for repository Related programs	Site identification Site characterization Test and evaluation facility Technology development for repository Related programs
Waste transportation	Spent fuel from reactor to repository	Solidified high level waste and transuranic wastes from reprocessor to repository
Waste storage (delayed repository variation only)	Spent fuel interim storage in steel storage casks	Interim waste storage • high level waste in steel storage casks • remote handled transuranic waste in concrete casks • contact handled transuranic waste in concrete building
Waste preparation	Dissassemble spent fuel rods Overpack	Overpack high level waste cannisters
Disposal	Spent fuel packages and assembly hardware cannisters commingled in boreholes	High level waste packages and remote handled transuranic waste cannisters commingled in boreholes Contact handled transuranic waste stacked in separate mined rooms

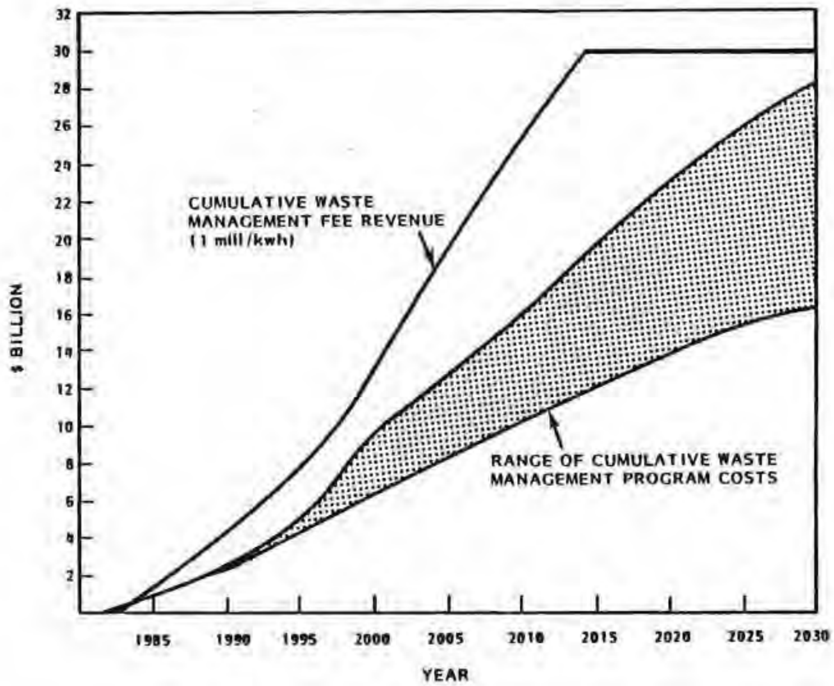

FIGURE 1.1. Cumulative Estimated Waste Management Program Costs and Fee Revenue (Constant 1982 Dollars)

Levelized unit waste management costs were calculated for each combination of spent fuel or reprocessing waste disposal and geologic medium, and for each parameter variation or cost uncertainty. These levelized unit costs were then compared to determine the relative impact of changes in key parameters or cost uncertainties on program cost. Table 1.2 summarizes the results for spent fuel or reprocessing waste disposal for the reference design and cost parameters. The table shows that disposal of reprocessing waste is projected to be less expensive than disposing of spent fuel in each of the geologic media. The selection of a geologic medium appears to have little impact on total cost. This result is for generic or representative properties for each medium and cannot be generalized for site specific comparisons.

TABLE 1.2. Levelized Unit Costs for Reference Design and Cost Assumptions ($/kg Spent Fuel or Reprocessing Waste Equivalent)

	Domed Salt	Bedded Salt	Tuff	Granite
Spent Fuel Disposal	155	157	160	163
Reprocessing Waste Disposal	146	148	153	155

The impact of variation in key design parameters and cost uncertainties was evaluated. Variations in waste package design and repository layout, and uncertainty in waste packaging cost, mining cost, waste transportation distance and repository startup date were considered. Of these, only the uncertainty in mining cost for tuff and granite geologies varied the waste management unit cost more than 10%. Table 1.3 shows the variation in levelized unit waste management cost resulting from uncertainty in mining cost. This uncertainty has a greater impact on spent fuel disposal costs than reprocessing waste disposal costs because for the reference assumptions, more underground area is mined in a spent fuel disposal repository.

TABLE 1.3. Sensitivity of Waste Management Levelized Unit Cost to Mining Cost Uncertainty

	Unit Cost Variation ($/kg)		
	Salt	Tuff	Granite
Spent Fuel Disposal	-3 to +7	-5 to +42	-6 to +24
Reprocessing Waste Disposal	-2 to +5	-3 to +28	-4 to 15

Collection of a 1-mill/kWh fee at the time fuel is irradiated will result in the federal government precollecting for future waste management services. The relationship between funds accumulated to offset future waste management liabilities and the estimated cost of these liabilities will depend on the inflation rate and on the interest the federal government earns on the accumulated funds. If inflation continues, future fee adjustments will be required to assure that adequate funds are available to dispose of wastes when they are received. Figure 1.2 shows when such adjustments must begin as a function of the inflation rate and the real, or inflation corrected, rate of return on accumulated funds. The figure shows that if the interest rate equals the inflation rate (0% real return) then the adjustments will be required approximately two years earlier than if the interest rate is 2% above the inflation rate. It also shows that for low inflation rates (2%-3%), the 1-mill/kWh fee could remain constant until the late 1980's. If 10% inflation is experienced, an adjustment will be required by 1985.

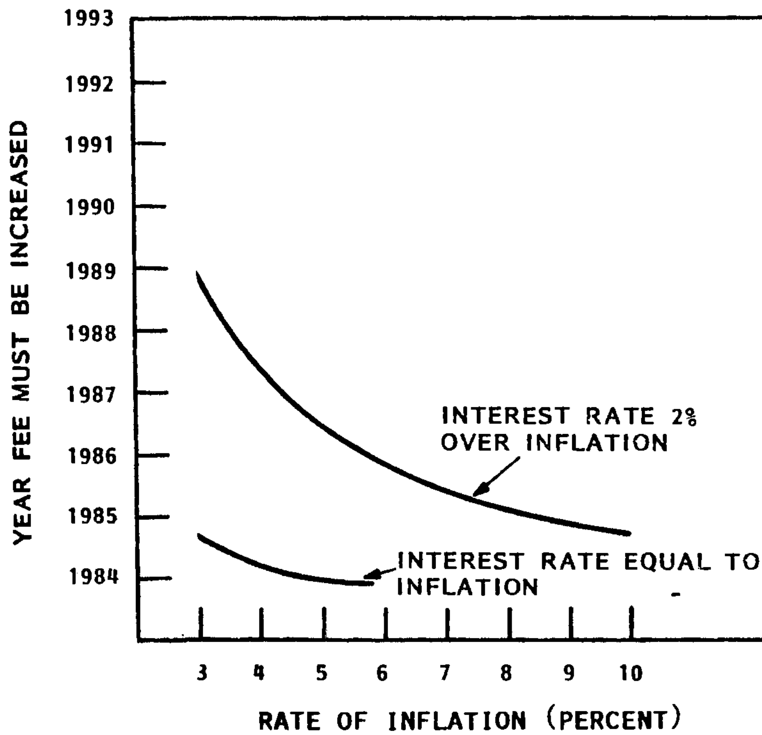

FIGURE 1.2. Year Fee Adjustments Are Required With Continued Inflation

2.0 INTRODUCTION

This year, Congress is considering legislation that proposes collecting a 1-mill/kWh fee from utilities as nuclear generated electricity is produced. This alternative would provide funds to offset the cost of siting and deploying waste management facilities. The projected revenues were compared to estimated waste management program costs to determine whether the proposed 1-mill/kWh fee is sufficient. Costs for repository site exploration and development, repository construction and operation, and waste transportation to the repository were included in the estimate of program costs. The exploration and development cost data and the repository cost data were developed by the Office of NWTS Integration (N/TM-3).

This report examines the range of estimated waste management program costs that results from variation of major system parameters or the uncertainty in major system cost components. Currently, both spent fuel and reprocessing wastes must be considered as possible waste forms for ultimate disposition. There are several candidate geologic media under consideration as hosts for waste repositories. There are system design and cost uncertainties that cannot be resolved until repository licensing issues are resolved. Many costs depend on the characteristics of the actual sites that are selected for repositories. The cost impact of the variation or uncertainty in many of these parameters is examined in this report based on current waste management program assumptions and repository design concepts.

The assessment of a 1-mill/kWh fee at electricity generation results in the precollection of funds by the federal government for future waste management services. These funds must be managed to assure that money will be available to pay for the cost of managing wastes when they are received. The inflation rate and the interest earnings on accumulated funds can have a major impact on the sufficiency of funds available to satisfy the federal government's future waste management liability. If there is continued inflation, the 1-mill/kWh fee will have to be adjusted to insure sufficient funds. This report examines the relationship between when such adjustments might occur and the key financial parameters.

The key results of these analyses are described in the summary. Section 3.0 discusses the comparison of program costs and revenues, and the relationship between the timing for future fee adjustments and the key financial parameters. Section 4.0 describes the waste management program assumptions used in this analysis. Section 5.0 presents an analysis of the sensitivity of waste management program cost to variation of key parameters. The relationship between the results of these cost estimates and previously published waste management estimates is described in Section 6.0.

3.0 CASH FLOW ANALYSIS RESULTS

This section of the report compares the range of projected program costs to revenues and examines the impact on future cash flows of uncertainty in financial parameters. Section 3.1 describes the revenue projection corresponding to waste for the first two repositories. Section 3.2 discusses the waste management fund concept. Section 3.3 examines the relationship between future revenue requirements, inflation, and interest earnings for the waste management fund.

3.1 REVENUE PROJECTION

Revenues to offset the costs for the first two repositories are assumed to be generated by a 1-mill/kWh fee for electricity generated prior to 2014, when enough spent fuel has been discharged to generate waste to fill both repositories. For this analysis, fee collection at electricity generation was assumed to begin in 1983, and would result in $28.0 billion by 2014. The energy generation schedule for this period is discussed in Section 4.1.

It is likely that a fee equivalent to 1-mill/kWh wold be assessed at or before the time that the spent fuel or equivalent reprocessing waste from the 1982 spent fuel backlog (9115 MT) is received by the government. For the revenue projection, it was assumed that the first waste delivered to the repositories is from the backlog, and that the average burnup of this fuel is 25,000 MWD/MT. These assumptions result in an additional revenue of $1.8 billion for the period 1998 to 2002. These revenues are shown on Table 3.1.

Figure 3.1 shows the cumulative revenue projection for the proposed fee. Also displayed in the figure is the range of estimated cumulative waste management program costs as a function of time. These revenues and costs are expressed in constant 1982 dollars. The program costs include costs for repository site exploration and development, construction and operation of the first two repositories, and transportation of either spent fuel or reprocessing waste to the repository. This range reflects the uncertainty in waste form, repository medium, and system design and cost variations. This

TABLE 3.1. Waste Management Fee Revenues for the 1982 Spent Fuel Backlog

Year	Delivery Schedule (MTHM)	Equivalent Energy (10^9 kWh)	Revenue ($ Millions)
1998	1800	351	351
1999	1800	351	351
2000	1800	351	351
2001	1800	351	351
2002	1915	373	373
Total	9115	1777	1777

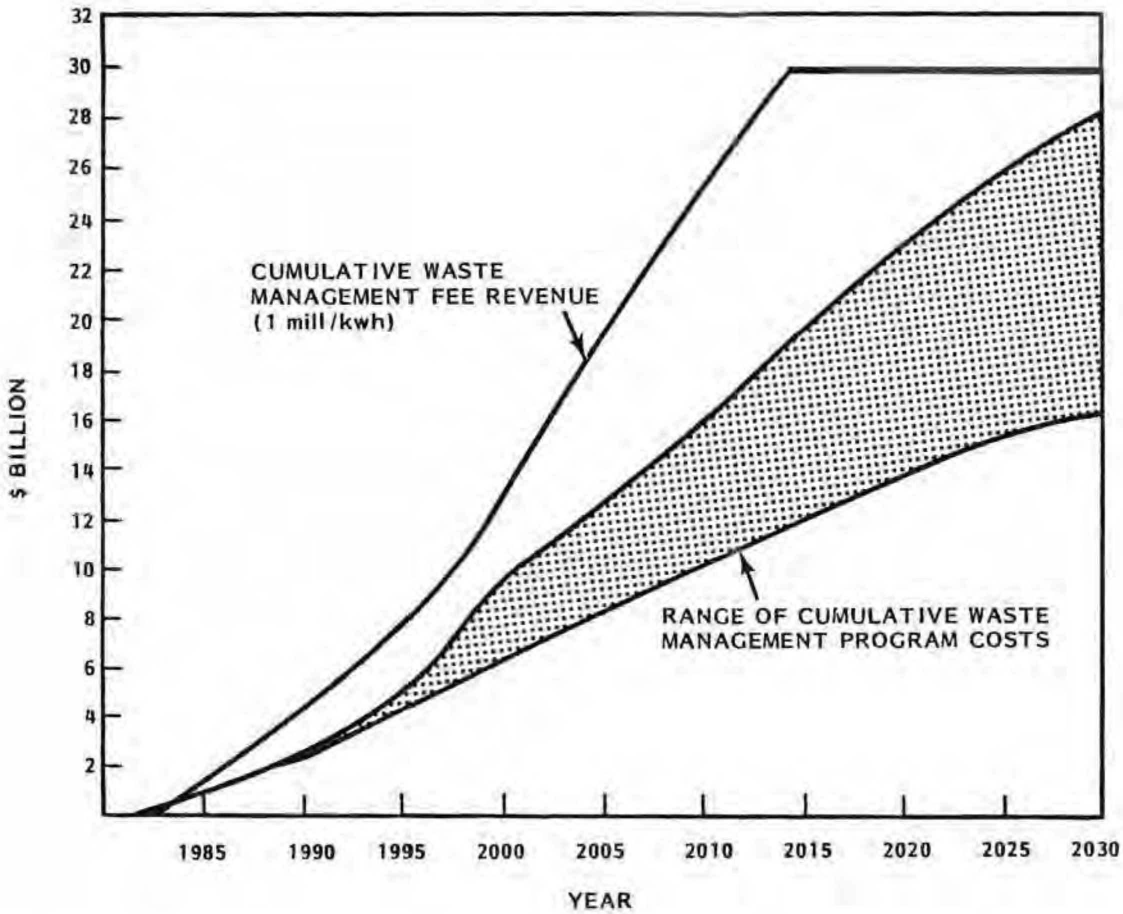

FIGURE 3.1. Cumulative Estimated Waste Management Program Costs and Fee Revenue (Constant 1982 Dollars)

cost range is developed from cost estimates discussed in Section 4.0. The figure shows that, except for the potential impact of inflation, the proposed 1-mill/kWh fee provides sufficient revenue for the full range of projected program costs. The cumulative fee revenue is $29.8 billion by 2014, and the upper bound expense is $28.4 billion by 2030, when the second repository is decommissioned.

3.2 WASTE MANAGEMENT FUND

Collecting a 1-mill/kWh energy generation fee will result in the federal government accumulating funds for future services. The waste from a particular reactor batch may not be disposed of until many years after the fuel is discharged. The legislation proposing the 1-mill/kWh fee also proposes establishing a waste management fund, which would receive revenues from the 1-mill/kWh fee and disburse funds for program costs. The fund would have the authority to borrow money from the Federal Treasury if program costs exceeded revenues for some period of time. If revenues exceed costs, the excess would be invested in treasury securities, which would earn interest at the prevailing rate.

The proposed waste management fund provides a mechanism for insuring that sufficient money is available for future waste management program liabilities. During the early years of the fund, revenues would exceed costs, so a surplus would accrue. The accumulated surplus, plus any interest earnings would be available to meet program costs that occur after all of the revenue is received.

Ideally, the fund would run out of money when the last program expense was incurred. Figure 3.2 illustrates the relationship between revenues, expenses, and the fund balance for an ideal case. The costs projected on the figure are the upper bound cost estimate shown on Figure 3.1. No inflation of projected costs is assumed. The projected cumulative fee revenue of $25.2 billion would result from a fee of .85 mills/kWh, which is the fee that would generate exactly the required revenue for these costs. In this case, the difference between total costs and total revenue is exactly offset by $3.2 billion interest earned on the fund.

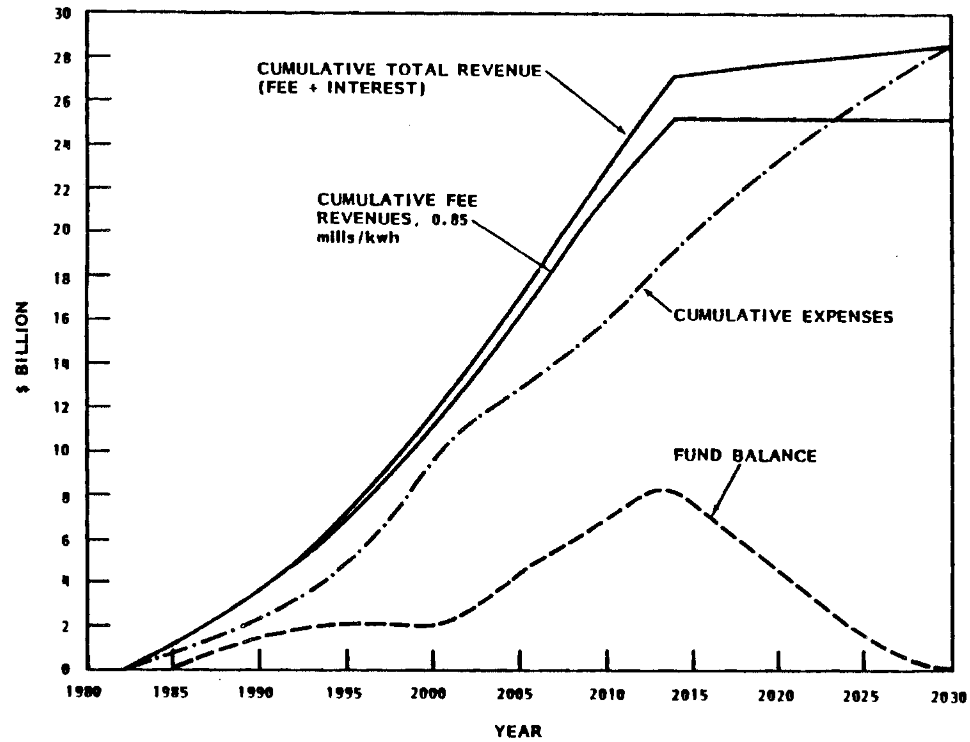

FIGURE 3.2. Waste Management Program Estimated Cumulative Revenues, Cumulative Expenses, and Fund Balance ($1982) With Upper Bound Cost Estimate, .85 Mill/kWh Fee, 2% Earnings on Fund Balance

The fund balance for this case is also displayed on the figure. Each year the fund balance changes by an amount equal to annual revenues minus annual expense, plus interest on the previous balance. For the case illustrated it was assumed that the fund balance earned 2% interest. This is a typical inflation adjusted return for short term federal treasury securities. The illustrated fund balance peaks as the last revenues are collected, and decreases to zero as the remaining program costs are incurred.

3.3 SENSITIVITY OF THE WASTE MANAGEMENT FEE TO FINANCIAL PARAMETERS

In practice, there are major uncertainties that make balancing revenues, fund earnings, and program expenses very difficult. The uncertainty in program cost is discussed in Section 5.0. Energy generation will vary from projections as reactor capacity factors and fuel management schemes change. If inflation continues, it will affect both incurred and projected costs. The actual interest earnings on the fund balance will vary, depending on the inflation rates and the market for government securities.

Because of these uncertainties, program cash flows will need to be reassessed periodically to determine whether the fee should be adjusted. To illustrate this process, the projected cash flows for the upper bound cost estimate were examined assuming 5%/yr inflation. Evaluating the program cash flows at the end of 1985 would result in the data shown on Table 3.2. The fund balance would be $.1 billion. In addition, another 28.4 billion in fee revenue and $4.0 billion interest revenue would be projected. Again, it was assumed that the interest earnings for the fund are 2% above inflation. Projected costs for 1986 and beyond, adjusted for inflation experienced between 1982 and 1985, would be $31.4 billion. Since the fund balance plus projected revenues exceed projected costs, a fee increase would not be required in 1986.

TABLE 3.2. Cash Flow Analysis with 5%/Year Inflation Through 1985 (Billions of 1985 dollars)

Fund Balance (1985)	$ .1
Projected Fee Revenues (1986-2014)	$28.4
Projected Interest Revenues (1986-2030)	$ 4.0
Total	$32.5
Projected Costs (1986-2030)	$31.4

Table 3.3 illustrates the fund evaluation at the end of 1986, assuming 5%/year inflation continues through 1986. In this case the fund balance plus projected revenues and interest earnings are less than projected costs. If this were the case, the fee would need to increase in 1987 to meet future program expenses.

Such evaluations are likely to be performed annually. For the example illustrated, such an evaluation would indicate a need for a fee change in

TABLE 3.3. Cash Flow Analysis with 5%/Year Inflation Through 1986 (Billions of 1986 dollars)

Fund Balance (1986)	$ .3
Projected Fee Revenues (1987-2014)	$27.8
Projected Interest Earnings (1987-2026[a])	$ 3.2
Total	$31.3
Projected Costs (1987-2030)	$32.7

(a) Fund is exhausted in 2026.

1987. The date of the first indication that the fee should be adjusted depends on both the inflation rate and the inflation adjusted interest rate for earnings on the fund. Figure 3.3 shows the date the fee would have to be increased, as a function of inflation rate, for both 0% and 2% inflation adjusted interest rates. The figure shows that for low inflation rates (2% to 3%), the fee could remain constant until the late 1980's. For 5% inflation, an adjustment would be required in 1987, as shown by the data on Tables 3.2 and 3.3. For higher inflation rates, an adjustment could be required before 1985.

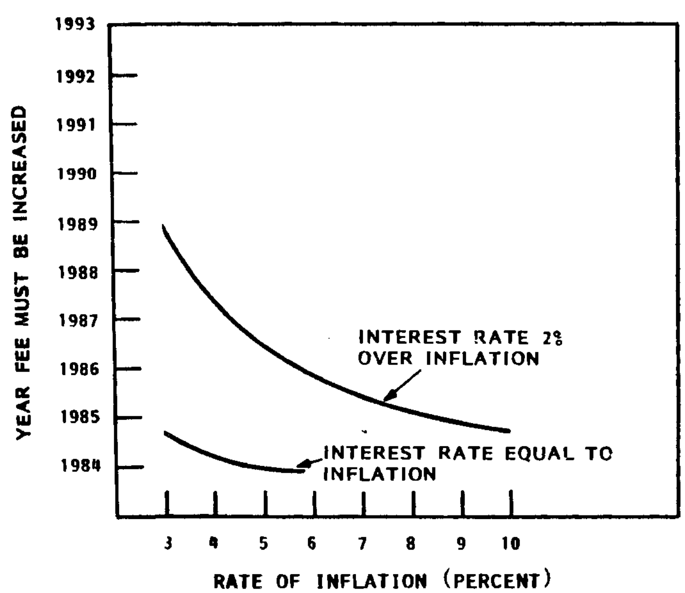

FIGURE 3.3. Year Fee Adjustments Are Required With Continued Inflation

4.0 WASTE MANAGEMENT SYSTEM DESCRIPTION

In this analysis, costs and revenues are projected for siting, constructing and operating the first two radioactive waste repositories. It is assumed that each repository will begin receiving waste from 72,000 metric tons (MT) of spent fuel in 1998 and 2002, respectively. Both high level waste (HLW) and transuranic (TRU) waste is assumed emplaced in the repository. Two waste form options, spent fuel and reprocessing wastes, are considered.

In the following sections the nuclear forecast and waste generation assumptions, the waste disposal schedule for the two repositories, and the reference cost data used in this analysis are discussed.

4.1 NUCLEAR ENERGY AND WASTE GENERATION PROJECTIONS

The installed nuclear capacity and energy generation forecast for this analysis is based on a recent modification (DOE/RL-82-1) of the last Energy Information Administration forecast (DOE/EIA-0315). This forecast predicts 165 GWe installed capacity by the year 2000, and 285 GWe installed capacity by the year 2020. The nuclear generation capacity, spent fuel discharge, and energy generation for this scenario are shown in Table 4.1 This table contains data through the year 2014, when a cumulative total of 144,000 MT of fuel will be discharged. This fuel, or waste resulting from this fuel, is assumed to fill the first two repositories.

Table 4.2 shows the reprocessing schedule assumed in the analysis when reprocessing waste is the reference waste form. Four reprocessing plants are required to reprocess the 144,000 MT of spent fuel.

4.2 REPOSITORY MASS FLOWS

The design receipt and disposal rate of each repository is 3000 metric tons heavy metal (MTHM) (spent fuel or equivalent reprocessing waste) per year. A reduced receiving rate of 1800 MTHM per year was assumed for the first five years of operation. Each repository has a total capacity of 72,000 MTHM. The mass flows for the first two repositories is shown on Table 4.3.

TABLE 4.1. Assumed Nuclear Forecast

Year	Installed Capacity (GWe)	Annual Spent Fuel Discharge (MT)	Cumulative Spent Fuel Discharge (MT)	Electrical Generation 10^9 kWh
1983	74.4	1601	10,716(a)	399
1984	85.2	1734	12,450	457
1985	91.8	2168	14,618	492
1986	101.0	2598	17,216	545
1987	112.4	2600	19,816	610
1988	114.9	2870	22,685	628
1989	118.4	3224	25,909	651
1990	121.4	3092	29,002	665
1991	122.5	3116	32,118	678
1992	125.8	3526	35,644	696
1993	130.4	3449	39,093	723
1994	132.9	3430	42,523	737
1995	135.3	3576	46,099	747
1996	140.6	3490	49,589	780
1997	146.6	3539	53,127	813
1998	152.6	3900	57,027	846
1999	158.2	3881	60,908	876
2000	165.0	4004	64,912	911
2001	171.2	4386	69,324	945
2002	179.3	4407	73,753	990
2003	188.6	4570	78,361	1041
2004	197.1	4919	83,308	1088
2005	205.3	4841	88,169	1133
2006	213.3	5225	98,434	1177
2007	221.3	6082	99,543	1221
2008	229.2	6043	105,582	1265
2009	237.2	6536	112,158	1309
2010	245.2	6251	118,441	1353
2011	249.2	6228	124,699	1375
2012	253.2	6381	131,121	1397
2013	257.2	6484	137,635	950(b)
2014	261.2	6365	144,000	482(b)
				27,980

(a) Includes an initial inventory of 9,115 MT as of the end of 1982.
(b) Reduced to compensate for end effect. Part of burnup is fuel that will be emplaced in next repository.

TABLE 4.2. Spent Fuel Reprocessing Schedule (MTHM)

Year	First Reprocessing Plant	Second Reprocessing Plant	Third Reprocessing Plant	Fourth Reprocessing Plant	Total	Cumulative Total
1989	500				500	500
1990	1000				1000	1,500
1991	1500				1500	3,000
1992	1500				1500	4,000
1993	1500				1500	6,000
1994	1500				1500	7,500
1995	1500				1500	9,000
1996	1500				1500	10,500
1997	1500				1500	12,000
1998	1500				1500	13,500
1999	1500				1500	15,000
2000	1500	500			2000	17,000
2001	1500	1000			2500	19,500
2002	1500	1500			3000	22,500
2003	1500	1500			3000	25,500
2004	1500	1500	500		3500	29,000
2005	1500	1500	1000		4000	33,000
2006	1500	1500	1500		4500	37,500
2007	1500	1500	1500		4500	42,000
2008	1500	1500	1500	500	5000	47,000
2009	1500	1500	1500	1000	5500	52,500
2010	1500	1500	1500	1500	6000	58,500
2011	1500	1500	1500	1500	6000	64,500
2012	1500	1500	1500	1500	6000	70,500
2013	1500	1500	1500	1500	6000	76,500
2014	1500	1500	1500	1500	6000	82,500
2015	1500	1500	1500	1500	6000	88,500
2016	1500	1500	1500	1500	6000	94,500
2017	1500	1500	1500	1500	6000	100,500
2018	1500	1500	1500	1500	6000	106,500
2019	1500	1500	1500	1500	6000	112,500
2020	1500	1500	1500	1500	6000	118,500
2021		1500	1500	1500	4500	123,000
2022		1500	1500	1500	4500	127,500
2023		1500	1500	1500	4500	132,000
2024		1500	1500	1500	4500	136,500
2025		1500	1500	1500	4500	142,000
2026		667	667	667	2000	144,000

TABLE 4.3 Spent Fuel (or Reprocessing Waste Equivalent) Disposal (MTHM)

Year	Repository 1	Repository 2	Total	Cumulative
1998	1800		1800	1,800
1999	1800		1800	3,600
2000	1800		1800	5,400
2001	1800		1800	7,200
2002	1800	1800	3600	10,800
2003	3000	1800	4800	15,600
2004	3000	1800	4800	20,400
2005	3000	1800	4800	25,200
2006	3000	1800	4800	30,000
2007	3000	3000	6000	36,000
2008	3000	3000	6000	42,000
2009	3000	3000	6000	48,000
2010	3000	3000	6000	54,000
2011	3000	3000	6000	60,000
2012	3000	3000	6000	66,000
2013	3000	3000	6000	72,000
2014	3000	3000	6000	78,000
2015	3000	3000	6000	84,000
2016	3000	3000	6000	90,000
2017	3000	3000	6000	96,000
2018	3000	3000	6000	102,000
2019	3000	3000	6000	108,000
2020	3000	3000	6000	114,000
2021	3000	3000	6000	120,000
2022	3000	3000	6000	126,000
2023	3000	3000	6000	132,000
2024		3000	3000	135,000
2025		3000	3000	138,000
2026		3000	3000	141,000
2027		3000	3000	144,000

The same annual waste disposal rate is assumed for both the spent fuel and reprocessing waste cases.

In the spent fuel disposal option, the spent fuel is assumed disassembled at the repository and repackaged. Canisters of disassembled spent fuel pins are emplaced in the repositories, as well as canisters of end fittings. In the reprocessing waste disposal option, canisters of solidified high-level waste, canisters of remote-handled TRU waste (including hulls and assembly hardware), and drums of contact-handled TRU waste are all assumed to be emplaced in the repository. The waste generation rate, volume per package, and the loaded repository contents are shown in Table 4.4.

TABLE 4.4. Waste Generation and Repository Content

	Waste Generation m^3/MTHM	Package Volume m^3	Number of Packages per Repository
Spent Fuel Disposal			
Disassembled Spent Fuel Pins	0.19	0.57	24,374
End Fittings	0.047	0.68	5,010
Reprocessing Waste Disposal			
Solidified High-Level Waste	0.083	0.19	31,560
Cladding and Remote-Handled TRU	1.27	1.39	66,000
Contact-Handled TRU Waste	1.0	.21	343,000

4.3 WASTE MANAGEMENT PROGRAM COSTS

Waste management legislation under consideration by Congress proposes that the federal government shall collect a fee that will provide full cost recovery for the disposal of commercial nuclear waste. This analysis assumes that the government will 1) take title to spent fuel or reprocessing waste at the reactor or reprocessing plant, 2) transport the spent fuel or reprocessing waste to the federal-owned and operated repository, and 3) dispose of the spent fuel or reprocessing waste. The estimated costs for this waste management program are grouped into three categories, which are discussed in the following sections. The costs for repository site exploration and development are dicussed in Section 4.3.1. The costs for waste transportation are discussed in Section 4.3.2. The costs for building and operating reference waste preparation and disposal facilities are presented in Section 4.3.3.

4.3.1 Exploration and Development Costs

The current DOE plan is to begin operating two repositories in 1998 and 2002, respectively. The National Terminal Waste Storage (NWTS) program strategy for deploying these repositories is specified in the NWTS Major Systems Acquisition Plan (DOE/NWTS-4). The major components of this plan are site identification and characterization, site approval and construction authorization, test and evaluation facility, repository technology development, and related costs. The cost estimate for this plan is shown in Table 4.5. For this analysis, the impact mitigation and fund management accounts were extended through the lifecycle of the second repository. This increases the $4.1 billion total estimated costs shown on Table 4.5 to $4.7 billion.

4.3.2 Waste Transportation Costs

Unit costs for transporting waste to the repository were developed for this analysis. The unit costs for shipping wastes 1500 miles are summarized in Table 4.6. The unit cost for each of the major components (cask, shipping, and security) and for each waste category are shown. The average spent fuel disposal transportation cost is $27/kg HM. The reprocessing waste disposal transportation cost is $23/kg HM equivalent waste. The estimated transportation costs for the two repository campaign totals $3.9 billion for the spent fuel disposal and $3.3 billion for the reprocessing waste disposal.

Transportation costs consist of the cost of transporting either spent fuel from the reactor to the repository or reprocessing wastes from the reprocessing plant to the repository. For this analysis, transportation costs are based on the assumption that DOE will contract with private industry to provide transportation services. Table 4.7 lists the basic logistics and financial assumptions for the transportation cost estimates.

TABLE 4.5. Estimated NWTS Program Exploration and Development Costs
Reference Case
(R1 Startup - 98, R2 Startup - 02)
(Millions-82)

	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	Total	Total
EXPLORATION AND DEVELOPMENT																											
Site Identification																											332
- First Three Sites	85	98																								183	
- National Screening		12	39	50	48																					149	
Site Characterization																											708
- First Three Sites	17	142	120	55	32	17	10	10	10	10																423	
- Other Sites		6	5	6	70	73	80	15	15	15																285	
Site Approval and Construction Authorization	8	9	12	15	20	18	8	8	7	9	9	12	6	6	6	6	4	4	4	4	4					179	179
T&E Facility																											176
- R&D Construction/Operations	2	2	8	22	27	15	7	3	3	2	2	2	2	3	3	3										106	
- Cask Acquisition			10	20	10																					40	
- Transportation							5	5	5					5	5	5										30	
Technology Development for Repositories																											1458
- Systems	8	9	12	12	12	11	8	8	8	8	8	8	8	8	8	8	8	8	4	4	4					172	
- Package	12	12	12	12	12	12	11	10	7	4	10	8	7	6	5	5	5	6	5	6	5					173	
- Repository	25	26	33	34	35	21	18	17	15	14	18	12	11	9	12	23	25	17	9	9	9					392	
- At Depth Testing						20	35	25	4	24	39	28	4	4	4	3										190	
- Other Test Facilities	24	20	28	29	10	8	8	8	8	7	7	7	7													171	
- Management	17	19	21	21	21	21	21	21	21	21	21	21	16	14	12	12	12	12	12	12	12					360	
Subtotal																											2853
RELATED PROGRAMS																											
- Related R&D	7	7	16	19	25	25	21	21	21																	162	1238
- Impact Mitigation										60	60	60	64	64	64	64	64	68	8	8	8	8	8	8	8	684	
- Fund Management		4	8	10	10	10	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20	20	20	20	20	392	
TOTAL	188	235	347	369	291	263	247	231	139	190	214	173	145	139	139	149	138	135	122	63	62	28	28	28	28		4091

TABLE 4.6. Unit Transportation Charge ($/kg HM or Equivalent Waste)

Waste Category	Cask Charge	Shipping Charge	Security	Total
Spent Fuel				
Rail	14	13	1	28
Truck	5	15	5	25
Weighted Average	12	14	2	27
Reprocessing Waste				
High-Level Waste	1	3	.2	4
Remote-Handled TRU Waste	7	10	0	17
Contact-Handled TRU Waste	1	1	0	2
Total Reprocessing Waste	9	14	.2	23

TABLE 4.7. Basic Transportation Assumptions

	Rail	Truck
Mode Shipping Fraction		
Spent Fuel	0.75	0.25
Reprocessing Waste	1.	0.
Shipping Speed, miles/day	150	900
Cask Utilization, days/year	300	300
Cask Leasing Capital Recovery		
Constant Dollar Rate of Return, percent	10	10
Economic Life, years	15	15
Annual Capital Recovery Factor	0.1315	0.1315
Average Distance to Repository, miles	1500	1500
Combined Time to Load and Unload Cask, days	4	3

Waste transportation cost has three major components, cask use charges, shipping charges, and security costs. Cask use charges depend on cask capital cost, cask payload, and the financial and logistical assumptions from Table 4.7. These parameters are related by the equation:

$$CUC = \frac{\frac{(CAP)(CRF) + M}{U} \times \left(\frac{2D}{S} + LU\right)}{WL}$$

where

CUC = Cask use charge ($/kg)

CAP = Cask capital cost ($)

CRF = Annual capital recovery factor

M = Annual maintenance cost ($)

U = Utilization rate (days/year)

D = One-way distance to repository (miles)

S = Shipping speed (miles/day)

LU = Loading time plus unloading time (days)

WL = Waste payload (KGHM)

Table 4.8 gives the cask characteristics for the various casks required to ship spent fuel or reprocessing waste. This table provides the cost and payload data required in the cask use charge equation. There are currently a limited number of casks available for shipping spent fuel. The IF-300 cask was assumed to be a typical rail cask, and the NAC-1 was assumed as the typical truck cask (DOE/ET-0028). Commercial reprocessing waste has not previously been shipped in any substantial amount, so it was assumed that new transportation casks will be developed for HLW and remote handled TRU waste. The TRUPACT is presently being developed by Sandia National Laboratory to transport contact-handled TRU defense waste. This cask was assumed to be suitable for commercial contact-handled TRU waste.

Shipping charges are based on the weight of a shipment (cask weight plus waste weight) and the distance traveled. The shipping charges for the assumed 1500-mile distance are shown in Table 4.9. The truck shipping charge was extracted from published rate schedules for radioactive waste shipments (Tri-State Motor Transit Company). The rail shipping data was derived with a linear regression of a set of rail shipping costs for a range of distances. The details of these calculations are discussed in Appendix A. This data, along with the cask weight and payload data on Table 4.8, are used to calculate shipping cost per unit of spent fuel or waste equivalent.

TABLE 4.8. Waste Shipping Cask Characteristics

Waste Category	Transit Mode	Cask Type	Capital Cost ($Million)	Annual Maintenance $	Empty Weight MT	Loaded Weight MT	Payload Per Cask	
							Waste Packages	MTHM
Spent Fuel[1,2]	Rail	IF-300	3.9	70,000	76.8	81.6	7 PWR 18 BWR	3.25
		NAC-1	0.665	10,000	22.1	22.7	1 PWR 2 BWR	0.426
High Level Waste[1,2,3]	Rail	Conceptual	2	70,000	100	110	920.7	
Remote Handled TRU[1,2]	Rail	Conceptual	1.8	70,000	65	74	33.5	
Contact Handled TRU[4]	Rail	TRUPACT	0.4	10,000	10	15.5	36	7.6

REFERENCES

1) DOE/ET-0028 - "Technology for Commercial Radioactive Waste Management," May 1979.

2) SAND/80-0035 - "Economics of Radioactive Material Transportation in the Light Water Reactor Nuclear Fuel Cycle," October 1980.

3) PNL/2244 - "Conceptual Design of a Shipping Container for Transporting High Level Waste by Railroad," December 1978.

4) PNL-3721 - "Defense Waste Transportation Cost and Logistics Studies," August 1982.

TABLE 4.9. Shipping Charges for 1500-Mile Radioactive Shipments ($/100 pounds)

	Rail	Truck
Loaded Cask	12.00	7.27
Empty Cask	11.25	5.82

The final category of transportation cost is security costs. Nuclear Regulatory Commission (NRC) regulations (10 CFR 73.37) state that a spent fuel transport truck must, at the minimum, be occupied by two armed driver/escorts. Rail spent fuel shipments must be observed by at least one armed escort (two in heavily populated areas). It is assumed in this analysis that rail shipments of high level waste will have the same security requirements. The Tri-State Motor Transit Co. truck surcharge for the required security is $0.92 per one-way mile for special equipment and $0.20 per round-trip mile for the armed escort. The round-trip mileage for the armed escort is based on round-trip mileage from Tri-State headquarters. This was assumed to add 1000 miles to the 3000-mile cask round-trip, which results in a security cost of approximately $2200 for a 1500-mile truck shipment. No equivalent data was available for rail shipment security, so it was assumed that costs for armed escorts for rail shipments would be approximately the same, on a man-day basis, as for truck shipments. This cost, plus the rail fare for two armed escorts, would lead to approximately a $4500 security cost per 1500-mile rail shipment.

4.3.3 Costs for the Reference Waste Preparation and Disposal

The reference repository is assumed to have a total disposal capacity of 72,000 MT of spent fuel or equivalent reprocessing waste. Full life-cycle costs were projected for two repositories, starting operations in 1998 and 2002. The design receiving and disposal rate is 3000 MTHM/year with a reduced rate of 1800 MTHM/year for the first five years. The reference design uses borehole emplacement without tailored backfill. In the spent fuel disposal option, spent fuel is assumed disassembled at the repository and repackaged using the long-lived (Ticode-12) package (AESD-TME-3131). Assembly hardware is assumed packaged in carbon steel canisters and emplaced in boreholes interspersed (commingled) with the spent fuel boreholes. The spent fuel canisters contain either 6 PWR assemblies (2.76 MT) or 17.5 BWR assemblies (3.29 MT). For the reprocessing waste disposal option, solidified high-level waste is assumed received at the repository in a steel canister. At the repository, it is overpacked with a Ticode package. Remote-handled TRU waste is assumed received in steel canisters and emplaced in boreholes commingled with the high-level waste boreholes. Contact-handled TRU waste is assumed received in steel drums bound together in six-packs, and stacked in separate rooms in the repository.

Cost data were considered for four candidate geologic media. These cost estimates were provided by the Office of NWTS Integration (N/TM-2). The four media are domed salt, bedded salt, Tuff, and granite. The estimated costs for these media are shown in Table 4.10. The table gives cost estimates for waste preparation and waste disposal, broken ino capital construction, operating, and decommissioning cost categories. The estimated life-cycle costs for a spent fuel repository range from $5.23 billion for domed salt to $5.75 billion for granite. The life cycle estimated costs for a reprocessing waste repository range from $4.86 billion for domed salt to $5.45 billion for granite.

For projecting annual costs, construction is assumed to require six years with the following percentages of total capital cost spent each year:

Year	%
1	5
2	15
3	20
4	22
5	23
6	15

Decommissioning is assumed to require five years, with the following percentages of total decommissioning cost spent each year.

TABLE 4.10. Estimated Life Cycle Costs for Reference 72,000-MT Repository ($ Billion 1982)

Waste Form	Geologic Media	Waste Preparation				Disposal				Total Cost
		Capital	Operating	Decommissioning	Subtotal	Capital	Operating	Decommissioning	Subtotal	
Spent Fuel	Domed Salt	0.33	1.20	0.050	1.58	1.27	2.13	0.251	3.65	5.23
	Bedded Salt	0.33	1.20	0.050	1.58	1.38	2.13	0.267	3.77	5.35
	TUFF	0.33	1.20	0.050	1.58	1.29	2.43	0.286	4.00	5.59
	Granite	0.33	1.20	0.050	1.58	1.37	2.50	0.308	4.18	5.76
Reprocessing Waste	Domed Salt	0.29	1.00	0.044	1.34	1.24	2.08	0.211	3.53	4.86
	Bedded Salt	0.29	1.00	0.044	1.34	1.34	2.08	0.227	3.66	4.98
	Tuff	0.29	1.00	0.044	1.34	1.37	2.41	0.227	4.01	5.35
	Granite	0.29	1.00	0.044	1.34	1.44	2.43	0.239	4.12	5.45

Year	%
1	10
2	15
3	25
4	30
5	20

All operating costs are assumed to be variable, and are proportional to the waste emplacement rate.

4.3.4 Total Waste Management Program Costs

The estimated total waste management program costs for the first two repositories range from $17.7 billion to $20.1 billion, as shown in Table 4.11. These costs consist of the exploration and development costs, transportation costs, and life cycle costs for two repositories. The asso ciated cash flow tables are presented in Appendix B, Tables B.2 through B.8.

TABLE 4.11. Total Estimated Cost for Reference Waste Management Program ($ Billion 1982)

Waste Form	Geologic Medium	Exploration and Development	Waste Transportation	Waste Preparation	Waste Disposal	Total Program
Spent Fuel	Domed Salt	4.7	3.9	3.2	7.3	19.0
	Bedded Salt	4.7	3.9	3.2	7.5	19.3
	Tuff	4.7	3.9	3.2	8.0	19.7
	Granite	4.7	3.9	3.2	8.4	20.1
Reprocessing Waste	Domed Salt	4.7	3.3	2.7	7.1	17.7
	Bedded Salt	4.7	3.3	2.7	7.3	17.9
	Tuff	4.7	3.3	2.7	8.0	18.7
	Granite	4.7	3.3	2.7	8.2	18.9

5.0 SENSITIVITY ANALYSIS

The waste management program costs for the waste form and geologic medium alternatives discussed in the previous section are best estimates for current program assumptions. There are additional uncertainties related to programmatic assumptions and variation in key cost components. For example, waste packaging cost estimates depend on the assumed outcome of repository licensing issues. Repository mining cost for a specific geologic medium can vary significantly with variation of site-specific parameters. This section estimates the impact of programmatic alternatives and cost component variation on total program cost.

In this report, the cost impact of key parameter variations or cost uncertainties is expressed in terms of changes in the levelized unit cost for waste management. The levelized unit cost represents the waste disposal fee, based on waste delivery required to fully recover program costs. This fee is calculated so that present worth (discounted) revenues will equal present worth costs. Equating discounted costs and revenues in this calculation takes into account differences in the timing as well as the magnitude of costs. This equality is expressed as:

Present Worth Revenues = Present Worth Costs

or

$$\sum_{i=1}^{N} \frac{1}{(1+r)^{i-1}} U t_i = \sum_{i=1}^{N} \frac{1}{(1+r)^{i-1}} C_i$$

where U = levelized unit cost or expense

t_i = waste delivered in year i

C_i = cash expenditures in year i

r = discount rate

N = number of years

Solving for levelized unit cost gives:

$$U = \frac{\sum_{i=1}^{N} \frac{1}{(1+r)^{i-1}} C_i}{\sum_{i=1}^{N} \frac{1}{(1+r)^{i-1}} t_1}$$

The cost data used in the levelized unit cost calculation is expressed in constant (uninflated) 1982 dollars. A 2% real (uninflated) discount rate was used in the calculations for this section. This discount rate reflects the approximate inflation-adjusted cost of capital for the federal government.

Section 5.1 describes the cost impact of selecting between waste form and geologic medium alternatives. Section 5.2 discusses the impact of disposal system design variations and cost uncertainties. The impact of variation of transportation cost assumptions is described in Section 5.3. The impact of a five-year delay in implacing waste in the first repository is discussed in Section 5.4. Section 5.5 considers the aggregate impact of selected combined variations and uncertainties.

5.1 VARIATION OF WASTE FORM AND GEOLOGIC MEDIUM

The levelized unit cost for disposal of either spent fuel or reprocessing waste in a domed salt, bedded salt, Tuff, or granite repository was calculated using the methodology described above. Table 5.1 gives the results of these calculations. Also shown are levelized costs for each of the major subcomponents of waste management program cost. Annual cost data used for the levelized unit cost calculations are given in Appendix B.

Exploration and development unit costs are based on the cost estimates discussed in Section 4.1, levelized as described above. Since these costs and the waste receipt logistics for all of the waste form and repository geologic media are the same, the levelized unit cost for this component is the same, $48/kg spent fuel or reprocessing waste equivalent, for all variations.

TABLE 5.1. Waste Management Levelized Unit Cost for Variations in Waste Form and Geologic Medium - 2 percent Discount Rate ($/kg HM Delivered)

Waste Form	Medium	Cost for Exploration and Development	Cost for Transportation	Cost for Waste Preparation	Cost for Waste Disposal	Total Program Cost
Spent Fuel	Domed Salt	48	27	23	57	155
	Bedded Salt	48	27	23	59	157
	Tuff	48	27	23	61	160
	Granite	48	27	23	64	163
Reprocessing Waste	Domed Salt	48	23	20	55	146
	Bedded Salt	48	23	20	57	148
	Tuff	48	23	20	62	153
	Granite	48	23	20	64	155

The unit transportation costs discussed in Section 4.2 occur at the time of waste delivery, so do not require levelization. As shown on the table, these are $27/kg and $23/kg for spent fuel and reprocessing waste, respectively.

Disposal costs are broken into two components, waste preparation and waste disposal. These costs and the assumptions for calculating annual costs were discussed in Section 4.3. Waste preparation costs vary with waste form but not geologic medium. These levelized unit costs are $23/kg and $20/kg for spent fuel and reprocessing waste, respectively. Waste disposal costs are dependent on both waste form and geologic medium. The levelized unit cost for this component ranges from $55/kg for reprocessing waste disposal in domed salt to $64/kg for spent fuel disposal in granite.

5.2 DISPOSAL SYSTEM DESIGN AND COST VARIATIONS

The impact of modifying key disposal system design assumptions and uncertainty in major system cost components was evaluated. Tables 5.2 and 5.3 summarize the results of these evaluations for spent fuel and reprocessing waste disposal, respectively. The cost data for these sensitivity analyses were developed by the Office of NWTS Integration (NTM-3). The impacts of these variations on levelized waste management unit cost are summarized in Tables 5.4 and 5.5. The values under system total in Table 5.2 to 5.5 include exploration, development, and waste transportation, which are not shown on the tables.

The impact on disposal system costs from changing the waste package design was evaluated by estimating the change in the levelized unit cost for two package variations. The first variation used a simple, thin-walled steel canister rather than the long-lived Ticode package. The simple package design decreased costs by $8/kg for both spent fuel disposal and reprocessing waste disposal. The second variation, using a larger package for high level waste from reprocessing (9.5 kw/package vs. 2.2 kw/package), decreases waste preparation and waste disposal costs by a total of $6/kg.

TABLE 5.2. Cost Estimates for Variations in Spent Fuel Repository and Waste Package ($ Billion)

Variation Description	Geologic Medium	Waste Preparation Capital	Waste Preparation Operating	Waste Preparation Decommission	Waste Preparation Subtotal	Waste Disposal Capital	Waste Disposal Operating	Waste Disposal Decommission	Waste Disposal Subtotal	Total
Reference	Domed Salt	0.66	2.40	0.10	3.16	2.54	4.26	0.50	7.30	19.0
	Bedded Salt	0.66	2.40	0.10	3.16	2.75	4.26	0.53	7.54	19.3
	Tuff	0.66	2.40	0.10	3.16	2.58	4.85	0.57	8.01	19.7
	Granite	0.66	2.40	0.10	3.16	2.73	5.00	0.62	8.35	20.1
Simple Steel Package	Domed Salt	0.60	1.43	0.09	2.12	2.51	4.20	0.50	7.20	17.9
	Bedded Salt	0.60	1.43	0.09	2.12	2.72	4.20	0.53	7.44	18.1
	Tuff	0.60	1.43	0.09	2.12	2.55	4.79	0.57	7.91	18.6
	Granite	0.60	1.43	0.09	2.12	2.70	4.94	0.61	8.25	18.9
High Preparation Cost	Domed Salt	0.93	3.24	0.14	4.31	2.54	4.26	0.53	7.32	20.2
	Bedded Salt	0.93	3.24	0.14	4.31	2.75	4.26	0.56	7.56	20.4
	Tuff	0.93	3.24	0.14	4.31	2.58	4.85	0.57	8.01	20.9
	Granite	0.93	3.24	0.14	4.31	2.73	5.00	0.62	8.35	21.2
Low Preparation Cost	Domed Salt	0.40	1.56	0.06	2.02	2.54	4.26	0.53	7.32	17.9
	Bedded Salt	0.40	1.56	0.06	2.02	2.75	4.26	0.56	7.56	18.1
	Tuff	0.40	1.56	0.06	2.02	2.58	4.85	0.57	8.01	18.6
	Granite	0.40	1.56	0.06	2.02	2.73	5.00	0.62	8.35	18.9
High Mining Cost	Domed Salt	0.66	2.40	0.10	3.16	2.92	4.66	0.62	8.20	19.9
	Bedded Salt	0.66	2.40	0.10	3.16	3.13	4.66	0.65	8.45	20.2
	Tuff	0.66	2.40	0.10	3.16	4.76	7.33	1.27	13.4	25.1
	Granite	0.66	2.40	0.10	3.16	3.88	6.53	1.02	11.43	23.1
Low Mining Cost	Domed Salt	0.66	2.40	0.10	3.16	2.35	4.06	0.44	6.85	18.6
	Bedded Salt	0.66	2.40	0.10	3.16	2.56	4.06	0.48	7.09	18.8
	Tuff	0.66	2.40	0.10	3.16	2.31	4.54	0.48	7.34	19.1
	Granite	0.66	2.40	0.10	3.16	2.45	4.62	0.52	7.58	19.3
No Commingling	Domed Salt	0.66	2.40	0.10	3.16	2.54	4.42	0.53	7.49	19.2
	Bedded Salt	0.66	2.40	0.10	3.16	2.75	4.42	0.56	7.73	19.4
	Tuff	0.66	2.40	0.10	3.16	2.58	5.00	0.59	8.17	19.9
	Granite	0.66	2.40	0.10	3.16	2.73	5.16	0.64	8.53	20.2

TABLE 5.3. Cost Estimates for Variations in Reprocessing Waste Repository and Waste Packages

Variation Description	Geologic Medium	Waste Preparation				Waste Disposal				Total
		Capital	Operating	Decommission	Subtotal	Capital	Operating	Decommission	Subtotal	
Reference	Domed Salt	0.59	2.00	0.09	2.67	2.48	4.15	0.42	7.05	17.7
	Bedded Salt	0.59	2.00	0.09	2.67	2.69	4.15	0.45	7.29	17.9
	Tuff	0.59	2.00	0.09	2.67	2.74	4.83	0.45	8.02	18.7
	Granite	0.59	2.00	0.09	2.67	2.88	4.87	0.48	8.23	18.9
Maximum Size Package	Domed Salt	0.52	1.42	0.08	2.02	2.49	3.97	0.43	6.90	16.9
	Bedded Salt	0.52	1.42	0.08	2.02	2.70	3.97	0.47	7.14	17.1
Simple Steel Package	Domed Salt	0.47	1.15	0.07	1.69	2.42	4.06	0.41	6.90	16.6
	Bedded Salt	0.47	1.15	0.07	1.69	2.63	4.06	0.44	7.14	16.8
	Tuff	0.47	1.15	0.07	1.69	2.68	4.74	0.44	7.86	17.5
	Granite	0.47	1.15	0.07	1.69	2.82	4.78	0.47	8.08	17.7
High Preparation Cost	Domed Salt	0.82	2.67	0.12	3.61	2.48	4.15	0.42	7.05	18.6
	Bedded Salt	0.82	2.67	0.12	3.61	2.69	4.15	0.45	7.29	18.9
	Tuff	0.82	2.67	0.12	3.61	2.74	4.83	0.45	8.02	19.6
	Granite	0.82	2.67	0.12	3.61	2.88	4.87	0.48	8.23	19.8
Low Preparation Cost	Domed Salt	0.35	1.34	0.05	1.74	2.48	4.15	0.42	7.05	16.8
	Bedded Salt	0.35	1.34	0.05	1.74	2.69	4.15	0.45	7.29	17.0
	Tuff	0.35	1.34	0.05	1.74	2.74	4.83	0.45	8.02	17.7
	Granite	0.35	1.34	0.05	1.74	2.88	4.87	0.48	8.23	17.9
High Mining Cost	Domed Salt	0.59	2.00	0.09	2.67	2.81	4.32	0.50	7.63	18.3
	Bedded Salt	0.59	2.00	0.09	2.67	3.02	4.32	0.53	7.87	18.5
	Tuff	0.59	2.00	0.09	2.67	5.05	5.39	0.89	11.33	22.0
	Granite	0.59	2.00	0.09	2.67	4.09	5.18	0.71	9.98	20.6
Low Mining Cost	Domed Salt	0.59	2.00	0.09	2.67	2.31	4.07	0.38	6.76	17.4
	Bedded Salt	0.59	2.00	0.09	2.67	2.52	4.07	0.42	7.00	17.7
	Tuff	0.59	2.00	0.09	2.67	2.45	4.76	0.40	7.61	18.3
	Granite	0.59	2.00	0.09	2.67	2.58	4.79	0.42	7.79	18.4
No Commingling	Domed Salt	0.59	2.00	0.09	2.67	2.48	4.45	0.47	7.39	18.0
	Bedded Salt	0.59	2.00	0.09	2.67	2.69	4.45	0.50	7.63	18.3
	Tuff	0.59	2.00	0.09	2.67	2.74	5.71	0.59	9.04	19.7
	Granite	0.59	2.00	0.09	2.67	2.88	5.55	0.58	9.02	19.7

TABLE 5.4. Waste Management System Levelized Unit Cost for Variations in Spent Fuel Repository and Waste Package ($/kg HM)

Variation Description	Repository Medium	Waste Preparation	Waste Disposal	Total System
Reference	Domed Salt	23	57	155
	Bedded Salt	23	59	157
	Tuff	23	61	160
	Granite	23	64	163
Simple Steel Package	Domed Salt	16	56	147
	Bedded Salt	16	58	149
	Tuff	16	61	152
	Granite	16	63	155
High preparation Cost	Domed Salt	32	57	164
	Bedded Salt	32	59	166
	Tuff	32	61	169
	Granite	32	64	171
Low Preparation Cost	Domed Salt	15	57	147
	Bedded Salt	15	59	149
	Tuff	15	61	152
	Granite	15	64	154
High Mining Cost	Domed Salt	23	64	162
	Bedded Salt	23	66	165
	Tuff	23	103	202
	Granite	23	88	187
Low Mining Cost	Domed Salt	23	53	152
	Bedded Salt	23	55	154
	Tuff	23	56	155
	Granite	23	58	157
No Commingling	Domed Salt	23	58	157
	Bedded Salt	23	60	159
	Tuff	23	62	161
	Granite	23	65	164

TABLE 5.5. Waste Management System Levelized Unit Cost for Variations in Reprocessing Waste Repository and Waste Package ($/kg HM)

Variation Description	Repository Medium	Waste Preparation	Waste Disposal	Total System
Reference	Domed Salt	20	55	146
	Bedded Salt	20	57	148
	Tuff	20	62	153
	Granite	20	64	155
Simple Steel Package	Domed Salt	13	54	138
	Bedded Salt	13	56	140
	Tuff	13	61	145
	Granite	13	63	147
Maximum Size Package	Domed Salt	15	54	140
	Bedded Salt	15	56	142
High Preparation Cost	Domed Salt	27	55	153
	Bedded Salt	27	57	155
	Tuff	27	62	160
	Granite	27	64	162
Low Preparation Cost	Domed Salt	13	55	139
	Bedded Salt	13	57	141
	Tuff	13	62	146
	Granite	13	64	148
High Mining Cost	Domed Salt	20	59	151
	Bedded Salt	20	62	153
	Tuff	20	90	181
	Granite	20	79	170
Low Mining Cost	Domed Salt	20	52	144
	Bedded Salt	20	55	146
	Tuff	20	58	150
	Granite	20	60	151
No Commingling	Domed Salt	20	57	148
	Bedded Salt	20	59	150
	Tuff	20	69	160
	Granite	20	69	160

The impact on the levelized unit cost of variation in waste preparation costs was estimated by assuming that waste preparation capital costs varied by ±40%, operating costs by ±50%, and package components by ±20%. This cost uncertainty results in a ±$8/kg variation of waste preparation cost for spent fuel disposal and ±$7/kg variation of waste preparation cost for reprocessing waste disposal.

Two waste disposal cost variations were considered. The first variation was a modification of the disposal system design to place TRU waste in a separate area of the repository rather than commingling it with spent fuel or high-level waste. This increases the mined area of a repository. Table 5.4 and 5.5 show that the impact of this design variation is $1 to $2/kg for spent fuel disposal, and $2 to $7/kg for reprocessing waste disposal, depending on geologic medium.

The second disposal cost variation evaluated the impact of uncertainty in mining cost due to site-specific parameters. The Office of NWTS Integration estimated that the uncertainties in unit mining costs are -25% to +50% for salt geologies, -25% to +100% for granite, and -25% to +200% for TUFF. The impact of these variations, as shown in Tables 5.4 and 5.5. ranges from -$6/kg to +42/kg, depending on waste form and geologic medium.

5.3 COST SENSITIVITY TO VARIATIONS IN TRANSPORTATION DISTANCE

Repository location will not be determined for several years. The impact on costs of shipping waste an average of 2500 miles rather than 1500 miles was evaluated. This variation would increase the spent fuel unit cost to $42/kg HM, an increase of $15/kg HM. This represents an increase of $2.2 billion for spent fuel shipped to the first two repositories. For the reprocessing waste disposal option, the transportation cost would increase from $23/kg HM equivalent to $34/kg HM. This is an increase of about $1.6 billion for reprocessing waste shipped to the first two repositories.

5.4 DELAYED WASTE EMPLACEMENT AT THE FIRST REPOSITORY

For the reference logistics scenario, the first repository is assumed to receive and emplace waste in 1998. Costs were estimated for providing interim storage located at the repository site for wastes received the first five years because of a delay in waste emplacement capability. Potential causes of such a delay are slippages in the repository construction or licensing schedule.

Table 5.6 summarizes the impact of these incremental costs on the total waste management cost and the levelized unit waste management cost. The delay in waste emplacement increases spent fuel disposal costs by $0.9 billion or reprocessing waste disposal costs by $0.5 billion. The table shows that interim storage has two impacts on the levelized unit waste management cost. The increase in the levelized unit cost for the incremental cost of interim storage is partially offset by deferral of the waste preparation and disposal construction and operating costs. The net effect of the five year delay is an increase in the levelized unit cost of about $5/kg for spent fuel or about $1/kg for reprocessing waste disposal.

TABLE 5.6. Cost Impact of Delayed Repository

	Spent Fuel Disposal	Reprocessing Waste Disposal
Increase in Cumulative System Cost ($billions)	0.9	0.5
Change in Levelized Unit Cost ($/kg)		
Interim Storage	+9.3	+4.7
Waste Preparation and Disposal Deferral	-4.1	-3.8
TOTAL SYSTEM	+5.2	+0.9

It was assumed that the waste delivery schedule is the same as the reference assumption, only the preparation and disposal operations are delayed. The modified waste logistics for the first repository are shown in Table 5.7.

TABLE 5.7 Delayed First Repository Logistics

Year	Waste Delivery (MT)	Waste Disposal (MT)	Waste Stored (MT)	Stored Waste Inventory (MT)
1998	1800	0	1800	1,800
1999	1800	0	1800	3,600
2000	1800	0	1800	5,400
2001	1800	0	1800	7,200
2002	1800	0	1800	000
2003	3000	1800	1200	10,200
2004	3000	1800	1200	11,400
2005	3000	1800	1200	12,600
2006	3000	1800	1200	13,800
2007	3000	1800	1200	15,000
2008-2023	3000	3000	0	15,000
2024	0	3000	-3000	12,000
2025	0	3000	-3000	9,000
2026	0	3000	-3000	6,000
2027	0	3000	-3000	3,000
2028		3000	-3000	0

For this analysis, it was assumed that only the repository receiving facilities were completed on time. The rest of the repository construction schedule, and therefore construction costs, were slipped five years. It was assumed that spent fuel or high level waste would be stored in steel storage casks, remote-handled TRU wastes in concrete surface casks, and contact-handled TRU waste in warehouse-type buildings. The cask capacity assumptions are shown in Table 5.8.

The steel and concrete storage casks were assumed to cost $700,000 per cask and $25,000 per cask, respectively. Both steel and concrete casks were assumed stored on concrete pads costing $2,000 each in 1000-pad storage yards. The cost of site preparation for a storage yard was estimated at $300,000 per 1000-pad storage yard. For the reprocessing case, two warehouses for contact-handled TRU waste were estimated to cost $9,000,000. A $4,000,000 cost was added to the waste receiving facility cost for a crane and cask transporter. Receiving facility construction and unit operating costs were assumed to be the same as for the reference logistics scenario. This

TABLE 5.8. Storage Cask Capacities

	Number of Assemblies or Containers	MTHM
Steel Storage Casks		
PWR	24	11.0
BWR	52	9.4
Average	N/A	10.4
HLW	14	31.9
Concrete Storage Casks	3	3.3

N/A - Not applicable

represents increased life cycle operating costs since the waste will eventually be removed from interim storage and emplaced in the repository.

5.5 COMBINED IMPACT OF SELECTED VARIATIONS AND UNCERTAINTIES

To identify reasonable upper and lower bounds for waste management program costs, the impacts of selected variations and uncertainties were considered simultaneously. These estimates are shown in Table 5.9. The upper bound waste management program costs were approximated by assuming that spent fuel was emplaced in Tuff repositories. The high mining cost, high waste preparation costs and the longer (2500 mile) waste transportation distance were assumed. This combination of waste form, geology, and cost variations resulted in a projected upper bound waste management program cost of $28.4 billion, which corresponds to a levelized unit cost of $225/kg. The annual expenses for this case are reported in Appendix B, Table B.9.

The lower bound waste management program cost was approximated by assuming that reprocessing waste was emplaced in domed salt repositories. Low mining cost and low waste preparation cost variations were assumed. This combination of assumptions resulted in a lower bound waste management cost of $16.4 billion, or a levelized unit cost of $137/kg. The annual expenses are reported in Appendix B, Table B.10.

TABLE 5.9. Variation Composites to Bound Program Cost Estimates

	Upper Bound		Lower Bound	
	Cumulative Cost ($ Billion)	Levelized Unit Cost ($/kg HM)	Cumulative Cost ($ Billion)	Levelized Unit Cost ($/kg HM)
Exploration and Development	4.7	48	4.7	48
Waste Transportation	6.0	42	3.3	23
Waste Preparation	4.3	32	1.7	13
Waste Disposal	13.4	103	6.8	52
Total System Cost	28.4	225	16.4	137

6.0 COMPARISON WITH PREVIOUS FEE ANALYSIS

DOE reported a spent fuel disposal fee in 1980 (DOE/SR-0006). The earlier analysis also used a present value, levelized unit cost methodology. However, there are two major differences in the methodology application which make direct comparison difficult. The first difference is the discount rate; 7.5% was used earlier, 2% was used in the current analysis. The second difference is in the length of time over which costs were levelized. The previous analysis used a fixed time period, cutting off expenditures and revenues in 2010, but allowing a credit for utilized facilities. The current analysis used costs and revenues for the full life cycle of the two repositories. The earlier analysis considered only a salt geology.

To facilitate the comparison of the two fee analyses, the levelized unit costs, based on current cost estimates for spent fuel disposal in both salt media, were calculated using a 7.5% discount rate. Only those cost components common to this analysis and the previous fee analysis were compared. The comparison is summarized in Table 6.1. In Table 6.1 the fee from the 1980 analysis has been escalated to 1982 for direct comparison, using the U.S Department of Commerce Composite Construction Cost Index. This comparison shows that the two estimates for combined waste preparation and disposal are nearly the same, while exploration and development costs have increased slightly.

TABLE 6.1. Comparison of 1980 Fee Analysis to the Current Analysis Levelized Unit Cost Discounted at 7.5% ($/kg HM)

	1980 Analysis		1982 Analysis	
	1980 Dollars	1982 Dollars	Domed Salt	Bedded Salt
Comparable Components				
Spent Fuel Preparation	40	44	30	30
Spent Fuel Disposal	65	72	83	87
Exploration and Development plus Government Overhead	115	127	146	146
Total Comparable Components	220	243	259	263
Noncomparable Components				
AFR	13			
Transportation - AFR to Repository	1			
Total Fee	234			

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APPENDIX A

WASTE TRANSPORTATION SHIPPING CHARGES

APPENDIX A

WASTE TRANSPORTATION SHIPPING CHARGES

This appendix discusses the development of the waste transportation shipping charges used in this analysis. The charges are proportional to the weight of the shipment, including the shipping cask and its contents, and are given in $ per 100 pounds. These shipping charges were used in Section 4.0 for the waste transportation unit cost and total cost.

The truck shipping charge rates were obtained directly from Tri-State Motor Transit Co. published rates. The complete table is shown in Table A.1. Two different shipping distances were assumed in this analysis, 1500 miles for the reference and 2500 miles for sensitivity analysis. The relevant truck charges in $/100 pounds are:

	Loaded Cask	Empty Cask
1500 Miles	7.27	5.82
2500 Miles	12.10	9.83

The rail shipping charge rate was developed with a linear regression analysis from a set of estimated trip charges and distances provided by the DOE Traffic Manager (Rockwell Hanford Operations). The table of charges and distances is shown in Table A.2. The regression model used is

$$RATE = A + B \times DIST$$

where RATE = shipping charge rate in $/100 pounds
DIST = one-way distance shipped in miles
A,B = regression constants

The results of the regression analysis are

	Loaded Cask	Empty Cask
r^2	.94	.94
A	4.12	3.887
B	.0053	.0049
RATE		
when DIST = 1500	12.00	11.25
when DIST = 2500	17.27	16.17

TABLE A.1. Truck Shipping Charges for Spent Fuel and High-Level Wastes (Tri-State Motor Transit Co. 1981)[a]

Rates in Dollars Per 100 Pounds[b]					
Miles Not Over	Full	Empty	Miles Not Over	Full	Empty
100	1.52	0.98	950	4.68	3.71
110	1.60	0.99	975	4.76	3.81
120	1.61	1.03	1000	4.84	3.89
130	1.65	1.06	1025	4.93	4.01-
140	1.71	1.08	1050	5.10	4.10
150	1.77	1.10	1075	5.20	4.17
160	1.84	1.11	1100	5.35	4.27
170	1.90	1.14	1125	5.46	4.42
180	2.02	1.17	1150	5.56	4.48
190	2.07	1.21	1175	5.72	4.56
200	2.16	1.24	12200	5.80	4.68
225	2.23	1.31	1225	5.94	4.76
250	2.35	1.39	1250	6.07	4.87
275	2.42	1.40	1275	6.19	4.96
300	2.49	1.45	1300	6.31	5.08
325	2.59	1.56	1325	6.41	5.15
350	2.68	1.60	1350	6.57	5.25
375	2.73	1.61	1375	6.66	5.36
400	2.83	1.65	1400	6.79	5.45
425	2.94	1.77	1425	6.91	5.54
450	3.02	1.82	1450	7.01	5.63
475	3.09	1.90	1475	7.17	5.75
500	3.19	1.97	1500	7.27	5.82
525	3.24	2.12	1525	7.38	5.95
550	3.32	2.20	1550	7.53	6.05
575	3.44	2.29	1575	7.63	6.12
600	3.51	2.39	1600	7.77	6.21
625	3.60	2.50	1625	7.90	6.33
650	3.67	2.62	1650	7.98	6.41
675	3.76	2.66	1675	8.13	6.52
700	3.84	2.72	1700	8.24	6.61
725	3.93	2.89	1725	8.35	6.79
750	4.01	2.98	1750	8.49	6.87
775	4.08	3.03	1775	8.59	6.98
800	4.16	3.11	1800	8.73	7.11

TABLE A.1. (contd)

Rates in Dollars Per 100 Pounds[b]

Miles Not Over	Full	Empty	Miles Not Over	Full	Empty
825	4.26	3.22	1825	8.84	7.17
850	4.31	3.30	1850	8.96	7.25
875	4.44	3.39	1875	9.08	7.37
900	4.49	3.50	1900	9.23	7.50
925	4.57	3.63	1925	9.34	7.57
1950	9.43	7.64	3200	15.53	12.55
1975	9.60	7.76	3250	15.77	12.78
2000	9.68	7.84	3300	16.02	12.92
2025	9.83	7.93	3350	16.22	13.14
2050	9.94	8.05	3400	16.49	13.35
2075	10.07	8.16	3450	16.74	13.53
2100	10.19	8.24	3500	16.98	13.72
2125	10.30	8.32	3550	17.20	13.91
2150	10.40	8.44	3600	17.45	14.12
2175	10.56	8.53	3650	17.69	14.33
2200	10.67	8.65	3700	17.95	14.48
2250	10.92	8.82	3750	18.18	14.74
2300	11.16	9.04	3800	18.42	14.92
2350	11.40	9.23	3850	18.64	15.11
2400	11.65	9.42	3900	18.92	15.29
2450	11.91	9.62	3050	19.16	15.50
2500	12.10	9.83	4000	19.41	15.69
2550	12.35	10.00	4050	19.63	15.92
2600	12.60	10.21	4100	19.87	16.09
2650	12.85	10.39	4150	20.10	16.29
2700	13.09	10.61	4200	20.38	16.48
2750	13.34	10.77	4250	20.61	16.65
2800	13.57	11.00	4300	20.84	16.87
2850	13.83	11.18			
2900	14.05	11.39			
2950	14.32	11.53			
3000	14.52	11.78			
3050	14.79	11.96			
3100	15.03	12.12			
3150	15.27	12.32			

(a) Updated April 22, 1982.
(b) Source: Tri-State Motor Transit Co. Docket MC-109397. Item No. 2000, First Revision.

TABLE A.2. Rail Shipping Charges, Distances, and Transit Times for Several Origin/Destination Combinations

From (Origin)	To (Destination)	Dollars per 100 pounds Loaded	Dollars per 100 pounds Empty	Approximate One-way Mileages	One-Way Transit Time (Days)
Hanford, WA	Barnwell, SC	16.89	15.83	2700	12-15
Mercury, NV	Barnwell, SC	16.89	15.83	2200	10-13
Berwick, PA	Barnwell, SC	7.13	6.69	750	5-7
Palo, IA	Barnwell, SC	8.82	8.27	1050	9-12
Port Gibson, MS	Barnwell, SC	6.79	6.37	700	6-8
Waterford, CT	Barnwell, SC	7.88	7.39	900	8-11
Eirela. CA	Barnwell, SC	19.15	17.95	2950	12-15
Hanford, WA	Mercury, NV	11.09	10.40	1000	9-12
Berwick, PA	Mercury, NV	16.89	15.83	2400	12-15
Palo, IA	Mercury, NV	13.39	12.55	1500	10-13
Port Gibson, MS	Mercury, NV	14.78	13.86	1600	10-13
Waterford, CT	Mercury, NV	16.89	15.83	2650	12-15
Eureka, CA	Mercury, NV	9.25	8.67	800	7-9
Rainer, OR	Hanford, WA	5.22	4.90	300	3-5
Satsop, WN	Hanford, WA	5.03	4.72	350	4-7
Eureka, CA	Hanford, WA	10.86	10.18	1200	7-9

Source: Personal communication with Mr. Frank Votaw, Rockwell Hanford Operations, Traffic Division, Motor Rates and Routes.

APPENDIX B

ANNUAL EXPENSES FOR REFERENCE CASES AND FOR UPPER AND LOWER BOUNDS

APPENDIX B

ANNUAL EXPENSES FOR REFERENCE CASES AND FOR UPPER AND LOWER BOUNDS

Tables

TABLE B.1

CASH FLOW SUMMARY ($ MILLION)
SPENT FUEL DOMED SALT REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATIO CAPITAL	OPERATING	DECOMM	SUBTOTAL	WASTE DISPOSAL CAPITAL	OPERATING	DECOMM	SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	16.5	.0	.0	16.5	101.5	.0	.0	101.5	332.0	2872.0
1993	173.0	.0	49.7	.0	.0	49.7	184.5	.0	.0	184.5	407.1	3279.2
1994	145.0	.0	66.2	.0	.0	66.2	246.0	.0	.0	246.0	457.2	3736.4
1995	139.0	.0	72.8	.0	.0	72.8	270.6	.0	.0	270.6	482.4	4218.8
1996	139.0	.0	92.7	.0	.0	92.7	344.4	.0	.0	344.4	576.1	4794.9
1997	149.0	.0	99.3	.0	.0	99.3	369.0	.0	.0	369.0	617.3	5412.2
1998	138.0	48.6	66.2	30.0	.0	96.2	246.0	53.2	.0	299.2	582.0	5994.2
1999	135.0	48.6	72.8	30.0	.0	102.8	270.6	53.2	.0	323.8	610.3	6604.5
2000	122.0	48.6	76.1	30.0	.0	106.2	282.9	53.2	.0	336.1	612.9	7217.4
2001	63.0	48.6	49.7	30.0	.0	79.7	184.5	53.2	.0	237.7	429.0	7646.4
2002	62.0	97.2	.0	60.0	.0	60.0	.0	106.4	.0	106.4	325.7	7972.1
2003	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	8351.7
2004	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	8731.3
2005	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	9110.9
2006	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	9490.5
2007	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	9958.0
2008	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	10425.5
2009	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	10893.0
2010	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	11360.5
2011	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	11828.0
2012	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	12295.5
2013	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	12763.0
2014	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	13230.5
2015	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	13698.0
2016	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	14165.5
2017	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	14633.0
2018	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	15100.5
2019	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	15568.0
2020	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	16035.5
2021	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	16503.0
2022	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	16970.5
2023	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	17438.0
2024	24.0	81.0	.0	50.0	5.0	55.0	.0	88.7	25.1	113.8	273.8	17711.8
2025	24.0	81.0	.0	50.0	7.5	57.5	.0	88.7	37.6	126.4	288.9	18000.7
2026	24.0	81.0	.0	50.0	12.5	62.5	.0	88.7	62.7	151.5	319.0	18319.7
2027	24.0	81.0	.0	50.0	15.0	65.0	.0	88.7	75.3	164.0	334.0	18653.8
2028	.0	.0	.0	.0	15.0	15.0	.0	.0	75.3	75.3	90.3	18744.1
2029	.0	.0	.0	.0	7.5	7.5	.0	.0	37.6	37.6	45.1	18789.2
2030	.0	.0	.0	.0	12.5	12.5	.0	.0	62.7	62.7	75.2	18864.5
2031	.0	.0	.0	.0	15.0	15.0	.0	.0	75.3	75.3	90.3	18954.8
2032	.0	.0	.0	.0	10.0	10.0	.0	.0	50.2	50.2	60.2	19015.0
TOTAL	4663.0	3888.0	662.0	2402.0	100.0	3164.0	2540.0	4258.0	502.0	7300.0	19015.0	

TABLE B.2

CASH FLOW SUMMARY ($ MILLION)
SPENT FUEL BEDDED SALT REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	WASTE PREPARATION OPERATING	WASTE PREPARATION DECOMM	WASTE PREPARATION SUBTOTAL	WASTE DISPOSAL CAPITAL	WASTE DISPOSAL OPERATING	WASTE DISPOSAL DECOMM	WASTE DISPOSAL SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	16.5	.0	.0	16.5	106.7	.0	.0	106.7	337.3	2877.3
1993	173.0	.0	49.7	.0	.0	49.7	200.2	.0	.0	200.2	422.9	3300.2
1994	145.0	.0	66.2	.0	.0	66.2	267.0	.0	.0	267.0	478.2	3778.4
1995	139.0	.0	72.8	.0	.0	72.8	293.7	.0	.0	293.7	505.5	4283.9
1996	139.0	.0	92.7	.0	.0	92.7	373.8	.0	.0	373.8	605.5	4889.4
1997	149.0	.0	99.3	.0	.0	99.3	400.5	.0	.0	400.5	648.8	5538.2
1998	138.0	48.6	66.2	30.0	.0	96.2	267.0	53.2	.0	320.2	603.0	6141.2
1999	135.0	48.6	72.8	30.0	.0	102.8	293.7	53.2	.0	346.9	633.4	6774.6
2000	122.0	48.6	76.1	30.0	.0	106.2	307.0	53.2	.0	360.3	637.0	7411.6
2001	63.0	48.6	49.7	30.0	.0	79.7	200.2	53.2	.0	253.5	444.7	7856.4
2002	62.0	97.2	.0	60.0	.0	60.0	.0	106.4	.0	106.4	325.7	8182.1
2003	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	8561.7
2004	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	8941.3
2005	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	9320.9
2006	28.0	129.6	.0	80.1	.0	80.1	.0	141.9	.0	141.9	379.6	9700.5
2007	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	10168.0
2008	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	10635.5
2009	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	11103.0
2010	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	11570.5
2011	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	12038.0
2012	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	12505.5
2013	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	12973.0
2014	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	13440.5
2015	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	13908.0
2016	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	14375.5
2017	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	14843.0
2018	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	15310.5
2019	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	15778.0
2020	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	16245.5
2021	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	16713.0
2022	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	17180.5
2023	28.0	162.0	.0	100.1	.0	100.1	.0	177.4	.0	177.4	467.5	17648.0
2024	24.0	81.0	.0	50.0	5.0	55.0	.0	88.7	26.7	115.4	275.4	17923.4
2025	24.0	81.0	.0	50.0	7.5	57.5	.0	88.7	40.0	128.8	291.3	18214.7
2026	24.0	81.0	.0	50.0	12.5	62.5	.0	88.7	66.7	155.5	323.0	18537.7
2027	24.0	81.0	.0	50.0	15.0	65.0	.0	88.7	80.1	168.8	338.8	18876.6
2028	.0	.0	.0	.0	15.0	15.0	.0	.0	80.1	80.1	95.1	18971.7
2029	.0	.0	.0	.0	7.5	7.5	.0	.0	40.0	40.0	47.5	19019.2
2030	.0	.0	.0	.0	12.5	12.5	.0	.0	66.7	66.7	79.2	19098.5
2031	.0	.0	.0	.0	15.0	15.0	.0	.0	80.1	80.1	95.1	19193.6
2032	.0	.0	.0	.0	10.0	10.0	.0	.0	53.4	53.4	63.4	19257.0
TOTAL	4663.0	3888.0	662.0	2402.0	100.0	3164.0	2750.0	4258.0	534.0	7542.0	19257.0	

TABLE B.3

CASH FLOW SUMMARY ($ MILLION)
SPENT FUEL TUFF REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	WASTE PREPARATION OPERATING	WASTE PREPARATION DECOMM	WASTE PREPARATION SUBTOTAL	WASTE DISPOSAL CAPITAL	WASTE DISPOSAL OPERATING	WASTE DISPOSAL DECOMM	WASTE DISPOSAL SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	247.0	1940.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2171.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2310.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2500.0
1992	214.0	.0	16.5	.0	.0	16.5	64.5	.0	.0	64.5	295.0	2795.0
1993	173.0	.0	49.7	.0	.0	49.7	193.5	.0	.0	193.5	416.1	3211.2
1994	145.0	.0	66.2	.0	.0	66.2	258.0	.0	.0	258.0	469.2	3680.4
1995	139.0	.0	72.8	.0	.0	72.8	283.8	.0	.0	283.8	495.6	4176.0
1996	139.0	.0	92.7	.0	.0	92.7	361.2	.0	.0	361.2	592.9	4768.9
1997	149.0	.0	99.3	.0	.0	99.3	387.0	.0	.0	387.0	635.3	5404.2
1998	138.0	48.6	66.2	30.0	.0	96.2	258.0	60.7	.0	318.7	601.5	6005.7
1999	135.0	48.6	72.8	30.0	.0	102.8	283.8	60.7	.0	344.5	630.9	6636.6
2000	122.0	48.6	76.1	30.0	.0	106.2	296.7	60.7	.0	357.4	634.1	7270.7
2001	63.0	48.6	49.7	30.0	.0	79.7	193.5	60.7	.0	254.2	445.4	7716.2
2002	62.0	97.2	.0	60.0	.0	60.0	.0	121.3	.0	121.3	340.6	8056.8
2003	28.0	129.6	.0	80.1	.0	80.1	.0	161.8	.0	161.8	399.5	8456.3
2004	28.0	129.6	.0	80.1	.0	80.1	.0	161.8	.0	161.8	399.5	8855.7
2005	28.0	129.6	.0	80.1	.0	80.1	.0	161.8	.0	161.8	399.5	9255.2
2006	28.0	129.6	.0	80.1	.0	80.1	.0	161.8	.0	161.8	399.5	9654.7
2007	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	10147.0
2008	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	10639.3
2009	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	11131.7
2010	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	11624.0
2011	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	12116.3
2012	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	12608.7
2013	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	13101.0
2014	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	13593.3
2015	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	14085.7
2016	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	14578.0
2017	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	15070.3
2018	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	15562.7
2019	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	16055.0
2020	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	16547.3
2021	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	17039.7
2022	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	17532.0
2023	28.0	162.0	.0	100.1	.0	100.1	.0	202.2	.0	202.2	492.3	18024.3
2024	24.0	81.0	.0	50.0	5.0	55.0	.0	101.1	28.6	129.7	289.8	18314.1
2025	24.0	81.0	.0	50.0	7.5	57.5	.0	101.1	42.9	144.0	306.6	18620.7
2026	24.0	81.0	.0	50.0	12.5	62.5	.0	101.1	71.5	172.6	340.2	18960.8
2027	24.0	81.0	.0	50.0	15.0	65.0	.0	101.1	85.8	186.9	357.0	19317.8
2028	.0	.0	.0	.0	15.0	15.0	.0	.0	85.8	85.8	100.8	19418.6
2029	.0	.0	.0	.0	7.5	7.5	.0	.0	42.9	42.9	50.4	19469.0
2030	.0	.0	.0	.0	12.5	12.5	.0	.0	71.5	71.5	84.0	19553.0
2031	.0	.0	.0	.0	15.0	15.0	.0	.0	85.8	85.8	100.8	19653.8
2032	.0	.0	.0	.0	10.0	10.0	.0	.0	57.2	57.2	67.2	19721.0
TOTAL	4663.0	3888.0	662.0	2402.0	100.0	3164.0	2580.0	4854.0	572.0	8006.0	19721.0	

TABLE B.4

CASH FLOW SUMMARY (\$ MILLION)
SPENT FUEL GRANITE REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	WASTE PREPARATION OPERATING	WASTE PREPARATION DECOMM	WASTE PREPARATION SUBTOTAL	WASTE DISPOSAL CAPITAL	WASTE DISPOSAL OPERATING	WASTE DISPOSAL DECOMM	WASTE DISPOSAL SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	16.5	.0	.0	16.5	106.3	.0	.0	106.3	336.9	2876.9
1993	173.0	.0	49.7	.0	.0	49.7	199.0	.0	.0	199.0	421.7	3298.6
1994	145.0	.0	66.2	.0	.0	66.2	265.4	.0	.0	265.4	476.6	3775.2
1995	139.0	.0	72.8	.0	.0	72.8	291.9	.0	.0	291.9	503.8	4279.0
1996	139.0	.0	92.7	.0	.0	92.7	371.6	.0	.0	371.6	603.2	4882.2
1997	149.0	.0	99.3	.0	.0	99.3	398.1	.0	.0	398.1	646.4	5528.6
1998	138.0	48.6	66.2	30.0	.0	96.2	265.4	62.5	.0	327.9	610.7	6139.3
1999	135.0	48.6	72.8	30.0	.0	102.8	291.9	62.5	.0	354.5	640.9	6780.3
2000	122.0	48.6	76.1	30.0	.0	106.2	305.2	62.5	.0	367.7	644.5	7424.7
2001	63.0	48.6	49.7	30.0	.0	79.7	199.0	62.5	.0	261.6	452.8	7877.6
2002	62.0	97.2	.0	60.0	.0	60.0	.0	125.0	.0	125.0	344.3	8221.9
2003	28.0	129.6	.0	80.1	.0	80.1	.0	166.7	.0	166.7	404.4	8626.3
2004	28.0	129.6	.0	80.1	.0	80.1	.0	166.7	.0	166.7	404.4	9030.7
2005	28.0	129.6	.0	80.1	.0	80.1	.0	166.7	.0	166.7	404.4	9435.1
2006	28.0	129.6	.0	80.1	.0	80.1	.0	166.7	.0	166.7	404.4	9839.5
2007	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	10338.0
2008	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	10836.5
2009	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	11335.0
2010	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	11833.5
2011	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	12332.0
2012	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	12830.5
2013	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	13329.0
2014	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	13827.5
2015	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	14326.0
2016	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	14824.5
2017	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	15323.0
2018	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	15821.5
2019	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	16320.0
2020	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	16818.5
2021	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	17317.0
2022	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	17815.5
2023	28.0	162.0	.0	100.1	.0	100.1	.0	208.4	.0	208.4	498.5	18314.0
2024	24.0	81.0	.0	50.0	5.0	55.0	.0	104.2	30.8	135.0	295.0	18609.0
2025	24.0	81.0	.0	50.0	7.5	57.5	.0	104.2	46.2	150.4	312.9	18922.0
2026	24.0	81.0	.0	50.0	12.5	62.5	.0	104.2	77.0	181.2	348.7	19270.7
2027	24.0	81.0	.0	50.0	15.0	65.0	.0	104.2	92.4	196.6	366.6	19637.4
2028	.0	.0	.0	.0	15.0	15.0	.0	.0	92.4	92.4	107.4	19744.8
2029	.0	.0	.0	.0	7.5	7.5	.0	.0	46.2	46.2	53.7	19798.5
2030	.0	.0	.0	.0	12.5	12.5	.0	.0	77.0	77.0	89.5	19888.0
2031	.0	.0	.0	.0	15.0	15.0	.0	.0	92.4	92.4	107.4	19995.4
2032	.0	.0	.0	.0	10.0	10.0	.0	.0	61.6	61.6	71.6	20067.0
TOTAL	4663.0	3888.0	662.0	2402.0	100.0	3164.0	2734.0	5002.0	616.0	8352.0	20067.0	

TABLE B.5

CASH FLOW SUMMARY ($ MILLION)
REPROCESSING WASTE DOMED SALT REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	OPERATING	DECOMM	SUBTOTAL	WASTE DISPOSAL CAPITAL	OPERATING	DECOMM	SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	14.6	.0	.0	14.6	99.9	.0	.0	99.9	328.6	2868.6
1993	173.0	.0	43.9	.0	.0	43.9	179.9	.0	.0	179.9	396.8	3265.4
1994	145.0	.0	58.6	.0	.0	58.6	239.8	.0	.0	239.8	443.4	3708.8
1995	139.0	.0	64.5	.0	.0	64.5	263.8	.0	.0	263.8	467.2	4176.0
1996	139.0	.0	82.0	.0	.0	82.0	335.7	.0	.0	335.7	556.8	4732.8
1997	149.0	.0	87.9	.0	.0	87.9	359.7	.0	.0	359.7	596.6	5329.4
1998	138.0	41.4	58.6	25.0	.0	83.6	239.8	51.9	.0	291.7	554.7	5884.1
1999	135.0	41.4	64.5	25.0	.0	89.5	263.8	51.9	.0	315.7	581.5	6465.6
2000	122.0	41.4	67.4	25.0	.0	92.4	275.8	51.9	.0	327.6	583.4	7049.0
2001	63.0	41.4	43.9	25.0	.0	68.9	179.9	51.9	.0	231.7	405.1	7454.1
2002	62.0	82.8	.0	50.0	.0	50.0	.0	103.7	.0	103.7	298.5	7752.6
2003	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	8096.0
2004	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	8439.4
2005	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	8782.8
2006	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	9126.2
2007	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	9548.5
2008	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	9970.7
2009	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	10393.0
2010	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	10815.2
2011	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	11237.5
2012	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	11659.7
2013	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	12082.0
2014	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	12504.2
2015	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	12926.5
2016	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	13348.7
2017	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	13771.0
2018	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	14193.2
2019	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	14615.5
2020	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	15037.7
2021	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	15460.0
2022	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	15882.2
2023	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	16304.5
2024	24.0	69.0	.0	41.7	4.4	46.1	.0	86.5	21.1	107.6	246.6	16551.1
2025	24.0	69.0	.0	41.7	6.6	48.3	.0	86.5	31.6	118.1	259.4	16810.5
2026	24.0	69.0	.0	41.7	11.0	52.7	.0	86.5	52.7	139.2	284.9	17095.4
2027	24.0	69.0	.0	41.7	13.2	54.9	.0	86.5	63.3	149.8	297.6	17393.0
2028	.0	.0	.0	.0	13.2	13.2	.0	.0	63.3	63.3	76.5	17469.5
2029	.0	.0	.0	.0	6.6	6.6	.0	.0	31.6	31.6	38.2	17507.7
2030	.0	.0	.0	.0	11.0	11.0	.0	.0	52.7	52.7	63.7	17571.5
2031	.0	.0	.0	.0	13.2	13.2	.0	.0	63.3	63.3	76.5	17648.0
2032	.0	.0	.0	.0	8.8	8.8	.0	.0	42.2	42.2	51.0	17699.0
TOTAL	4663.0	3312.0	586.0	2000.0	88.0	2674.0	2478.0	4150.0	422.0	7050.0	17699.0	

TABLE B.6

CASH FLOW SUMMARY ($ MILLION)
REPROCESSING WASTE BEDDED SALT REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION: CAPITAL	WASTE PREPARATION: OPERATING	WASTE PREPARATION: DECOMM	WASTE PREPARATION: SUBTOTAL	WASTE DISPOSAL: CAPITAL	WASTE DISPOSAL: OPERATING	WASTE DISPOSAL: DECOMM	WASTE DISPOSAL: SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	14.6	.0	.0	14.6	105.2	.0	.0	105.2	333.8	2873.8
1993	173.0	.0	43.9	.0	.0	43.9	195.6	.0	.0	195.6	412.5	3286.4
1994	145.0	.0	58.6	.0	.0	58.6	260.8	.0	.0	260.8	464.4	3750.8
1995	139.0	.0	64.5	.0	.0	64.5	286.9	.0	.0	286.9	490.3	4241.1
1996	139.0	.0	82.0	.0	.0	82.0	365.1	.0	.0	365.1	586.2	4827.3
1997	149.0	.0	87.9	.0	.0	87.9	391.2	.0	.0	391.2	628.1	5455.4
1998	138.0	41.4	58.6	25.0	.0	83.6	260.8	51.9	.0	312.7	575.7	6031.1
1999	135.0	41.4	64.5	25.0	.0	89.5	286.9	51.9	.0	338.8	604.6	6635.7
2000	122.0	41.4	67.4	25.0	.0	92.4	299.9	51.9	.0	351.8	607.6	7243.3
2001	63.0	41.4	43.9	25.0	.0	68.9	195.6	51.9	.0	247.5	420.8	7664.1
2002	62.0	82.8	.0	50.0	.0	50.0	.0	103.7	.0	103.7	298.5	7962.6
2003	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	8306.0
2004	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	8649.4
2005	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	8992.8
2006	28.0	110.4	.0	66.7	.0	66.7	.0	138.3	.0	138.3	343.4	9336.2
2007	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	9758.5
2008	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	10180.7
2009	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	10603.0
2010	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	11025.2
2011	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	11447.5
2012	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	11869.7
2013	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	12292.0
2014	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	12714.2
2015	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	13136.5
2016	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	13558.7
2017	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	13981.0
2018	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	14403.2
2019	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	14825.5
2020	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	15247.7
2021	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	15670.0
2022	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	16092.2
2023	28.0	138.0	.0	83.3	.0	83.3	.0	172.9	.0	172.9	422.2	16514.5
2024	24.0	69.0	.0	41.7	4.4	46.1	.0	86.5	22.7	109.2	248.2	16762.7
2025	24.0	69.0	.0	41.7	6.6	48.3	.0	86.5	34.0	120.5	261.8	17024.5
2026	24.0	69.0	.0	41.7	11.0	52.7	.0	86.5	56.7	143.2	288.9	17313.4
2027	24.0	69.0	.0	41.7	13.2	54.9	.0	86.5	68.1	154.6	302.4	17615.8
2028	.0	.0	.0	.0	13.2	13.2	.0	.0	68.1	68.1	81.3	17697.1
2029	.0	.0	.0	.0	6.6	6.6	.0	.0	34.0	34.0	40.6	17737.7
2030	.0	.0	.0	.0	11.0	11.0	.0	.0	56.7	56.7	67.7	17805.5
2031	.0	.0	.0	.0	13.2	13.2	.0	.0	68.1	68.1	81.3	17886.8
2032	.0	.0	.0	.0	8.8	8.8	.0	.0	45.4	45.4	54.2	17941.0
TOTAL	4063.0	3312.0	586.0	2000.0	88.0	2674.0	2688.0	4150.0	454.0	7292.0	17941.0	

TABLE B.7

CASH FLOW SUMMARY (\$ MILLION)
REPROCESSING WASTE TUFF REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	WASTE PREPARATION OPERATING	WASTE PREPARATION DECOMM	WASTE PREPARATION SUBTOTAL	WASTE DISPOSAL CAPITAL	WASTE DISPOSAL OPERATING	WASTE DISPOSAL DECOMM	WASTE DISPOSAL SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	247.0	1940.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2171.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2310.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2500.0
1992	214.0	.0	14.6	.0	.0	14.6	68.5	.0	.0	68.5	297.1	2797.1
1993	173.0	.0	43.9	.0	.0	43.9	205.5	.0	.0	205.5	422.4	3219.6
1994	145.0	.0	58.6	.0	.0	58.6	274.0	.0	.0	274.0	477.6	3697.2
1995	139.0	.0	64.5	.0	.0	64.5	301.4	.0	.0	301.4	504.9	4202.1
1996	139.0	.0	82.0	.0	.0	82.0	383.6	.0	.0	383.6	604.6	4806.7
1997	149.0	.0	87.9	.0	.0	87.9	411.0	.0	.0	411.0	647.9	5454.6
1998	138.0	41.4	58.6	25.0	.0	83.6	274.0	60.3	.0	334.3	597.3	6051.9
1999	135.0	41.4	64.5	25.0	.0	89.5	301.4	60.3	.0	361.7	627.6	6679.5
2000	122.0	41.4	67.4	25.0	.0	92.4	315.1	60.3	.0	375.4	631.2	7310.7
2001	63.0	41.4	43.9	25.0	.0	68.9	205.5	60.3	.0	265.8	439.2	7749.9
2002	62.0	82.8	.0	50.0	.0	50.0	.0	120.6	.0	120.6	315.4	8065.3
2003	28.0	110.4	.0	66.7	.0	66.7	.0	160.9	.0	160.9	365.9	8431.3
2004	28.0	110.4	.0	66.7	.0	66.7	.0	160.9	.0	160.9	365.9	8797.2
2005	28.0	110.4	.0	66.7	.0	66.7	.0	160.9	.0	160.9	365.9	9163.1
2006	28.0	110.4	.0	66.7	.0	66.7	.0	160.9	.0	160.9	365.9	9529.1
2007	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	9979.5
2008	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	10429.9
2009	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	10880.3
2010	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	11330.7
2011	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	11781.2
2012	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	12231.6
2013	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	12682.0
2014	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	13132.4
2015	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	13582.8
2016	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	14033.2
2017	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	14483.7
2018	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	14934.1
2019	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	15384.5
2020	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	15834.9
2021	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	16285.3
2022	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	16735.7
2023	28.0	138.0	.0	83.3	.0	83.3	.0	201.1	.0	201.1	450.4	17186.2
2024	24.0	69.0	.0	41.7	4.4	46.1	.0	100.5	22.7	123.2	262.3	17448.5
2025	24.0	69.0	.0	41.7	6.6	48.3	.0	100.5	34.0	134.6	275.9	17724.3
2026	24.0	69.0	.0	41.7	11.0	52.7	.0	100.5	56.7	157.3	303.0	18027.3
2027	24.0	69.0	.0	41.7	13.2	54.9	.0	100.5	68.1	168.6	316.5	18343.8
2028	.0	.0	.0	.0	13.2	13.2	.0	.0	68.1	68.1	81.3	18425.1
2029	.0	.0	.0	.0	6.6	6.6	.0	.0	34.0	34.0	40.6	18465.7
2030	.0	.0	.0	.0	11.0	11.0	.0	.0	56.7	56.7	67.7	18533.5
2031	.0	.0	.0	.0	13.2	13.2	.0	.0	68.1	68.1	81.3	18614.8
2032	.0	.0	.0	.0	8.8	8.8	.0	.0	45.4	45.4	54.2	18669.0
TOTAL	4663.0	3312.0	586.0	2000.0	88.0	2674.0	2740.0	4826.0	454.0	8020.0	18669.0	

TABLE B.8

CASH FLOW SUMMARY ($ MILLION)
REPROCESSING WASTE GRANITE REFERENCE CASE

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	WASTE PREPARATION OPERATING	WASTE PREPARATION DECOMM	WASTE PREPARATION SUBTOTAL	WASTE DISPOSAL CAPITAL	WASTE DISPOSAL OPERATING	WASTE DISPOSAL DECOMM	WASTE DISPOSAL SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	14.6	.0	.0	14.6	110.0	.0	.0	110.0	338.7	2878.7
1993	173.0	.0	43.9	.0	.0	43.9	210.1	.0	.0	210.1	427.1	3305.8
1994	145.0	.0	58.6	.0	.0	58.6	280.2	.0	.0	280.2	483.8	3789.6
1995	139.0	.0	64.5	.0	.0	64.5	308.2	.0	.0	308.2	511.7	4301.3
1996	139.0	.0	82.0	.0	.0	82.0	392.3	.0	.0	392.3	613.3	4914.6
1997	149.0	.0	87.9	.0	.0	87.9	420.3	.0	.0	420.3	657.2	5571.8
1998	138.0	41.4	58.6	25.0	.0	83.6	280.2	60.9	.0	341.1	604.1	6175.9
1999	135.0	41.4	64.5	25.0	.0	89.5	308.2	60.9	.0	369.1	635.0	6810.8
2000	122.0	41.4	67.4	25.0	.0	92.4	322.2	60.9	.0	383.1	638.9	7449.7
2001	63.0	41.4	43.9	25.0	.0	68.9	210.1	60.9	.0	271.0	444.4	7894.1
2002	62.0	82.8	.0	50.0	.0	50.0	.0	121.7	.0	121.7	316.5	8210.6
2003	28.0	110.4	.0	66.7	.0	66.7	.0	162.3	.0	162.3	367.4	8578.0
2004	28.0	110.4	.0	66.7	.0	66.7	.0	162.3	.0	162.3	367.4	8945.4
2005	28.0	110.4	.0	66.7	.0	66.7	.0	162.3	.0	162.3	367.4	9312.8
2006	28.0	110.4	.0	66.7	.0	66.7	.0	162.3	.0	162.3	367.4	9680.2
2007	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	10132.5
2008	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	10584.7
2009	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	11037.0
2010	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	11489.2
2011	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	11941.5
2012	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	12393.7
2013	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	12846.0
2014	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	13298.2
2015	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	13750.5
2016	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	14202.7
2017	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	14655.0
2018	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	15107.2
2019	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	15559.5
2020	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	16011.7
2021	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	16464.0
2022	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	16916.2
2023	28.0	138.0	.0	83.3	.0	83.3	.0	202.9	.0	202.9	452.2	17368.5
2024	24.0	69.0	.0	41.7	4.4	46.1	.0	101.5	24.0	125.5	264.5	17633.0
2025	24.0	69.0	.0	41.7	6.6	48.3	.0	101.5	36.0	137.5	278.7	17911.7
2026	24.0	69.0	.0	41.7	11.0	52.7	.0	101.5	60.0	161.5	307.1	18218.9
2027	24.0	69.0	.0	41.7	13.2	54.9	.0	101.5	72.0	173.5	321.3	18540.2
2028	.0	.0	.0	.0	13.2	13.2	.0	.0	72.0	72.0	85.2	18625.4
2029	.0	.0	.0	.0	6.6	6.6	.0	.0	36.0	36.0	42.6	18668.0
2030	.0	.0	.0	.0	11.0	11.0	.0	.0	60.0	60.0	71.0	18739.0
2031	.0	.0	.0	.0	13.2	13.2	.0	.0	72.0	72.0	85.2	18824.2
2032	.0	.0	.0	.0	8.8	8.8	.0	.0	48.0	48.0	56.8	18881.0
TOTAL	4663.0	3312.0	586.0	2000.0	88.0	2674.0	2882.0	4870.0	480.0	8232.0	18881.0	

TABLE B.9

CASH FLOW SUMMARY ($ MILLION)
COST UPPER BOUND COMPOSITE SF TUFF HIGH MINING HIGH PREP HI TRANSPORT

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	WASTE PREPARATION OPERATING	WASTE PREPARATION DECOMM	WASTE PREPARATION SUBTOTAL	WASTE DISPOSAL CAPITAL	WASTE DISPOSAL OPERATING	WASTE DISPOSAL DECOMM	WASTE DISPOSAL SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	247.0	1940.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2171.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2310.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2500.0
1992	214.0	.0	23.1	.0	.0	23.1	118.9	.0	.0	118.9	356.1	2856.1
1993	173.0	.0	69.4	.0	.0	69.4	356.8	.0	.0	356.8	599.3	3455.4
1994	145.0	.0	92.6	.0	.0	92.6	475.8	.0	.0	475.8	713.4	4168.8
1995	139.0	.0	101.9	.0	.0	101.9	523.4	.0	.0	523.4	764.2	4933.0
1996	139.0	.0	129.6	.0	.0	129.6	666.1	.0	.0	666.1	934.8	5867.8
1997	149.0	.0	138.9	.0	.0	138.9	713.7	.0	.0	713.7	1001.6	6869.4
1998	138.0	75.6	92.6	40.5	.0	133.1	475.8	91.6	.0	567.4	914.1	7783.5
1999	135.0	75.6	101.9	40.5	.0	142.4	523.4	91.6	.0	615.0	968.0	8751.5
2000	122.0	75.6	106.5	40.5	.0	147.0	547.2	91.6	.0	638.8	983.4	9734.9
2001	63.0	75.6	69.4	40.5	.0	110.0	356.8	91.6	.0	448.4	697.0	10431.9
2002	62.0	151.2	.0	81.0	.0	81.0	.0	183.2	.0	183.2	477.4	10909.3
2003	28.0	201.6	.0	108.1	.0	108.1	.0	244.3	.0	244.3	581.9	11491.3
2004	28.0	201.6	.0	108.1	.0	108.1	.0	244.3	.0	244.3	581.9	12073.2
2005	28.0	201.6	.0	108.1	.0	108.1	.0	244.3	.0	244.3	581.9	12655.1
2006	28.0	201.6	.0	108.1	.0	108.1	.0	244.3	.0	244.3	581.9	13237.1
2007	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	13957.5
2008	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	14677.9
2009	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	15398.3
2010	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	16118.7
2011	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	16839.2
2012	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	17559.6
2013	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	18280.0
2014	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	19000.4
2015	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	19720.8
2016	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	20441.2
2017	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	21161.7
2018	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	21882.1
2019	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	22602.5
2020	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	23322.9
2021	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	24043.3
2022	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	24763.7
2023	28.0	252.0	.0	135.1	.0	135.1	.0	305.3	.0	305.3	720.4	25484.2
2024	24.0	126.0	.0	67.5	7.0	74.5	.0	152.7	63.5	216.2	440.7	25924.9
2025	24.0	126.0	.0	67.5	10.5	78.0	.0	152.7	95.2	247.9	476.0	26400.8
2026	24.0	126.0	.0	67.5	17.5	85.0	.0	152.7	158.7	311.4	546.5	26947.3
2027	24.0	126.0	.0	67.5	21.0	88.5	.0	152.7	190.5	343.2	581.7	27529.0
2028	.0	.0	.0	.0	21.0	21.0	.0	.0	190.5	190.5	211.5	27740.5
2029	.0	.0	.0	.0	10.5	10.5	.0	.0	95.2	95.2	105.7	27846.2
2030	.0	.0	.0	.0	17.5	17.5	.0	.0	158.7	158.7	176.2	28022.5
2031	.0	.0	.0	.0	21.0	21.0	.0	.0	190.5	190.5	211.5	28234.0
2032	.0	.0	.0	.0	14.0	14.0	.0	.0	127.0	127.0	141.0	28375.0
TOTAL	4663.0	6048.0	926.0	3242.0	140.0	4308.0	4758.0	7328.0	1270.0	13356.0	28375.0	

TABLE B.10

CASH FLOW SUMMARY ($ MILLION)
COST LOWER BOUND COMPOSITE DOMED SALT REPR. LOW MINING LOW PREP

YEAR	SITE DEVELOP	TRANSP	WASTE PREPARATION CAPITAL	OPERATING	DECOMM	SUBTOTAL	WASTE DISPOSAL CAPITAL	OPERATING	DECOMM	SUBTOTAL	TOTAL ANNUAL	CUMULATIVE
1982	188.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	188.0	188.0
1983	235.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	235.0	423.0
1984	347.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	347.0	770.0
1985	369.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	369.0	1139.0
1986	291.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	291.0	1430.0
1987	263.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	263.0	1693.0
1988	247.0	.0	.0	.0	.0	.0	40.0	.0	.0	40.0	287.0	1980.0
1989	231.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	231.0	2211.0
1990	139.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	139.0	2350.0
1991	190.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	190.0	2540.0
1992	214.0	.0	11.7	.0	.0	11.7	95.7	.0	.0	95.7	321.4	2861.4
1993	173.0	.0	35.1	.0	.0	35.1	167.2	.0	.0	167.2	375.3	3236.8
1994	145.0	.0	46.8	.0	.0	46.8	223.0	.0	.0	223.0	414.8	3651.6
1995	139.0	.0	51.5	.0	.0	51.5	245.3	.0	.0	245.3	435.8	4087.4
1996	139.0	.0	65.5	.0	.0	65.5	312.2	.0	.0	312.2	516.7	4604.1
1997	149.0	.0	70.2	.0	.0	70.2	334.5	.0	.0	334.5	553.7	5157.8
1998	138.0	41.4	46.8	14.4	.0	61.2	223.0	50.8	.0	273.8	514.4	5672.2
1999	135.0	41.4	51.5	14.4	.0	65.9	245.3	50.8	.0	296.1	538.4	6210.7
2000	122.0	41.4	53.8	14.4	.0	68.2	256.4	50.8	.0	307.3	538.9	6749.6
2001	63.0	41.4	35.1	14.4	.0	49.5	167.2	50.8	.0	218.1	372.0	7121.6
2002	62.0	82.8	.0	28.8	.0	28.8	.0	101.6	.0	101.6	275.3	7396.9
2003	28.0	110.4	.0	38.5	.0	38.5	.0	135.5	.0	135.5	312.4	7709.3
2004	28.0	110.4	.0	38.5	.0	38.5	.0	135.5	.0	135.5	312.4	8021.7
2005	28.0	110.4	.0	38.5	.0	38.5	.0	135.5	.0	135.5	312.4	8334.1
2006	28.0	110.4	.0	38.5	.0	38.5	.0	135.5	.0	135.5	312.4	8646.5
2007	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	9030.0
2008	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	9413.5
2009	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	9797.0
2010	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	10180.5
2011	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	10564.0
2012	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	10947.5
2013	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	11331.0
2014	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	11714.5
2015	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	12098.0
2016	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	12481.5
2017	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	12865.0
2018	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	13248.5
2019	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	13632.0
2020	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	14015.5
2021	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	14399.0
2022	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	14782.5
2023	28.0	138.0	.0	48.1	.0	48.1	.0	169.4	.0	169.4	383.5	15166.0
2024	24.0	69.0	.0	24.0	3.5	27.5	.0	84.7	19.2	103.9	224.4	15390.4
2025	24.0	69.0	.0	24.0	5.2	29.3	.0	84.7	28.8	113.5	235.8	15626.2
2026	24.0	69.0	.0	24.0	8.8	32.8	.0	84.7	48.0	132.7	258.5	15884.7
2027	24.0	69.0	.0	24.0	10.5	34.5	.0	84.7	57.6	142.3	269.8	16154.6
2028	.0	.0	.0	.0	10.5	10.5	.0	.0	57.6	57.6	68.1	16222.7
2029	.0	.0	.0	.0	5.2	5.2	.0	.0	28.8	28.8	34.0	16256.7
2030	.0	.0	.0	.0	8.8	8.8	.0	.0	48.0	48.0	56.7	16313.5
2031	.0	.0	.0	.0	10.5	10.5	.0	.0	57.6	57.6	68.1	16381.6
2032	.0	.0	.0	.0	7.0	7.0	.0	.0	38.4	38.4	45.4	16427.0
TOTAL	4663.0	3312.0	468.0	1154.0	70.0	1692.0	2310.0	4066.0	384.0	6760.0	16427.0	

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