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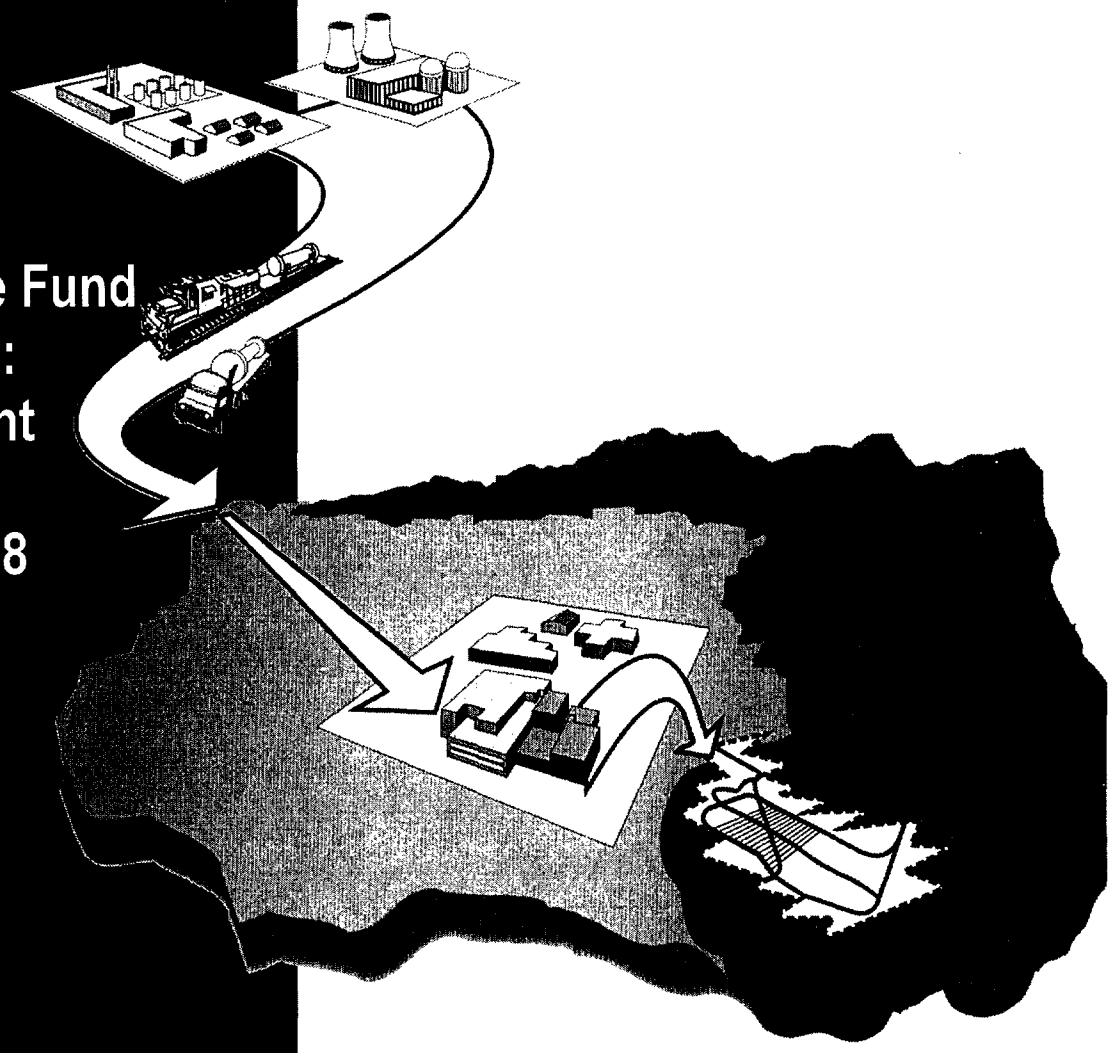

Nuclear Waste Fund Fee Adequacy: An Assessment

December 1998

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C. 20585

This publication was produced by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management

For further information, contact:

Office of Civilian Radioactive Waste Management National Information Center
600 Maryland Ave., S.W., Suite 695
Washington, DC 20024

or call:

1-800-225-NWPA (6972)
Washington, DC: 202-488-6720

or visit:

http:\\www.rw.doe.gov

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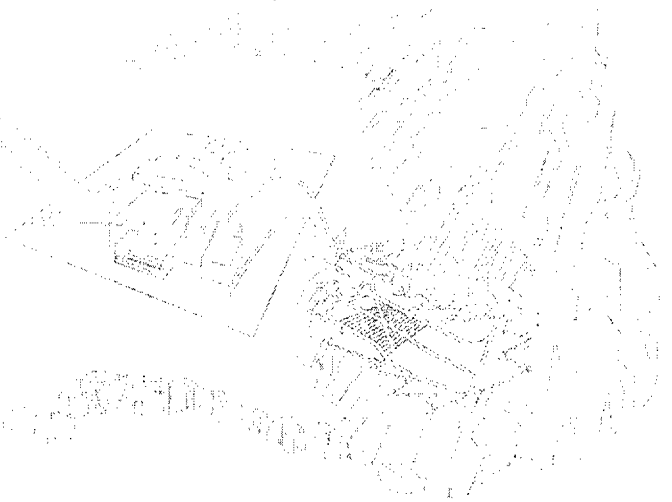

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LETTER FROM THE DIRECTOR

The *Nuclear Waste Fund Fee Adequacy: An Assessment* presents the Office of Civilian Radioactive Waste Management's most recent estimate of the adequacy of the Nuclear Waste Fund (NWF) fee. The NWF is a separate account, established in the Treasury of the United States by the Nuclear Waste Policy Act (NWPA). It consists of receipts, proceeds and recoveries realized by the U.S. Department of Energy (DOE) under the NWPA, any appropriations made by the Congress into the NWF, and any unexpended balances that were transferred to the NWF on the date of enactment of the NWPA. Fees paid by owners and generators of civilian spent nuclear fuel are deposited directly into the NWF. The fee is 1 mill (0.1 ¢) per kilowatt-hour of electricity generated and sold.

The NWF Fee Adequacy report only considers the costs associated with disposal of commercial spent nuclear fuel (SNF). Costs for the disposal of Government-managed nuclear materials, including DOE and naval SNF, vitrified high-level radioactive waste (HLW) glass, and "can-in-canister" immobilized plutonium, are not paid for with the fees assessed to commercial nuclear utilities.

The assessment is based on the *Analysis of the Total System Life Cycle Cost (TSLCC) of the Civilian Radioactive Waste Management Program* [DOE/RW-0510], which is available on the Office of Civilian Radioactive Waste Management's Home Page [http://www.rw.doe.gov]. The TSLCC analysis projects costs through the year 2116 for a surrogate, single repository, expanded to accommodate all the SNF and HLW projected. The analysis includes all Program costs, including disposal, acceptance and transportation, program management, and institutional categories. The NWF Fee Adequacy assessment uses the same commercial SNF projections and annual costs that are used in the TSLCC to determine the fee-generated income and earned interest.

The assessment identifies key uncertainties in projecting NWF balances, including variability in Program costs, NWF revenues, and economic conditions. The results indicate that the fee charged to utilities is adequate under the assumptions used in the analysis. Even with the uncertainties described in the assessment, there is no need at this time to adjust the fee.

Sincerely,

Lake H. Barrett, Acting Director
Office of Civilian Radioactive
Waste Management

Dated: December 1998

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1. INTRODUCTION AND EXECUTIVE SUMMARY

1.1 FEE ADEQUACY RECOMMENDATIONS

The U.S. Department of Energy (DOE), referred to as the Department, finds that the current 1.0 mill ($0.001) per kilowatt-hour (kWh) fee charged on generators of spent nuclear fuel (SNF) is adequate, and recommends that the fee not be changed. This recommendation is based on examination and analysis of the revenue forecasts and estimated costs for the Program's current approach to a waste management system (DOE 1998c), and on consideration of the uncertainties associated with economic assumptions, program revenues, program scope, and cost estimates.

The costs assumed for this analysis are based on the Civilian Radioactive Waste Management System Total System Life Cycle Cost (TSLCC) estimate (DOE 1998a). The TSLCC is consistent with the Viability Assessment (VA) of the Yucca Mountain site in Nevada (DOE 1998d), extended to address total waste management system costs for all wastes planned for geologic disposal in a repository. The Nuclear Waste Fund (NWF) is projected to have a positive balance at the end of waste emplacement activities, based on current cost estimates for the reference program, fee revenue projections, and independent projections of inflation and interest rates. This balance is expected to be sufficient to fund planned monitoring, closure and decommissioning actions, and to allow for probable contingencies such as implementation of design options or extended monitoring. Sufficient capital in the NWF at the end of the emplacement period will provide future decision-makers the flexibility to defer closure beyond the current planning assumption of 100 years after the start of emplacement. A positive balance provides a margin of safety for uncertainties and changes in program scope, costs, revenues, and economic assumptions.

1.2 BACKGROUND

The purpose of this report is to present the Department's analysis of the adequacy of the 1.0 mill per kWh fee being paid by the nuclear utilities for the permanent disposal of their SNF. In accordance with the Nuclear Waste Policy Act (NWPA) (DOE 1995b), the costs for disposal of commercial SNF in a geologic repository are to be funded by a fee levied on electricity generated and sold. The fee provides for intergenerational equity, i.e., it ensures that the beneficiaries of nuclear power pay for the costs of disposal of the wastes. These fees are retained in the NWF. The NWF is to be used for development and implementation of a radioactive waste management system in accordance with the NWPA, including a permanent geologic repository. Any fees received in excess of annual funding requirements are invested in U.S. Treasury obligations and earn interest at prevailing rates. The management of funds in the NWF is an important element of the Program, considering that the Fund must cover the cost of activities that extend far beyond the operating life of current nuclear power plants.

For SNF generated by nuclear reactors prior to enactment of the NWPA in 1983, utilities are required to pay a one-time fee equivalent to the ongoing fee of 1.0 mill per kWh paid for electricity generated after 1983.

The Civilian Radioactive Waste Management System (CRWMS) also was given the responsibility to dispose of radioactive wastes managed by the Department. The Department is required to pay its fair share of costs for disposal of defense-related materials such as DOE SNF, which includes navy SNF, and high-level waste (HLW) generated by weapons production activities. HLW includes Immobilized Plutonium Waste Form (IPWF). Costs for disposal of government-managed nuclear materials are paid through Defense Nuclear Waste Disposal appropriations. A methodology for allocating costs between government-managed nuclear materials and commercial wastes was developed by public rulemaking in the August 20, 1987 *Federal Register Notice* (52 FR 31508). This rulemaking provided a vehicle for computing each party's fair share of total costs.

This assessment assumes the Department will pay its full share of past and future costs, and therefore addresses only the continuing adequacy of the 1.0 mill per kWh nuclear utility fee to fund the civilian cost share. The Department is committed to satisfying prior outstanding financial obligations, including interest, prior to acceptance of DOE SNF and HLW at the repository.

1.3 PROGRAM STATUS

A viability assessment of the proposed Monitored Geologic Repository at the Yucca Mountain site has been completed. The VA is an interim assessment of the current base of knowledge from 15 years of characterization of the site. The VA provides an interim assessment for Congress and stakeholders in advance of a formal site recommendation. Should Yucca Mountain be found suitable, the objectives of the Program are to deliver a site recommendation and environmental impact statement to the President in 2001. If approved, the plan is to submit a license application (LA) to the Nuclear Regulatory Commission (NRC) in 2002, begin construction in 2005, and start waste acceptance and emplacement in 2010.

A TSLCC estimate was developed based on and consistent with the VA, expanded in scope to address total program costs, and extended to all wastes planned for geologic disposal. The 1998 TSLCC provides the cost basis for this assessment.

Significant changes have occurred in the Program since the last Fee Adequacy Assessment was published (DOE 1996) based on the 1995 TSLCC. The current cost estimate shows cost increases due to these program scope changes, but also shifts costs later in time. The result is that the ability of the NWF to meet program costs is not adversely affected.

Through fiscal year (FY) 1997, the Program has spent $5.5 billion in year of expenditure (YOE) dollars (DOE 1998b), excluding $47 million in accrued expenses. When escalated to 1998 dollars, the $5.5 billion becomes $6.7 billion. Of the $5.5 billion in YOE dollars, $3.8 billion was spent on the first repository, and $0.1 billion on a second repository. Approximately $0.3 billion was spent on plans for a proposed Monitored Retrievable Storage facility, engineering development, transportation system development, waste acceptance, project integration, and spent fuel storage. Program support has cost $1.0 billion. Program support consists of Quality Assurance, Human Resources and Administration, and Program Management and Integration, including all costs for Federal employees. Transfer appropriations for the NRC, Nuclear Waste

Technical Review Board, and the Office of the Nuclear Waste Negotiator have cost $0.2 billion, and interest expenses have been $0.1 billion. Program expenditures are expected to continue for 119 years through the assumed closure and decommissioning of the repository in 2116.

1.4 STATUS OF THE NUCLEAR WASTE FUND

The NWF balance, as of September 30, 1997, had a market value of $6.9 billion in U.S. Treasury obligations. This balance results from fees, interest, and unrealized gains due to market fluctuations. From FY 1983 to the end of FY 1997, ongoing fee payments accounted for $7.0 billion in YOE dollars ($8.5 billion in 1998 dollars) of utility contributions. Utilities have accrued, but not yet paid, $0.1 billion in one mill/kWh fees by the end of the accounting period. Cumulative one-time fee payments accounted for $1.5 billion in program revenues, with $0.8 billion in principal still owed. Interest received from fees and returns on the NWF investments have contributed $3.2 billion to the Fund, with outstanding receivables of $1.4 billion. Based on projections of nuclear power generation, using a no-new-orders scenario, the last fee revenue will be received in 2036, which is 80 years prior to the anticipated completion date for repository decommissioning in 2116.

Defense Nuclear Waste Disposal appropriations through FY 1997 totaled $0.7 billion. These appropriations are not added to the NWF, nor are they counted as disbursements from the NWF. An additional $1.2 billion of principal and interest is due from the Department for the disposal cost share for DOE SNF and HLW that were incurred through FY 1997. The outstanding balance of $1.2 billion differs from the $1.0 billion contained in OCRWM's fiscal year 1997 financial statement. This outstanding balance was recalculated based on the 1998 TSLCC estimate, and assumes that interest is calculated using the 13 week Treasury bills interest rate from fiscal years 1998 through 2010.

The NWF balance, interest income, and future Defense Nuclear Waste Disposal appropriations for the disposal of DOE SNF and HLW will cover program expenditures after the fee revenues have ended. Figure 1 shows the percentage of revenue required by appropriations from the Department, annual fees, one-time fees with accrued interest from the utilities, and the interest earned by the NWF to fund the program. These sources of revenue, except for Defense Nuclear Waste Disposal appropriations, are factors used in assessing the adequacy of the fee.

1.5 FACTORS AFFECTING THE ADEQUACY OF THE FEE

There are several factors that could affect fee adequacy and result in a need for adjustments to the 1.0 mill per kWh fee. Changes in the cost basis are a primary determinant of fee adequacy. Fee revenue projections affect the income that provides for program costs. Finally, economic assumptions affect both program costs through cost escalation, and interest income through interest rates.

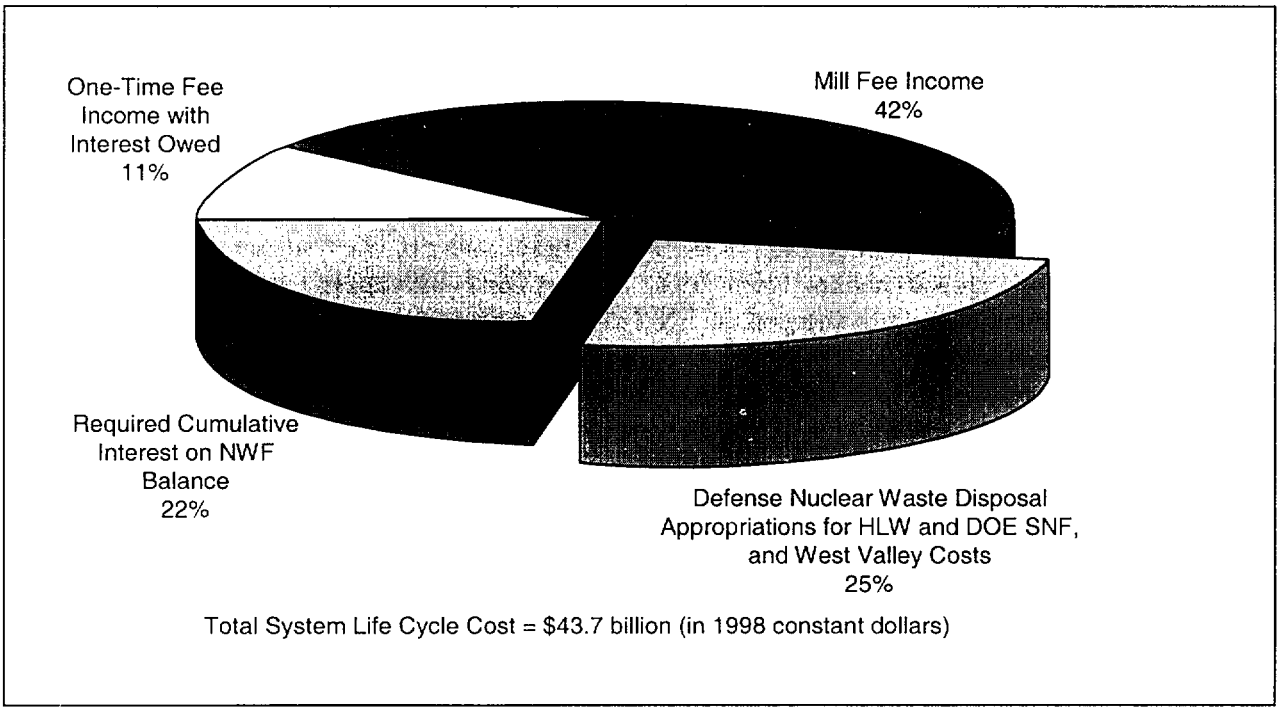

Figure 1. Revenue Sources Required to Fund the 1998 Total System Life Cycle Costs (in Percentages of 1998$)

1.5.1 Program Cost Basis

The fee adequacy assessment is sensitive to changes in program costs. Program cost estimates may change as a result of estimating uncertainty and scope changes. Estimating uncertainty is addressed in the reference design cost estimate through the use of contingency factors applied to the estimate. However, there is additional uncertainty in cost due to uncertainty in program scope. These uncertainties are currently not quantified. Cost uncertainties are addressed in Section 3.1.

The methodology used for determining the relative cost shares between civilian and government-managed nuclear materials is sensitive to program changes. The civilian share allocation decreased from the share used in the 1996 assessment due to incorporation of additional government-managed nuclear materials and elimination of predominantly civilian costs for multi-purpose canisters (MPC). Future program changes may again alter the share allocations.

1.5.2 Projected Fee Revenues

In the near term, fee revenue projections are known with a high degree of certainty, based on projections by the DOE Energy Information Administration. Future projections based on reactor characteristics, known spent fuel discharges, and operating licenses also can be closely estimated. Uncertainty is introduced by the potential for early reactor shutdowns, before license expiration, or by service life extensions. Reductions or increases in electricity generation by nuclear plants will impact both disposal costs and the amount of revenue paid into the NWF.

1.5.3 Economic Factors

As a result of the long duration of the Program, economic factors such as interest and inflation, and near-term expenditure profiles have significant impact on the adequacy of the 1.0 mill per kWh fee. Unforeseeable periods of either low or high real interest rates would significantly decrease or increase the interest earned on the balance in the NWF. The opposite is true for inflation during the life cycle of the Program. Increased inflation would cause higher costs, resulting in a lower NWF balance, thus resulting in less interest income. However, since inflation also directly affects the nominal interest rate, the effects of higher inflation on outlays may be partially offset by higher nominal interest earnings.

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2. METHODOLOGY

This section describes the methodology used in this analysis, and the key assumptions and data which provide the basis for the assessment. Changes in methodology from the last fee adequacy report are also described.

2.1 METHODOLOGY

The evaluation of fee adequacy is based on the principle of full cost recovery presented in Section 302 of the NWPA, under which all costs related to the waste disposal services will be paid for by the owners and generators of SNF and HLW. This principle of full cost recovery underlies the basic analytical methodology used by the Department. The methodology for projecting the adequacy of the fee uses a forecasted revenue stream of fees paid into the NWF by the utilities, and compares it to the disbursement forecast to determine the sufficiency of funds. Annual surpluses are invested in Treasury securities. Annual shortfalls in revenue will be met by redeeming securities held by the NWF or by borrowing from the U.S. Treasury, if necessary.

A cash flow analysis was used. This includes projections of the ongoing kWh fees and projections of when deferred one-time fee payments will be received by the NWF. In addition, the analysis uses the estimated expenditure profile, escalated to year of expenditure dollars, from the 1998 TSLCC analysis. For each year, the cash flow technique takes the previous year's fund balance, adds the current year revenues, and subtracts the escalated expenditures. This provides an annual analysis of cash flows, in YOE dollars, and annual NWF balances. It also calculates the income from investing the NWF Treasury Bond portfolio, using a forecasted nominal rate of return. This technique also would take into account interest expenses from borrowing for cases where the balance becomes negative, if required. Results are deescalated to constant 1998 dollars, consistent with the TSLCC, using the Consumer Price Index (CPI) to eliminate the effects of escalation and the distortions resulting from erosion of purchasing power of distant future dollars.

The model uses the projected coupon and maturity cash flows from the investments held by the NWF on September 30, 1997. At that time, the Fund had a market value of $6.9 billion and a face value, on which the cash flows are based, of $6.2 billion. The $6.2 billion Fund starting balance properly reflects the net effect of all fees paid, interest earned, and disbursements made to fund historical program costs. The NWF balance provides the starting point for the forward-looking analysis of program cash flows to determine fee adequacy. The difference between the market value and face value is a net unamortized premium of $0.5 billion and unrealized gains in market value of $0.2 billion. Starting the calculation with the face value of the fund balance versus the market value is immaterial, because all investments are assumed to be held to maturity. Using the projected cash flows adds realism to the model, although some investments will be redistributed based on the cost projections in the 1998 TSLCC. For purposes of this analysis, it is assumed that all future investments are at 100 percent of the face value and are held until maturity.

This cash flow analysis methodology produces the same results as a Net Present Value analysis when the same interest rates are used. The cash flow analysis provides more visibility into how

fee revenues, interest income, costs, and the NWF balance vary by year. This methodology allows cash flow modeling for the current fund portfolio of U.S. Treasury instruments, using the actual investment returns. In addition, this methodology for the 1998 Fee Adequacy Assessment uses a series of interest and inflation rates, during the period of 1998 through 2042, for investment of income and reinvestment of maturing securities, as opposed to applying a single average rate as in previous analyses.

2.2 CHANGES IN METHODOLOGY

The overall methods used for this analysis are primarily the same as those employed in previous fee adequacy assessments; however, there are a few changes in the methodology and assumptions since the last report was published in 1996.

Three methodology changes were implemented for this fee adequacy assessment. The first change used the actual NWF investment portfolio of Treasury securities, as of the end of Fiscal Year 1997, for calculating a portion of investment income. Modeling of the portfolio simulates the investment approach taken by the Office of Civilian Radioactive Waste Management by assuming that matching investments earn the 10-year note rate and the contingency portfolio earns the 1-year note rate. The matching and contingency portfolio investments are discussed later in Section 3.3.2. Using the 10-year note rate approximates management of the waste fund in that while many securities are held until maturity, some securities, both coupon-bearing and zero coupon, may be sold as required to meet program contingencies, or to rebalance the portfolio to adjust to changing needs. The 1-year and 10-year note rates used in the analysis are based on DRI/McGraw-Hill, Inc., (Standard & Poor's DRI 1998) annual forecasts, as described in Section 3.3.1. The second change used a series of annual interest and inflation rates, as opposed to average rates for interest and inflation over the entire life cycle. The series is based on 25 years of forecasted interest and inflation rates. After the 25-year period, constant average rates were used for the remaining life cycle. The third change phased in the effects of repayment of outstanding balances for government-managed nuclear materials and West Valley HLW prior to the start of waste acceptance.

3. ASSUMPTIONS

The principle underlying assumptions for this fee adequacy analysis fall into three categories: 1) cost assumptions, 2) revenue assumptions, and 3) economic assumptions. The cost assumptions are based upon the 1998 *Analysis of the Total System Life Cycle Cost* (DOE 1998a). Revenue assumptions are based on projections of nuclear power generation. DRI/McGraw-Hill provided 25 years of interest and inflation rate forecasts as part of the economic assumptions. Unless otherwise indicated, all dollar values in the remainder of this report are given in constant 1998 dollars in order to be consistent with the 1998 TSLCC report.

3.1 COST ASSUMPTIONS

The 1998 TSLCC estimate provides the cost basis for this assessment. The program costs obtained from the 1998 TSLCC analysis are for the current reference design concept of the waste disposal system, described in the VA, and expanded to cover all wastes planned for geologic disposal. However, this analysis differs from the 1998 TSLCC in categorizing future costs. The 1998 TSLCC includes estimated 1998 costs as part of the program historical costs, and starts future costs in 1999. This analysis includes $0.4 billion in estimated 1998 costs as part of the future costs to enable use of the OCRWM fiscal year 1997 audited financial statements as the starting point for the NWF balance. This concept consists of a one-repository system without interim storage. This concept should be viewed as representative of the system that will ultimately be developed. Program costs will vary from the current estimate if future design approaches differ from the VA reference design. Costs may be higher or lower. A number of design options have been identified as part of the VA. Rough-order-of-magnitude cost estimates have been developed to aid in their evaluation. In addition, significant design alternatives will be assessed in preparation for Site Recommendation and License Application. Cost uncertainties will be reduced over time as the Program moves through licensing and implementation.

Three significant changes in the system design and assumptions have occurred since the last published report. First, the program baseline has been changed to incorporate DOE SNF, IPWF, and increased quantities of HLW. Secondly, the system design has changed from one based on the extensive utilization of MPCs, using streamlined waste handling facilities. The current reference system is based on limited use of MPCs, using robust waste handling facilities that are capable of transferring mostly uncanistered fuel to disposal containers. Lastly, the types and capabilities for transportation casks also have changed, as well as the number of reactor sites assumed to require legal-weight truck transportation of their SNF. Although cost estimates have increased overall, fee adequacy has improved because early program costs for the MPCs have been eliminated. Increased system costs for a robust surface facility design and more expensive disposal containers, due to the elimination of MPCs, occur later in the system life cycle. The effect is to increase the NWF balance through reduced early expenditures and higher interest income, compounded over many years.

Total program future costs (1998 through 2116) are projected to be $37.0 billion in 1998 dollars. The estimated future cost provides the basis for analysis of future cash flows to determine the adequacy of the waste fund. The VA and 1998 TSLCC provide cost estimates for a design approach that appears viable based on what we know today regarding the candidate Yucca

Mountain Site and the associated preliminary design concept for the repository and waste packages. The ultimate system implemented will depend on the site suitability determination, design development for LA, and any changes that result as part of the licensing process. Program costs will vary from current estimates if the program scope changes. The discussions which follow describe the point estimate cost basis for the reference design, current design options addressed in the VA, and design alternatives which will be evaluated in preparing for LA.

Estimated total system life cycle costs are organized into three major categories: 1) Monitored Geologic Repository, 2) Waste Acceptance and Transportation, and 3) Program Integration. Table 1 displays future life cycle costs associated with a no-new-orders generation forecast in constant 1998 dollars. Program costs are expected to peak in 2008, remain approximately constant during emplacement operations from 2010 through 2040, decrease from 2041 through 2045, remain constant during monitoring from 2046 through 2110, and increase again for decommissioning and closure from 2111 until 2116. The civilian portion of the future $37.0 billion cost is $27.7 billion. Table 1 shows the combined government-managed nuclear materials and West Valley share allocations of estimated future total system cost. The determination of fee adequacy is based only on the civilian share of costs.

Table 1. Summary of Allocations of Total System Life Cycle Cost Future Costs (Millions of 1998$)

Category	Future Cost Allocation[1] (1998-2116)			
	Government-Managed Nuclear Material	West Valley	Civilian	Total
Monitored Geologic Repository	$7,300	$70	$20,570	$27,940
Waste Acceptance and Transportation	$1,180	$45	$5,080	$6,305
Program Integration	$660	$10	$2,070	$2,740
Total	$9,140	$125	$27,720	$36,985
Aggregate Allocation Percent[2]	24.7%	0.34%	74.9%	100%

[1] These future cost allocations differ from the 1998 TSLCC since estimated 1998 costs are included for forward-looking analysis.

[2] Percentages are based on allocating total system life cycle costs.

Note: Totals may not add due to independent rounding.

3.1.1 Design Options

The VA identifies several potential engineered barrier system design options that are being evaluated. Should system performance improvement be needed, given that the U.S. Environmental Protection Agency has not published a performance standard for geologic disposal, these options have the potential to improve system performance over the VA design. The design options currently under consideration include the following:

- Emplacement drift backfill

- Drip shields with backfill
- Ceramic coated waste packages with backfill.

The VA describes the options in Volume 2 and provides preliminary rough-order-of-magnitude cost estimates in Volume 5. If further evaluations indicate that one or more options should be incorporated into the reference repository design, they will be further developed and included in the LA. Preliminary cost estimates for the design options, scaled to all wastes planned for disposal in a repository, are as follows:

- Emplacement drift backfill ..... $0.5 billion
- Drip shield, with backfill ..... $1.1 billion
- Ceramic coating of the disposal container, with backfill ..... $1.1 billion

The later two options each include costs for backfill that would be used in conjunction with either drip shields or ceramic coatings.

3.1.2 Design Alternatives

An effort has been initiated to ensure that an appropriate and comprehensive range of alternative design features and concepts is examined before selecting the reference design to support the Site Recommendation and the subsequent License Application. Alternatives include independent design features and alternative design concepts. Design studies are underway for five alternative design concepts to assess their potential for performance enhancement. Costs associated with these potential design alternative concepts are not included in the VA or TSLCC cost estimates and have not yet been developed. Volume 2 of the VA provides a detailed discussion of alternative design features and concepts, and provides a basis for selection of alternatives.

The alternative design concepts, which vary significantly from the VA design, include the following:

- Waste-specific container design
- Low thermal load design
- Continuous ventilation design
- Enhanced access design
- Modified waste emplacement mode design.

These design concepts are representative of the type of design work that is being or will be undertaken before a reference design is selected to support the Site Recommendation and the License Application. In addition, design features not incorporated into the five alternative design concepts will be evaluated in separate design studies. Implementation of alternatives will result in variations from the single point estimates represented by the VA cost estimate and 1998 TSLCC, based on the current reference design. Uncertainties associated with these alternatives will be reduced progressively as the Program moves forward through its design and licensing phases.

3.1.3 Repository Closure

Future generations will make the ultimate decision on whether it is appropriate to continue to maintain the repository in an open, monitored condition or to close the repository. To ensure flexibility for future decision-makers, the repository is being designed with the capability of being kept open at least 100 years from initiation of waste emplacement. There is a reasonable expectation that it could be maintained open, with appropriate maintenance, for much longer periods of time. This fee adequacy analysis assumes closure of the repository 100 years after the start of emplacement.

3.1.4 Reduction in Cost Uncertainty

Program cost uncertainties will be reduced as the Program progresses from licensing to construction and finally to waste emplacement. Scope uncertainties will be eliminated as design issues are closed during licensing and major decisions are finalized. Summarized below are major decisions that will affect program scope, which drives system costs, and a schedule for their anticipated resolution.

- Site Recommendation – determines suitability of Yucca Mountain 2001
- License Application – narrows design alternatives 2002
- Nevada Rail route selection – narrows route choices from five to one 2002-2004
- Construction Authorization – defines additional requirements from NRC review 2005
- Determination of need for a second repository 2007-2010
- Decision to close the Repository 2060-2110
- Repository Closed 2116

3.2 REVENUE ASSUMPTIONS

The 1.0 mill per kWh fee revenue used in this analysis was derived from data on the Nuclear Fuel Data Form RW-859. This data was collected from the utilities for historical discharges and a forecast of future discharges, calculated by extending utility projections to end of reactor life (CRWMS M&O 1998). It is assumed in this projection that commercial units will operate for 40 years from the issuance of their operating licenses without extensions, and reactor performance will not be affected by aging. RW-859 SNF projections and the resulting fee projections have been adjusted for cancellation of three planned nuclear power units (Bellefonte 1 and 2 and Watts Bar 2), and early shutdowns of Zion 1 and 2, Big Rock Point, Maine Yankee, and Haddam Neck. This analysis has not been adjusted to reflect the recent announcement of plans to close Oyster Creek early; however, this closure does not materially affect the results. The cumulative discharge of civilian spent nuclear fuel is estimated to be approximately 86,000 metric tons of heavy metal. The actual and predicted burnup of this discharged fuel was used to obtain an estimate of electrical output, which was multiplied by the fee to obtain the fee revenue, after taking into account plant efficiencies.

This evaluation incorporates the revenue losses resulting from an amendment to the standard contract for disposal. The amendment was required by two D.C. Circuit Court decisions: one in 1985 and one in 1989 (Wisconsin Electric Power Co. v. Hodel, 778 F. 2d 1; Consolidated Edison

v. U.S. Department of Energy, 870 F. 2d 694). These decisions determined that ongoing nuclear utility fees should be based on electricity generated and sold. In FY 1995, the Department made its final reimbursement to the utilities as a result of this revision to fees collected through FY 1990. For this analysis, the Department assumed a 6 percent reduction in future net generation to account for transmission and distribution losses.

It is assumed that funds paid by the Department for the disposal of DOE SNF and HLW will be sufficient to cover its full cost share and accrued interest. It also is assumed that the New York State Energy Research and Development Authority will pay costs for disposal of HLW currently at West Valley in 2015. Any outstanding balances for prior year shares will be paid prior to initial waste acceptance. The actual appropriation levels will be developed according to the Department's memoranda of agreement (DOE 1998e, DOE1998f) and subject to congressional appropriations. After initial waste acceptance, it is assumed that Defense Nuclear Disposal appropriations match the annual share for material managed by the government.

Table 2 presents the amount of assumed annual appropriations for government-managed nuclear materials and West Valley HLW through 2015. For this analysis, it is assumed that the current appropriation of $190 million YOE dollars for Defense Nuclear Waste Disposal remains constant through 2003; and beginning in 2004, the annual appropriation is increased to $420 million YOE dollars through 2009. A final appropriation of $380 million would be required in 2010. This level of appropriation would reduce the prior outstanding financial obligation for government-managed nuclear materials to zero by the start of acceptance. Assumed annual appropriation amounts are included in this analysis since appropriations above annual cost share offset civilian program expenditures that would otherwise come from the Fund.

This analysis calculated the outstanding balance, owed for government-managed nuclear materials, to be $1.2 billion at the end of FY 1997. The outstanding balance of $1.2 billion is different than the $1.0 billion contained in OCRWM's fiscal year 1997 financial statement. The difference is due to a change in the share allocation percentages and an increase in the system costs calculated in the 1998 TSLCC. The 1998 TSLCC recalculated the civilian and government shares based on the updated estimate of total program costs, from inception through closure and decommissioning. Changes to prior year cost shares resulted in an increase in the outstanding obligation for government-managed materials. This analysis assumes repayment of the obligation, as described above, to allow analysis of the adequacy of the fees paid for commercial SNF to fund the civilian share of program costs.

The calculation of the outstanding obligation for government-managed materials takes into account both the annual share of prior year costs, and the interest accrued on outstanding obligations. The annual share factor is determined using constant dollars and by applying the methodology published in the Federal Register and described in the 1998 TSLCC. The prior year obligation is calculated using actual then-year program costs, and historical 13-week T-bill rates. The assumed repayment, or payment on a similar schedule, adjusts the starting point for the analysis, the NWF starting balance in FY 1998, in a realistic manner.

If the disposal fee remains unchanged at 1.0 mill per kWh of electricity generated and sold, the cumulative fee revenues will be equivalent to $23.2 billion in 1998 dollars. The cumulative fees

are comprised of annual disposal fees, one-time fees, and interest accrued on deferred one-time fees. Fee projections for 1998 through 2008 are estimates by the Energy Information Administration transmitted by DOE interoffice correspondence from the Director, Coal, Nuclear and Renewable Division to the Director, Waste Acceptance and Transportation Division, June 23, 1998. Annual disposal fee payments total $18.5 billion (in 1998 dollars) from FY 1983 to FY 2036 ($10.1 billion for FY 1998 through FY 2036) under the no-new-orders scenario.

Table 2. Assumed Annual Appropriation for Government-Managed Nuclear Materials and West Valley High-Level Waste (Millions of YOE Dollars)

Fiscal Year	Assumed Annual Appropriations for Government-Managed Nuclear Materials & West Valley HLW
1998	190
1999	190
2000	190
2001	190
2002	190
2003	190
2004	420
2005	420
2006	420
2007	420
2008	420
2009	420
2010	380
2011	210
2012	290
2013	290
2014	310
2015*	370

* Includes repayment of $70 million from New York State Energy Research and Development Authority for their outstanding balance.

Note: Actual payment schedules will be developed in accordance with Department's memoranda of agreement and subject to Congressional appropriations.

The standard contracts for disposal between the Department and utilities provided two deferred payment options for one-time fees. Deferred fees can be paid either as 40 quarterly payments in the 10 years prior to acceptance of fuel, or as a lump sum payment prior to waste acceptance. At the end of the 1997 fiscal year, $0.9 billion of principal currently remains deferred and accrues interest at the 13-week Treasury bill rate. For this analysis it was assumed, for those utilities electing the quarterly installment option, that quarterly installments for one-time payments begin in 2001. Lump-sum payments of deferred one-time fees are assumed to begin in 2010, and coincide with the first pick-up of SNF from a utility with an outstanding balance.

In addition to the fees and interest on deferred one-time payments discussed above, the interest on unexpended NWF balances provides revenue. NWF balances are invested by the Secretary of the Treasury in obligations of the United States with maturities appropriate to the needs of the Program. The analysis below addresses the sensitivity of the fee adequacy assessment to future combinations of nominal interest rates and inflation.

3.3 ECONOMIC ASSUMPTIONS

Economic assumptions used in this fee adequacy report consist of inflation and interest forecasts, and an assumed investment strategy.

3.3.1 Projected Inflation and Interest Rates

All inflation and interest rate forecasts, 1998 through 2022, were provided by DRI/McGraw-Hill using their long-range economic forecasting model. These forecasts were projected beyond 2022 based on the DRI/McGraw-Hill forecasts. Figure 2 shows the inflation and interest rate forecasts used in this analysis.

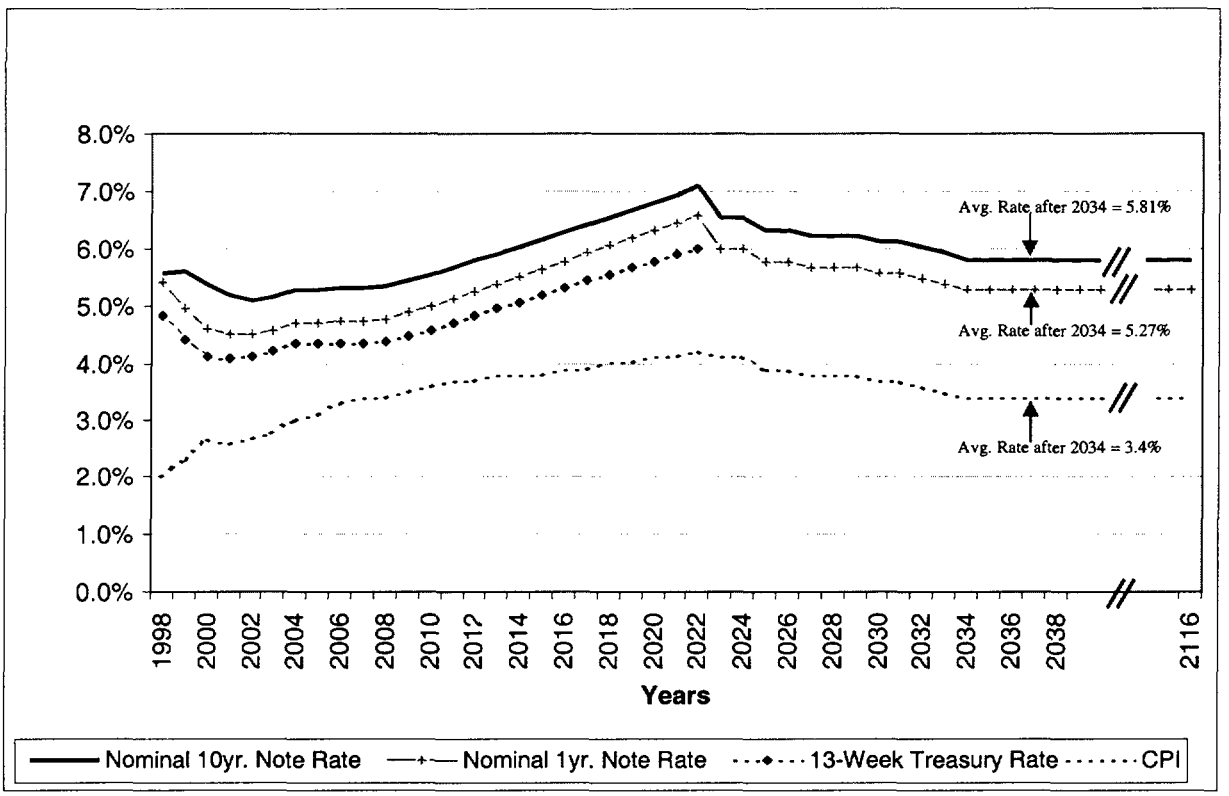

Figure 2. Inflation and Interest Rates Used for Calculating Fee Adequacy

Note: 1998 through 2022 used DRI/McGraw-Hill's forecast. Rates for 2023 through 2116 were projected based on the DRI/McGraw-Hill forecast. The 13-Week Treasury rate was used only through 2022.

Consumer Price Index (CPI) - All Urban Consumers – This forecast provides the discount rate used to convert year of expenditure fees and income to current year dollars. The index was extended beyond DRI/McGraw-Hill's forecast period. This was accomplished by gradually reducing the 2022 inflation level to the mean level of inflation over the entire DRI/McGraw-Hill CPI forecast period.

10-Year and 1-Year Treasury Note Series – The 10-year rate forecast provides the annual nominal interest rate earned on future investment portfolio holdings, excluding current investments. The 1-year note rate forecast provides the annual nominal interest rate earned on the contingency part of the fund. Both series were extended beyond 2022 by adding the average real rate of return to the CPI forecast. For purposes of simulating the investment strategy, current investments, held as of September 30, 1997, are assumed to be held until maturity and earn their actual coupon return until maturity.

13-Week Treasury Series – This forecast provides the rate used in the calculation of the interest portion of the deferred one-time fees and outstanding balance on government-managed nuclear materials. A projection beyond 2022 was not needed, as all deferred payments will be paid.

3.3.2 Investment Strategy

This analysis simulates the expected results of the program's investment strategy. The objectives of the strategy are to: 1) ensure that investment income is available when needed; 2) support the adequacy of the fee paid into the NWF by waste owners and generators; and 3) hedge against uncertainty and unplanned funding requirements. To achieve these objectives, the NWF is managed as two portfolios: a contingency portfolio and a match portfolio. The purpose of the contingency portfolio is to hedge against reasonable contingencies, such as unexpected near-term expenditures. The purpose of the match portfolio is to provide reliable funding for expected program expenditures. It serves to bring into balance the program's assets and liabilities and to maintain that balance. The contingency portfolio is highly liquid and consists of Treasury securities whose average maturity does not exceed 3 years. The match portfolio consists of a mix of Treasury bills, notes, bonds, and zero-coupon bonds. The durations and present values are matched or will be matched, year-for-year, to the durations and present values of the program's projected liabilities. Matching investments to planned spending reduces the sensitivity of the fee adequacy balance to changing interest rates. Each month, near-term cash flow expectations and current asset and liability values are reassessed and used as the basis for investment selection. The portfolio is rebalanced, as required, upon completion of each new total system life cycle cost analysis or when changes in program assumptions warrant.

4. FEE ADEQUACY

The Department finds that the current 1.0 mill per kWh fee charged on generators of commercial SNF is adequate, and recommends that the fee not be changed. This recommendation is based on the examination and analysis of the revenue forecasts and estimated costs for a representative waste management system as described in the Civilian Radioactive Waste Management System TSLCC estimate. The NWF is projected to have a positive balance at the end of waste emplacement activities, based on current program cost estimates, fee revenue projections, and independent projections of inflation and interest rates. This balance is expected to be sufficient to fund planned monitoring, closure and decommissioning actions, and to allow for probable contingencies such as implementation of design options or extended monitoring. Ending the emplacement period, with sufficient capital in the NWF, will retain alternatives for future decision-makers to defer closure decisions beyond the current planning assumption of closure 100 years after the start of emplacement. Fund balances also provide a margin of safety for uncertainties or changes in program scope, costs, revenues, and economic assumptions.

Figure 3 presents the results of this fee adequacy analysis, and its sensitivity to economic and cost assumptions. For any point above the diagonal black line, the current fee is adequate for the assumed costs of the Program. The point in the center of the chart, where the two axes cross, represents current forecasts of inflation and interest. This illustrates that the fee is adequate with the current program cost estimate and economic assumptions.

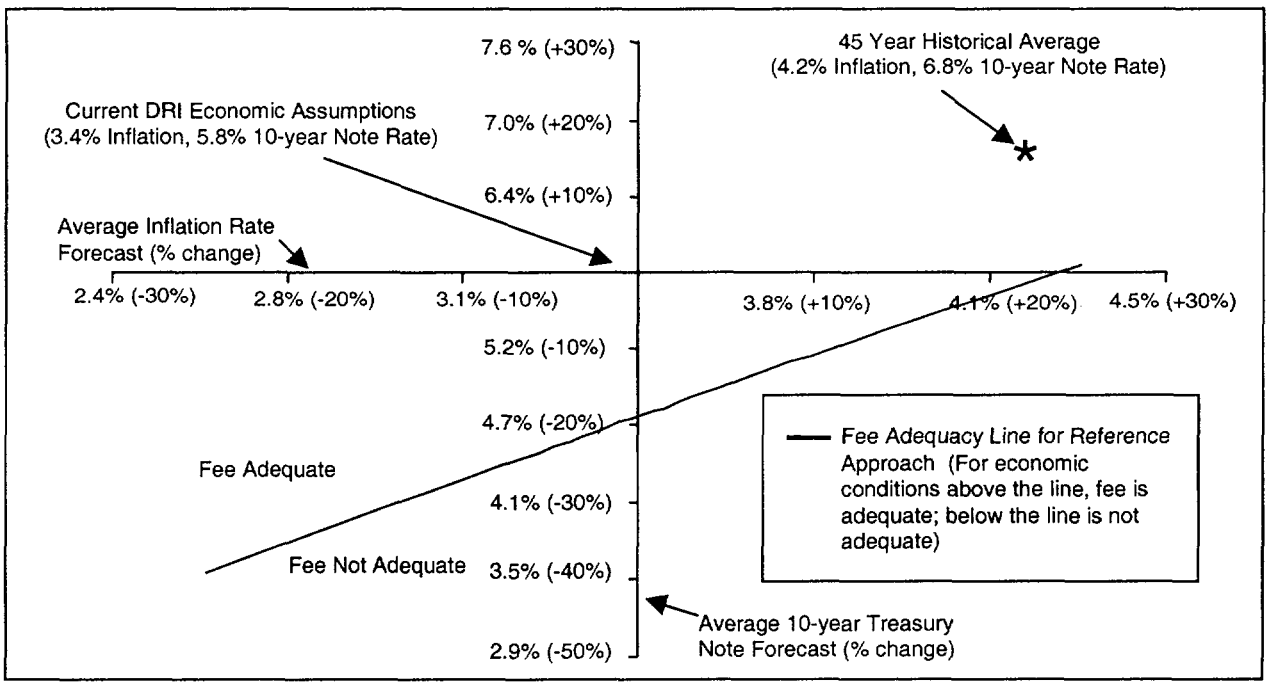

Figure 3. Fee Adequacy: Sensitivity to Changes in Economic Assumptions with Current Program Costs

With the current costs and economic assumptions, the black line on Figure 3 represents the boundary between the Fee Adequate/Fee Not Adequate areas. Points along the line reflect

different combinations of a percentage change in the annual inflation rate and a corresponding percentage change in the annual nominal interest rate, which results in a NWF balance of $2.5 billion constant 1998 dollars in 2042. The slope of the line represents the percentage increase in the inflation rate for a percent change in the 10-year Treasury note rate that keeps the program on the fee adequacy boundary. The $2.5 billion balance was calculated as the net present value of future costs needed to cover the monitoring, decommissioning and closure activities, and provide a program contingency of $1.0 billion in 1998 constant dollars. The average nominal interest rate for the period 2043 to 2116, decreased by 25 percent for economic uncertainty, was used as the discount rate for a net present value calculation to estimate the capital required in 2042. If the intersection point of the axes of percentage changes in the forecasted 10-year Treasury note rate and the CPI inflation rate falls below the line, the balance of the Fund after emplacement is too small to fund remaining projected costs. The zero intercept (center point) on the graph represents the current forecast contained in February's 1998 long-range forecast provided by DRI/McGraw-Hill. As a reference point, the asterisk in Figure 3 provides the 45-year historical average of inflation and the 10-year bond rate.

To illustrate the sensitivity of the NWF balance to changes in assumed interest and inflation rates, the following example was developed. If the forecasted CPI inflation rate increased 15 percent and the forecasted 10-year Treasury note rate decreased 15 percent, the result would be a NWF balance in 2042 that would not be large enough to cover the remainder of the Program. Under these conditions the fee would not be adequate.

The diagonal line in Figure 4 shows the sensitivity of fee adequacy to changes in estimated costs. The fee adequacy line in Figure 4 illustrates that under the current DRI/McGraw-Hill forecast, the Program is fee adequate with a 20 percent increase in future costs.

A summary of representative cash flows and sensitivity to changes in economic assumptions and cost estimates is provided in Table 3. The table summarizes total ongoing fee payments, one-time fees with interest, interest income, civilian cost share, and the resulting NWF balance in 2042. A balance of approximately $2.5 billion constant 1998 dollars in 2042 is considered adequate.

Table 3 presents fee adequacy summary results for three cases. The balance in the NWF would be adequate to fund all remaining projected costs for the reference case with current economic assumptions. In the second case, a 20 percent increase in all future program costs results in a balance of $2.8 billion at the end of emplacement. This balance would be sufficient to fund remaining costs, under the assumed interest and inflation rates. In the third case, assuming present cost estimates, 15 percent higher inflation, and a 15 percent reduction in interest rates, the NWF would have a zero balance in 2042. This amount is inadequate to pay for future costs.

Table 4 provides a detailed breakout of representative annual cash flows in constant 1998 dollars for the reference program cost estimate, using the DRI/McGraw-Hill forecasts of interest and inflation rates. For a given year, the current Fund balance equals the previous year's Fund balance plus fee payments, one-time fee payments, and income from investing less the civilian cost share. The civilian cost share cash flow in Table 4 is less than calculated annual shares, prior to 2010, due to assumed repayment of prior outstanding government financial obligations,

including interest, for government-managed nuclear materials and West Valley cost shares. The repayment of outstanding balances offsets the civilian cost share in the early years since this receipt of funds, greater than the annual cost share, reduces the need to withdraw funds from the NWF.

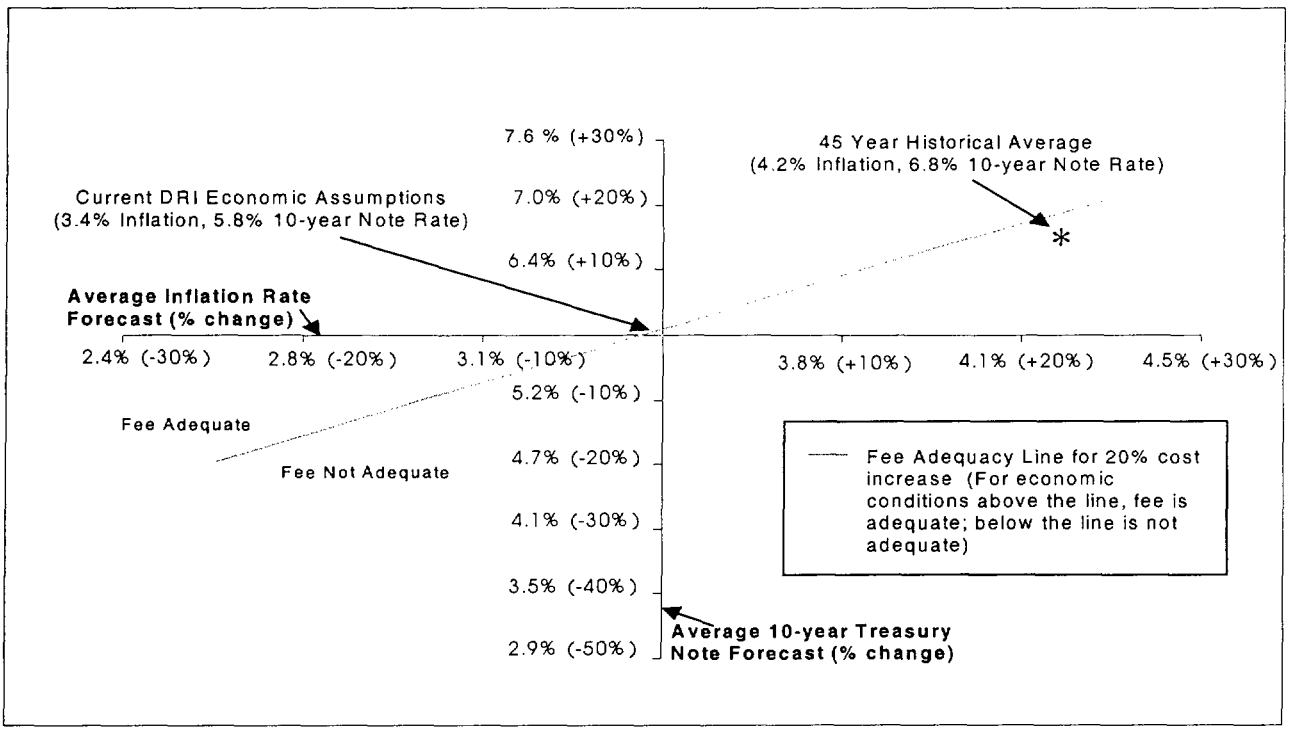

Figure 4. Fee Adequacy: Sensitivity to Changes in Economic Assumptions for a 20 Percent Increase in Program Costs

Table 3. Sensitivity of Nuclear Waste Fund Cash Flows to Different Future Costs and Economic Assumptions (Millions of 1998$)

1998 Starting NWF Balance	Total Ongoing Fee Payments (1998-2042)	Total One-Time Fee Payments (1998-2042)	Cumulative Income from Investing (1998-2042)	Cumulative Civilian Cost Share (1998-2042)	Fund Balance in 2042**	Fee Adequacy
Cumulative Cash Flows for Reference Program Cost and Economic Assumptions*						
6,200	10,100	2,600	14,500	23,100	10,300	Adequate
Cumulative Cash Flows for 20% Increase in Program Costs with Current Economic Assumptions						
6,200	10,100	2,600	11,600	27,700	2,800	Adequate
Cumulative Cash Flows with 15% Change in Economic Assumptions and Current Cost Estimate						
6,200	9,700	2,300	5,000	23,200	0	Not Adequate

* *See Table 4 for detailed cash flows for reference program and assumptions.*

** Totals may not add due to independent rounding.

Note: A fund balance greater than $2.5 billion (1998$s) in 2042 is considered adequate.

Table 4. Detailed Nuclear Waste Fund Cash Flows for Reference Cost Estimate and Economic Assumptions* (Millions of 1998$)

Fiscal Year	Fee Payments	One-Time Fee Payments	Income from Investing	Civilian Cost Share	Fund Balance
1998 Starting Balance					**6,200**
1998	600	0	450	180	7,100
1999	600	0	350	180	7,900
2000	590	0	330	230	8,600
2001	580	20	330	210	9,300
2002	560	20	330	220	10,000
2003	550	20	320	260	10,600
2004	540	20	310	80	11,400
2005	520	20	310	440	11,800
2006	500	20	290	800	11,800
2007	480	20	270	540	12,100
2008	470	20	270	580	12,200
2009	470	20	260	350	12,600
2010	430	1,430	270	400	14,400
2011	400	390	300	460	15,000
2012	370	0	330	600	15,100
2013	320	540	330	590	15,700
2014	270	0	360	600	15,700
2015	240	30	370	620	15,700
2016	220	0	370	700	15,600
2017	200	0	380	650	15,600
2018	180	0	380	600	15,500
2019	180	0	390	640	15,400
2020	170	0	400	630	15,400
2021	150	0	410	620	15,300
2022	130	0	420	550	15,300
2023	110	0	350	580	15,200
2024	90	0	350	610	15,000
2025	60	0	350	620	14,800
2026	40	0	340	560	14,600
2027	20	0	340	570	14,400
2028	10	0	330	570	14,200
2029	10	0	330	580	14,000
2030	0	0	320	610	13,700
2031	0	0	310	560	13,400
2032	0	0	310	630	13,100
2033	0	0	300	600	12,800
2034	0	0	290	670	12,400
2035	0	0	280	650	12,100
2036	0	0	280	640	11,700
2037	0	0	270	600	11,400
2038	0	0	260	600	11,100
2039	0	0	250	610	10,700
2040	0	0	240	540	10,400
2041	0	0	240	380	10,300
2042	0	0	230	150	10,300
Total(98-42)**	**10,100**	**2,600**	**14,500**	**23,100**	**10,300**

* See Table 3 for cost and economic sensitivities.

** Totals may not add due to independent rounding. Fee revenues continue until 2036 (for 2030 through 2036 the fee is less than $5M/yr and rounds to zero).

Note: A fund balance greater than $2.5 billion (1998$s) in 2042 is considered adequate.

Although this assessment indicates that the 1.0 mill per kWh fee is sufficient at this time, future economic conditions may vary from the forecasts used in this analysis, and costs may vary due to uncertainties in program scope. Further fee income projections may vary with either early reactor shutdowns before license expiration, or by service life extensions. Program scope uncertainty will be reduced significantly as the Program progresses through licensing and receives authorization to construct a repository. Based on the conclusions in this analysis, no change in the current fee is recommended at this time.

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APPENDIX A

ACRONYMS

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ACRONYMS

C

CPI	Consumer Price Index
CRWMS	Civilian Radioactive Waste Management System

D

DOE	U.S. Department of Energy

F

FY	Fiscal Year

H

HLW	High-Level Waste

I

IPWF	Immobilized Plutonium Waste Form

K

kWh	Kilowatt-hour

L

LA	License Application

M

MPC	Multi-Purpose Canister

N

NRC	Nuclear Regulatory Commission
NWF	Nuclear Waste Fund
NWPA	Nuclear Waste Policy Act

S

SNF	Spent Nuclear Fuel

T

TSLCC	Total System Life Cycle Cost

V

VA	Viability Assessment

Y

YOE	Year of Expenditure

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