results are presented in Tables 5 and 6. With a 40 percent overrun of DOE base-case costs (see Table 5), the optimal fee across all four nuclear-growth cases would still be below one mill per kilowatt hour; the fees would be .672, .718, .764, and .792 mills per kilowatt hour for the high, medium, low, and very low cases, respectively. If base-case costs increased 160 percent (see Table 6), the optimal fee would exceed one mill across all four growth rates. The optimal fees would become 1.238, 1.324, 1.407, and 1.458 mills per kilowatt hour for the high, medium, low, and very low cases, respectively. These fee increases are directly proportional to the degree of the assumed cost overruns, since cost overruns increase all costs in tandem. Including a MRS and transportation costs would increase the optimal fee under a 160 percent cost overrun to 1.459, 1.560, 1.644, and 1.688, again in descending order of nuclear growth. These are the highest fees imagined in this study. In the worst case (1.688 mills), they would add up to 3 to 4 percent to consumer electricity bills.

TABLE 5. OPTIMAL FEES AND TOTAL PROGRAM COSTS WITH A 40 PERCENT COST OVERRUN, UNDER FOUR NUCLEAR CAPACITY GROWTH RATES

	High Growth	Medium Growth	Low Growth	Very Low Growth
Optimal Fee (In mills per kilowatt hour; in fiscal year 1982 dollars)	.672	.718	.764	.792
Total Program Costs (In billions of current dollars)	66.9	66.9	120.7	137.8
Total Program Costs (In billions of fiscal year 1982 dollars)	20.7	20.7	22.3	22.2
Total Financing Costs (In billions of current dollars)	-22.1	-12.1	-39.0	3.0
Total Financing Costs (In billions of fiscal year 1982 dollars)	-1.8	-0.5	-0.5	2.2

TABLE 6. OPTIMAL FEES AND TOTAL PROGRAM COSTS WITH A 160 PERCENT COST OVERRUN, UNDER FOUR NUCLEAR CAPACITY GROWTH RATES

	High Growth	Medium Growth	Low Growth	Very Low Growth
Optimal Fee (In mills per kilowatt hour; in fiscal year 1982 dollars)	1.238	1.324	1.407	1.458
Total Program Costs (In billions of current dollars)	124.3	124.3	224.0	256.0
Total Program Costs (In billions of fiscal year 1982 dollars)	38.5	38.5	41.3	41.3
Total Financing Costs (In billions of current dollars)	-41.7	-23.3	-73.6	3.4
Total Financing Costs (In billions of fiscal year 1982 dollars)	-3.6	-1.2	-1.2	3.7

ALTERNATIVES TO THE GENERATION FEE

Following the major legislative proposals to finance the waste disposal program, this analysis has concentrated on the characteristics of a constant dollar generation fee. Since Public Utility Commissions allow electric utilities to earn revenues as they generate power, it would be relatively simple to build the generation fee into the administrative structure that governs utility revenues. But alternatives to this type of fee exist.

One option would be to assess utilities a fee based on the weight of the waste that they generate. For each type of reactor, the relationship between the number of kilowatt hours a nuclear plant generates and the weight of the resulting waste is fairly constant. Thus, a weight-based fee is tantamount to a generation fee in virtually all respects, particularly since it poses the same risks related to cost overrun, program definition, and rates of nuclear capacity growth.

A second option would be to charge utilities for waste disposal services on a time-of-delivery basis. Since this payment presumably would

be based on the weight of the waste delivered, it would resemble both the weight-based fee and the generation fee, again particularly since it poses the same kinds of risk. It should be noted, however, that charging utilities (and, in turn, their consumers) at the time-of-delivery, rather than at the moment of generation, means deferring any and all program revenues by over ten years. Thus, the program trust fund would be obliged to borrow all of its up-front capital for the purposes of research and development, site selection, test facility construction, and actual repository construction. This would create a sizable initial deficit for the trust fund, and would, therefore, increase the total borrowing and interest costs associated with the program. Such a financing method would require far higher fees than those assessed at the moment of generation.

A final option would set the fee at 1.0 mills per kilowatt hour, as proposed in S. 1662. As seen in this chapter, the value of the optimal generation fee is consistently less than 1.0 mills per kilowatt hour, unless cost overruns in the range of about 100 percent or greater occur. Such a fee would produce excessive revenues under all other cases. Because of the particular mathematics of the trust fund, the value of the optimal fee could determine the percentage of inflation by which the 1.0 mill per kilowatt hour initial fee should be adjusted to produce a self-financing waste disposal program. For example, under the high-growth case and in the absence of new program additions or cost overruns, the optimal generation fee would be .483 mills per kilowatt hour. Thus, an initial fee of 1.0 mills per kilowatt hour, if adjusted for 48.3 percent of the inflation rate, would result in a trust fund value of zero once the program's last dollar has been expended and the repository's decommissioning completed. It should be noted, however, that an initial 1.0 mill per kilowatt hour fee, if partially adjusted for inflation, would violate one of the conditions for such a fee's equity. By only partially reflecting inflation, such a fee would charge current electricity users a higher price for the disposal of radioactive wastes than it would charge future users. If this intergenerational inequity is considered, the partial adjustment of a 1.0 mill per kilowatt hour fee would be less desirable than a fee set at a correct initial level and fully adjusted for inflation during the program's life.

CHAPTER IV. EVALUATING THE FEE: THE ISSUE OF RISK

Barring cost overruns or changes in the growth rate of nuclear generating capacity, the radioactive waste disposal program could be made self-financing through a generation fee that would add about 1 percent to the cost of nuclear-powered electricity. But the prospects of cost overruns or changes in the growth rate of nuclear capacity cannot be excluded; to the contrary, waste disposal program planners face substantial uncertainty regarding the costs of the repository program and the growth rate of the nuclear generating capacity that the program serves.

THE PROBLEM OF FINANCIAL RISKS

Setting the level of the generation fee necessarily entails financial risks--either that the fee would prove too low and additional revenues would have to be raised subsequently, or that it would prove too high and impose an economic burden on energy consumers. In both cases, intergenerational subsidization would occur. This chapter presents alternative approaches for dealing with the financial risk associated with the radioactive waste disposal program: assign it to current ratepayers, assign it to future ratepayers, allow the taxpayers (the federal government) to bear the risk, or allow private investors to bear the risk in exchange for the prospects of economic gain.

These alternative approaches can be evaluated in terms of economic efficiency and fairness. An economically efficient program would be conducted at its lowest possible cost, consistent with proper provision for public health and safety and for environmental protection. This would require incentives to hold down program costs, and to minimize trust fund financing costs. The second principle, that of fairness, would require matching those who consume nuclear-generated electricity with the costs of the waste that such consumption engenders, and charging current and future electricity consumers the same price for the same service.

If the real costs of the radioactive waste program deviate from the planned costs by a small amount, then the efficiency losses and equity concerns are likely to be insignificant. But the possibility, however remote, of major errors in estimating the optimal fee, raises the issue of who should bear the financial risk.

OPTIONS FOR ASSIGNING THE FINANCIAL RISK

This report examines four approaches to assigning the financial risks associated with the waste disposal program:

- Assign the Risk to Current Ratepayers. Current ratepayers would be forced to bear the risk by paying a fee higher than that calculated to be optimal, thus building into the trust fund assumptions regarding the amount of cost overrun.

- Assign the Risk to Future Ratepayers. Future ratepayers would be forced to bear the risk if an optimal generation fee were calculated using current DOE base-case cost estimates and these estimates later proved to be wrong and had to be adjusted upward.

- Assign the Risk to the Federal Government. The government could bear the risk by promising to meet any costs above those anticipated at the beginning of the program or some other announced level.

- Assign the Risk to the Private Sector. A federal corporation could be chartered and licensed by the Nuclear Regulatory Commission to construct and operate the waste disposal facility. In return for its profit, it would assume responsibility for any cost overruns or other unanticipated financial difficulties with the program.

Assign the Risk to Current Ratepayers

Two arguments can be made for setting the initial fee at a level higher than that warranted by the best current cost estimates. First, experience has shown such early estimates consistently are understated. A higher initial fee would simply ratify that experience. Second, it can be argued that present electricity users have created the demand for nuclear power plants and have borne the other financial risks of nuclear power. Therefore, these present electricity users should also bear the financial risks of disposing of its wastes.

Three objections may be made to these arguments. First, it is not possible to know how high to raise the fee above current estimates in order to cover future unforeseen costs, and current cost estimates already include substantial margins for error. Second, the existence of a financial cushion might reduce the incentives for efficient program management, thus leading to self-fulfilling cost overruns. Third, future electricity users would also

benefit from the same nuclear power plants paid for by the current generation of consumers.

If the risk of cost overruns were assigned to current ratepayers by setting a higher fee, but the risk did not materialize, how would the optimal fees change? Table 7 presents estimates of the optimal fees under these circumstances. These estimates assume that an initial fee of 1.0 mills per kilowatt hour (adjusted for inflation) was set, but that the DOE base-case costs were not exceeded. After seven years of program life, planners would realize that the base-case costs were realistic, and that the generation fee could be reduced to a level that would be considered optimal over the balance of the program's life. The optimal fee for the balance of the program's life would decline by about 50 percent from the original optimal fee level set by the DOE base-case costs. Thus, early electricity consumers would subsidize later ones. The value of this subsidy can be estimated by examining total financing costs. By creating an initial surplus in the trust

TABLE 7. OPTIMAL FEES AND FINANCIAL COSTS, ASSUMING A FEE OF 1.0 MILLS PER KILOWATT HOUR FOR THE FIRST SEVEN YEARS OF PROGRAM LIFE AND DOE BASE-CASE PROGRAM COSTS, UNDER FOUR NUCLEAR CAPACITY GROWTH RATES (In fiscal year 1982 dollars)

	High Growth	Medium Growth	Low Growth	Very Low Growth
Optimal Fee for Remaining Program Life (In mills per kilowatt hour)[a]	.200	.258	.301	.345
Total Trust Fund Earnings (In billions of dollars)	3.6	2.8	3.2	1.8
Base-Case Trust Fund Earnings (In billions of dollars)[b]	1.2	0.3	0.2	-1.7
Value of Subsidy to Future Ratepayers (In billions of dollars)	2.4	2.5	3.0	3.5

a. For eighth through final year.
b. From Table 2 in Chapter III.

fund, the institution of a 1.0 mill fee over the first seven years of the program would result in lower total financing costs (or greater earnings) of $2.4 billion to $3.5 billion (depending on the nuclear-growth rate) when compared to the DOE base-case found in Table 2 in Chapter III. Thus, if current ratepayers assumed the risk of overruns, but this risk did not materialize, they would have subsidized future ratepayers by those amounts, depending on the rate of nuclear capacity growth.

Assign the Risk to Future Ratepayers

If the waste disposal fee were set at the current optimum level--that is, in the range of .483 to .570 mills per kilowatt hour--and adjusted later if conditions warrant, then future ratepayers would bear the financial risks. The advantage of such an approach is that it makes the best use of currently available information. The disadvantage is that all the surprises that the disposal program might encounter are likely to push costs upward. Even though the program's managers cannot now discern these unexpected events --if they could, they would presumably include such events in the current cost estimate--history suggests that they might indeed occur. Therefore, a fee based on the current optimum estimate might well result in an effective subsidy of present electricity users by future ones.

As was the case when risks were assigned to current ratepayers, there would be a cost and subsidy involved if the risks were assigned to future ratepayers. Table 8 presents optimal fees in the event of a 160 percent cost overrun. These fees were calculated under the assumption that planners know that such overruns would occur, and that fees were initially set to accommodate them. Table 8 calculates optimal fees under the assumption that 160 percent cost overruns would occur from the beginning of the program, but that the generation fee was not adjusted to reflect them until seven years of the program have transpired. The fees in Table 8, therefore, are charged during the eighth through last years of the program. When compared to Table 6 in Chapter III, it can be seen that these fees are about 33 percent higher during the latter program period than the fees that would have been set had cost overruns been perfectly anticipated.

By not anticipating the degree of cost overruns when setting the fees' initial levels, current ratepayers would be subsidized by future ratepayers. The value of this subsidy can be estimated by observing the difference in financial costs. By deferring the increases in the generation fee that cost overruns require, the program's net financial costs increase by $3.5 billion to $7.3 billion, depending on the rate of nuclear capacity growth assumed. These increased financial costs must be made up by future ratepayers, and are therefore equal to the subsidy provided from future ratepayers to current ones.

TABLE 8. OPTIMAL FEES AND FINANCIAL COSTS, ASSUMING AN INITIAL FEE BASED ON DOE BASE-CASE COST ESTIMATES FOR THE FIRST SEVEN YEARS OF PROGRAM LIFE AND 160 PERCENT COST OVERRUNS, UNDER FOUR NUCLEAR CAPACITY GROWTH RATES (In fiscal year 1982 dollars)

	High Growth	Medium Growth	Low Growth	Very Low Growth
Optimal Fee for Remaining Program Life (In mills per kilowatt hour)[a]	1.652	1.756	1.879	1.922
Total Trust Fund Earnings (In billions of dollars)	0.1	-3.0	-4.5	-11.0
Base-Case Trust Fund Earnings (In billions of dollars)[b]	3.6	1.2	1.2	-3.7
Value of Subsidy to Future Ratepayers (In billions of dollars)	3.5	4.2	5.7	7.3

a. For eighth through final year.
b. From Table 6 in Chapter III.

The subsidy would still occur if the fee were set at a level that included an unforeseen cost increase but that level still proved too low. The figures in Table 9 were calculated under the assumption that a 1.0 mill fee (adjusted for inflation) was initially set, but that a 160 percent increase in costs would occur, rendering the 1.0 mill per kilowatt hour fee insufficient to cover program costs. After seven years, therefore, the fee would be reestimated to reflect the higher program costs and to cover the larger trust fund deficit built during the first seven years. The fee for the eighth through last year of the program is about 10 percent higher than it would have been if cost overruns had been perfectly anticipated at the onset. Total financial costs would increase by from $1.1 billion to $3.8 billion, depending on the nuclear capacity growth rate assumed. Thus, if a fee of 1.0 mills per kilowatt hour was set but 160 percent cost overruns occurred, future ratepayers would subsidize current ones by an amount within this range.

TABLE 9. OPTIMAL FEES AND FINANCIAL COSTS, ASSUMING AN INITIAL FEE OF 1.0 MILLS PER KILOWATT HOUR FOR THE FIRST SEVEN YEARS OF PROGRAM LIFE AND 160 PERCENT COST OVERRUNS, UNDER FOUR NUCLEAR CAPACITY GROWTH RATES (In fiscal year 1982 dollars)

	High Growth	Medium Growth	Low Growth	Very Low Growth
Optimal Fee for Remaining Program Life (In mills per kilowatt hour)[a]	1.369	1.497	1.630	1.697
Total Trust Fund Earnings (In billions of dollars)	2.5	-0.5	-1.5	-7.5
Base-Case Trust Fund Earnings (In billions of dollars)[b]	3.6	1.2	1.2	-3.7
Value of Subsidy to Future Ratepayers (In billions of dollars)	1.1	1.7	2.7	3.8

a. For eighth through final year.
b. From Table 6 in Chapter III.

Assign the Risk to the Federal Government

The principles of efficiency and equity suggest that the radioactive waste disposal program should be self-financing, that is, that the users of nuclear-powered electricity should pay for the disposal of the resulting radioactive wastes. Nevertheless, several rationales exist for the federal government to assume the risk that the required generation fee could increase dramatically.

First, the government as manager of the radioactive waste disposal program cannot escape some part of the responsibility for cost overruns. Indeed, requiring federal payments to defray part or all of the costs in excess of current estimates might provide an incentive for accurate cost estimates, top-management attention to the program, and strong Congressional oversight. Second, the government must bear some of the responsibility for the lack of past progress in developing the waste disposal program.

The fact that the current program is in its nascent stages partly results from the historic inability of the government to develop the program expeditiously. Third, the government might consciously wish to subsidize nuclear energy. Such subsidies are hardly new to the energy sector--for example, oil and gas exploration is currently granted tax subsidies worth over $5 billion annually. The case for nuclear subsidies would rest on its long-term value as an essentially inexhaustible energy resource (with the use of breeder reactors) and its value as a hedge against environmental crises resulting from the use of fossil fuels--for example, the buildup of carbon dioxide in the atmosphere.

Table 10 provides estimates of the government cost to guarantee to utilities some maximum value of the generation fee. These estimates assume that a 160 percent cost overrun would occur, but that the government would guarantee that the generation fee would be no greater than 1.0 mills per kilowatt hour (adjusted for inflation) or no greater than the generation fee obtained using DOE base-case costs (obtained from Table 2 in Chapter III). If either of these circumstances occurred, then the trust fund would be in deficit in the year that the second repository is decommissioned and the program terminated. The cost to the government given in Table 10 is the "present value" of this future trust fund deficit--that is, the amount the government would have to put in a bank account now to cover this deficit.

TABLE 10. PRESENT VALUE OF FEDERAL SUBSIDY TO THE RADIOACTIVE WASTE PROGRAM, UNDER 160 PERCENT COST OVERRUN (In billions of fiscal year 1982 dollars)

Nuclear-Growth Case	Government Assumes Costs in Excess of 1.0 Mills Per Kilowatt Hour	Government Assumes Costs in Excess of Optimal Generation Fee Reflecting DOE Base-Case Costs[a]
High	4.0	12.6
Medium	5.1	12.6
Low	5.7	11.8
Very Low	5.9	11.5

a. See Table 2 in Chapter III. The fees are: high growth, .483 mills per kilowatt hour; medium growth, .517; low growth, .549; very low growth, .570.

If the government imposed an initial fee of 1.0 mills per kilowatt hour but a 160 percent cost overrun occurred, then its liabilities would have a present value in the range of $4.0 billion to $5.9 billion, depending on the rate of growth of nuclear capacity (see first column of Table 10). Lower rates of growth in nuclear capacity would imply larger present values of ultimate trust fund deficits. This would occur because the "gap" between the 1.0 mill fee and the corresponding optimal fee under cost overruns would increase as generating growth decreases. The optimal fee, presuming a 160 percent cost overrun, would range from 1.238 mills per kilowatt hour under the high-growth case to 1.458 under the very low-growth case. Thus, the government's commitment to cover costs above the 1.0 mill per kilowatt level would increase as the rate of nuclear capacity growth decreased.

The second column of Table 10 presents equivalent present values if the government covered costs above the base-case optimal fee level. If 160 percent cost overruns occurred, the present value of this commitment should be in the range of $11.5 billion to $12.6 billion. But in this case, the value of the government subsidy would increase as nuclear capacity growth increased, in contrast to the 1.0 mill case. This would occur because, unlike the 1.0 mill case, the optimal fee would be proportionate to the cost overruns. Thus, the present value of the government's subsidy would depend not on the difference between the guaranteed maximum fee and the actual costs of the program, but on the time at which this difference occurred. Under the very low case, many costs would be deferred until the next century. Thus, costs in excess of the fee guaranteed by government would occur later under low-growth cases than they would under higher ones. This means that the government's "bank account" would earn interest longer, and the present value of its subsidy would be lower.

These estimates suggest that, if the government committed itself to covering costs above some level of generation fee, for whatever reason, its commitment might end up costing several billion dollars. To be sure, the figures in Table 10 depend on the worst case analyzed in this paper--a 160 percent cost overrun. The point is not to assert that this would happen; rather it is to assess the magnitude of the federal obligation if it did.

Assign the Risk to the Private Sector

The problems associated with assigning the disposal program's financial risks concern two hazards: first, that costs would be misestimated and that fees would have to be adjusted upward; and second, that no incentives would exist to minimize project costs, particularly if a trust fund surplus was planned. These difficulties suggest the possibility of assigning program management and financing to a private entity. Such a federally chartered

corporation could be licensed by the Nuclear Regulatory Commission, could be provided with a monopoly franchise, and could be given authority to set rates calculated in the same fashion as the optimal fees in this report were calculated. This approach might have several advantages. If the corporation were obligated to provide its disposal service at a fixed long-term price, it would be forced to minimize costs and would effectively absorb the risks of cost overruns. Should these overruns occur, they presumably would be borne by the management and stockholders of the corporation.

Such an approach, however, would present several difficulties. First, it might be difficult to find private parties interested in providing this service. Licensing requirements would be extraordinarily rigorous, and the liabilities that such a firm would incur if a major accident occurred at the repository could be uninsurable. All of these extraordinary costs would force private investors to earn a rate of return higher than conventional entrepreneurial activity, which, in turn, would raise the fees charged to utilities for their waste disposal. Since the private sector has no experience in projects of this sort, it might be unwilling to assume the financial risks.

Finally, there is the possibility that such a corporation would fail. If it were to go bankrupt, it is likely that the federal government would have to assume responsibility for the program. Under these circumstances, the goals of private sector involvement would not be achieved, but the higher price that the private corporation would charge would have been paid until its failure. Under these circumstances, utilities would have paid more for waste disposal without realizing any of the benefits of private management over the life of the project. If the government was to assume responsibility, it would either be forced to raise the fees assessed utilities or to honor the corporation's long-term contracts with utilities, leading it to subsidize the waste disposal program. As was seen in Table 10, this subsidy could cost the government over $12 billion. One way of ensuring against this cost would be to require a substantial amount of bonding by the corporation, but this level of up-front capital commitment might make privately financed waste disposal prohibitively expensive.

APPENDIX

TECHNICAL APPENDIX: PROCEDURES USED TO CALCULATE THE GENERATION FEE

This appendix reviews the procedures used to calculate the optimal generation fee. There are three essential computations involved in this process:

- The derivation of the annual revenue estimates;
- The annual program costs; and
- The annual trust fund balance.

ANNUAL REVENUES

The generation fee revenues in any particular year are estimated by multiplying the optimal fee times the number of kilowatt hours that the installed nuclear capacity is assumed to produce over that year. An average capacity factor of 60 percent is assumed for all nuclear units throughout all four growth-rate scenarios. This means each unit operates for 5,256 hours each year. The high, medium, and low nuclear growth cases were based on Department of Energy (DOE) forecasts through the year 2000. A steady state assumption was made once capacity levels reached their projected maximums; capacity additions are just sufficient to replace retired units. The very low-growth case, in which a steady state of 100 gigawatts of installed nuclear capacity is reached by 1995, was added to reflect the possibility that nuclear growth could fail to provide a large portion of electric power in the future.

The capacity estimates are supplied on a five-year basis. Nuclear capacity growth between these five-year intervals is derived by linear interpolation. For example, nuclear capacity under the high-growth case is assumed to increase from 109 gigawatts in 1985 to 144 gigawatts in 1990. This growth of 35 gigawatts is assumed to come on-line in equal increments of seven gigawatts per year over this period.

These revenues are supplemented by payments for the 8,200 metric tons of outstanding spent fuel at the end of fiscal year 1981. It is assumed that this waste will be paid for in equal increments of 1,640 metric tons annually over these five years. To do this requires conversion of the optimal fee to a metric ton equivalent. Using the same assumption of a yearly

average discharge rate of 25 metric tons per gigawatt and a 60 percent capacity factor means that one metric ton of nuclear waste, on average, is produced every 210.24 gigawatt hours by a one-gigawatt nuclear plant. Thus, obtaining the equivalent equitable payment for outstanding spent fuel requires multiplying the appropriate optimal fee times .21024 to derive the appropriate metric ton equivalent fee (in millions of dollars).

ANNUAL PROGRAM COSTS

Annual program costs in any particular year are derived simply by summing together the relevant common and repository-specific elements, based on the DOE's estimates, and multiplying by the appropriate compound inflation rate for that year. Total program costs for the low- and very low-nuclear growth cases are higher than the high- and medium-growth cases. This is attributed to the longer program lives of the lower-growth cases. Again, the program lives are 19 and 24 years longer for the low- and very low-growth cases, respectively. Adjusted for inflation, however, the increase in program costs is only $1.1 billion for both the low- and very low-growth cases. This is attributable to the $44 million in annual fixed operating charges that both the low- and very low-growth cases experience for an additional 25 years. These two cases have identical program costs because the additional five-year program life of the very low-growth case occurs in the form of a five-year delay in the construction of the second repository. Understandably, there are no fixed or operating costs associated with this delay.

EQUATIONS FOR THE TRUST FUND

These revenue and cost relationships were formulated as equations to calculate trust fund values under different fee levels. The equation used to calculate annual fee revenues was specified as follows:

Equation 1.

TR_x = nuclear capacity$_x$ * 5.256 * optimal fee * compound inflation rate$_x$

where

TR_x = total revenues in year x

nuclear capacity$_x$ = installed capacity in year x in gigawatts

5.256 = the number of thousands of hours each unit operates over the year, assuming a 60 percent capacity factor

optimal fee = the fee, in fiscal year 1982 mills per kilowatt hour, giving a trust fund balance of zero in the year the program terminates

compound inflation $rate_x$ = the adjustment to the optimal fee giving total revenues in current dollars for year x.

In addition, the supplemental revenues paid by existing stocks of waste were added as follows:

Equation 2.

SR_x = .21024 * optimal fee * compound inflation $rate_x$ * 1640

where

SR_x = supplemental revenues in year x

.21024 = factor that converts number of gigawatt hours to metric tons of spent fuel per nuclear unit; converts metric tons of spent fuel to a kilowatt hour fee equivalent

optimal fee = the fee, in fiscal year 1982 mills per kilowatt hour, giving a trust fund balance of zero in the year the program terminates

compound inflation $rate_x$ = the adjustment to supplemental revenues to change constant fiscal year 1982 dollars to current dollars in year x

1640 = the number of metric tons of outstanding spent fuel assumed paid for annually over fiscal years 1984-1988.

A cost equation was then specified as follows:

Equation 3.

TC_x = (common cost $elements_x$ + repository $capital_x$ + repository $operating_x$ + social economic $costs_x$) * compound inflation rate

where

TC_x = total program costs in year x

common cost $elements_x$ = technological development costs, site exploration and evaluation, test and evaluation facility costs

repository capital$_x$ = the construction costs of either or both the first and second repository during year x

repository operating$_x$ = operating costs for either or both repositories incurred during year x

social economic costs$_x$ = payments to state and local governments in year x

compound inflation rate = the same inflation factor used to adjust total revenues in year x from 1982 dollars to current dollars.

With these specifications for annual costs and revenues, the status of the trust fund can be obtained for year x by the following equation:

Equation 4.

$TFBAL_x = (BAL_x + TFBAL_{x-1}) * (1 + \text{annual inflation rate} + \text{real interest rate})$

where

BAL_x = the difference between total revenues, equations 1 and 2, and total costs, equation 3, in year x

$TFBAL_{x-1}$ = the trust fund balance outstanding from the previous year, in year x

annual inflation rate = the price level increase, either 7 percent annually through 1985, or 5 percent annually thereafter

real interest rate = the amount earned or paid out by the trust fund in excess of the inflation rate; assumed to be 4 percent throughout the relevant program life.

With an equation for trust fund balance in hand, the optimal fee is calculated through an iterative procedure. Only one value of the generation fee results in a trust fund value of zero at the end of the year in which decommissioning of the second repository occurs. This value was obtained through iteration. Different assumptions regarding nuclear capacity growth were then substituted into the revenue equation, and assumptions regarding program costs and definition were inserted into the cost equations. The generation fee yielding a trust fund value of zero in the program's final year was then recalculated.

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