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A Research Report for Westinghouse Hanford
Company

Preliminary Benefit-Cost Analysis of the Fast Flux Test Facility (FFTF) Power Addition

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July 1984

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

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

PNL-5206

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A RESEARCH REPORT FOR WESTINGHOUSE HANFORD COMPANY

PRELIMINARY BENEFIT-COST ANALYSIS
OF THE FAST FLUX TEST FACILITY (FFTF)
POWER ADDITION

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EXECUTIVE SUMMARY

The Fast Flux Test Facility (FFTF) is a liquid metal reactor (LMR). FFTF is located on the Hanford reservation in southeastern Washington and is operated by Westinghouse Hanford Company (WHC) for the U.S. Department of Energy (DOE). Since FFTF was designed to test LMR fuels and materials it currently generates no electricity. DOE is now considering the feasibility of installing steam generation and electricity production equipment on FFTF. The net electrical generating capacity of the proposed FFTF power addition is approximately 101 MW.

The primary objective of this report is to conduct a preliminary benefit-cost study for the proposed power addition to FFTF to determine whether the project is cost-effective. If the project is authorized, construction will begin in 1986 and end in 1991. Full power operation is scheduled to begin in 1991 and a project life of 20 years is assumed. The undiscounted cost during the construction period of the FFTF power addition is estimated to be approximately \$117 million over the construction period (1984 dollars). An additional \$3 million is estimated as the opportunity cost--or value of these resources in their most favorable alternative use--of surplus FFTF equipment and unused CRBR equipment, including materials for steam generator fabrication. The annual operating and maintenance cost of the project is estimated to be about \$2.1 million in 1984 dollars.

The FFTF power addition has the potential to produce two different kinds of benefits. The first is related to the production of electricity for sale in the region. Because of the relatively low marginal cost of FFTF power in comparison to alternative Pacific Northwest resources, adding this power to the regional base will displace some of the power produced by more expensive types of resources. As such, the net benefits of power production in the region can be approximated by the "avoided cost" of power in each year the project operates. "Avoided cost" is the cost avoided by not having to build or by being able to defer the construction of new power producing facilities. Measured this way, the present value of the benefits of the FFTF power addition could range from \$83 million to \$463 million (\$1984), depending on project life, capacity factor, and discount rates. The second type of benefit is related to

the use of the project to test and improve the technology, the design and the operating procedures for commercial LMRs. This type of activity will be of value to society to the extent that it reduces the capital and operating costs of commercial LMRs in the future. Given current uncertainties about the future of a commercial LMR industry, no effort was made to value these benefits.

The benefit-cost computations were performed using three different capacity factors (60, 68, and 80 percent); three different project lifetimes (10, 15, and 20 years) and four different real discount rates (3, 8, 10 and 12 percent). Capital costs were computed for a nominal construction schedule (1986-1991) and a compressed schedule (1986-1990). However, the analysis demonstrated that these changes in scheduling had very little impact on the results of the benefit-cost calculations. In all but two of the cases the net present value (NPV) of the project was positive. Excluding those cases for which a 3 percent discount rate was used, the NPV estimates for the project ranged from a low of about -\$10 million to a high of about \$134 million in 1984 dollars. At 3 percent, NPV was higher--by as much as \$325 million.

Current expectations are that the FFTF power addition can be operated for 20 years at an average capacity factor of .68. Given these assumptions, and capital costs based on the nominal construction schedule, the estimated NPV of the project ranged from \$31.22 million using a real discount rate of 12 percent to \$91.64 million using a real discount rate of 8 percent. The corresponding real internal rates of return on the project ranged from 10 to 19 percent per annum, which are equivalent to nominal rates of return in the range of 17 to 26 percent, per annum, using an expected rate of inflation of 6 percent. These rates are greater than the real, long-term bond rate for investor-owned utilities as reflected by the June 1984 Moody average. Section 7.0 of this report provides a complete summary of the benefit-cost results.

The report concludes that society as a whole could be made better off by funding the FFTF power addition (as opposed to leaving the funds for its construction in the private sector), provided that the real rate of return on the private sector spending that would be displaced by the tax dollars used to fund the project is less than the internal rate of return of the project (e.g., 10 to 19 percent real per annum depending on the case used). However, in view

of the preliminary nature of the information used to approximate project benefits, this finding should also be regarded as preliminary.

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1.0 INTRODUCTION

The Fast Flux Test Facility (FFTF) is a liquid metal reactor (LMR). Located on the Hanford Reservation in southeastern Washington, FFTF is operated by Westinghouse Hanford Company (WHC) for the U.S. Department of Energy (DOE). The primary mission of FFTF is to act as a breeder reactor fuel, materials and components irradiation testing vehicle. It has functioned smoothly in this role since 1981.

Since FFTF was designed to be a reactor testing vehicle, no power generation capability was incorporated into its design. Currently, the 400 MW of thermal energy produced during operation of the FFTF reactor is being rejected to the atmosphere by means of dump heat exchangers. This is consistent with the original plans of the DOE breeder reactor program which called for the development of large scale steam generators and the associated electricity production capability as part of the Clinch River Breeder Reactor Plant (CRBR). However, in 1984 the Congress did not authorize the funds necessary to continue construction of CRBR and the project has subsequently been terminated. As a result of the CRBR termination, the liquid metal reactor development program is now in the process of being restructured.

One alternative, currently under review by DOE, involves installing sodium-cycle, steam generation and electricity production equipment on two of FFTF's three secondary heat transport system (HTS) loops (Kaiser Engineers 1983). The gross electric power production from the modified plant would be approximately 108 MW, sufficient to meet all loads on the Hanford Reservation. In this configuration, FFTF could also serve as a vehicle for long-term testing of sodium-cycle steam generators under actual plant operating and transient conditions, without materially affecting the ability of FFTF to perform its original mission.

The primary objective of this report is to conduct a preliminary benefit-cost study of the above alternative. It is assumed that if money were not spent to fund the FFTF power addition, there would be a reduction in tax collections of an equivalent amount. Thus, the opportunity cost of the proposed addition is consumption and investment in the private sector. This study

explores whether the proposed power addition to FFTF is an economically superior alternative to leaving the funds for its construction in the hands of economic agents (i.e., firms and individual consumers) within the private sector.

The remainder of this report consists of six sections. Section 2.0 contains the major conclusions of this study. Section 3.0 provides a brief overview of the technical aspects of the FFTF power addition and the objectives which it is intended to satisfy. Section 4.0 outlines the basic principles of benefit-cost analysis and shows how they can be applied in this case to consistently value the benefits and costs of the project. The last three sections of the report are quantitative. Sections 5.0 and 6.0 present the estimates used in the benefit-cost analyses for the capital and operating costs of the FFTF power addition and the societal benefits and costs associated with this project. Section 7.0 contains the formal benefit-cost analysis of the FFTF power addition. It presents the core assumptions used in the analysis and identifies the variables to be changed in the sensitivity analysis. Numerical results are presented for the net present value (NPV), internal rate of return (IRR) and payback period for the project. Appendix A, at the end of the report, contains more detailed results of the benefit-cost analysis and Appendix B contains listings of the computer programs used to obtain those results.

2.0 CONCLUSIONS

The numerical results for the benefit cost analysis are shown in Tables 7, 8, and 9 in Section 7.0. In reviewing the conclusions to this report, the reader may want to refer to these tables. Basically, two important conclusions can be drawn from this study:

- The FFTF power addition is a good investment. It appears that FFTF is one of the most cost-effective means of generating additional electric power in the Pacific Northwest. As long as the real rate of return on the private sector spending that would be displaced by the tax dollars used to fund the project is below 10-19 percent per annum, society as a whole could be made better off by the project as opposed to leaving the funds in the private sector. This assessment

ignores possible, but unquantifiable, benefits to the commercial LMR industry in the future due to experience gained through a power addition to FFTF. If such benefits were included, the results of the benefit-cost computations might appear even more favorable.

- The results of the analysis are preliminary. The project benefit estimates are based on estimates of the incremental avoided costs of producing electricity from within the region from 1991-2003. The avoided cost estimates are preliminary. Subsequent experience with the model on which they are based may cause these preliminary estimates to increase or decrease, thus causing estimated benefits to increase or decrease.

3.0 OVERVIEW OF THE PROJECT

This section of the report has two objectives. The first is to provide a brief discussion of the technical modifications that will be made to the FFTF. The second is to identify the various types of benefits that may result from the proposed FFTF power addition.

3.1 Overview of Modifications to FFTF

Figure 1 is a schematic diagram of the FFTF power addition, showing two of the plant's three heat transport system (HTS) loops. The third loop will not be modified. As currently configured, the FFTF reactor is used to heat liquid sodium which is pumped through an intermediate heat exchanger (IHX) in each primary HTS loop and then back into the reactor. The heat from each primary loop is transferred to a secondary HTS loop. The heated sodium in each of the secondary loops then passes through a dump heat exchanger (DHX) which is used to reject this heat into the atmosphere. The cooler sodium that comes out of the DHX in each loop is next pumped through the IHX where it acts to cool the sodium returning to the reactor in the primary loop.

The modifications to FFTF involve connecting a third sodium cycle loop to each of the secondary HTS loops. Instead of passing directly through the DHX, the heated sodium in each of the secondary loops is drawn off to a superheater, where it heats the steam used to drive a conventional turbine-generator system.

FIGURE 1. Schematic Diagram of FFTF Power Addition

The slightly cooler sodium passes through an evaporator where it loses more of its heat in the process of turning feedwater into saturated steam. The sodium is then returned to the secondary HTS loop from which it was originally drawn. In the reconfigured version of FFTF, the air flow to the dump heat exchanger in each secondary loop is now closed. This is because the heat that would otherwise be rejected into the atmosphere has been used to generate and superheat the steam which in turn drives the turbine generator system in the power addition to FFTF.

As seen from Figure 1, the major changes to the existing FFTF plant will consist of modifications to two of the three secondary HTS loops to incorporate the addition of four steam generators, a conventional turbine generator system and the structures required to house the steam generators and turbine generator. A number of the CRBR components, including the steam generator units, are compatible with and have been incorporated within the design of the project. A conventional design power plant steam/feedwater system will be used in the project. In addition, the design will utilize existing site support facilities and utility systems already available in the Hanford Reservation.

3.2 Overview of Project Benefits

The primary technical objective of the FFTF power addition is confirmation of large, sodium-heated, steam generator performance. Extensive qualification testing has been performed on a prototype CRBR steam generator at the Energy Technology Engineering Center (ETEC). Results of this testing have provided valuable short-term operating experience and future use of ETEC is planned to provide qualification testing for alternative steam generator design concepts. However, international experience has shown that problems caused by vibration, corrosion, erosion, fatigue, etc., may not become apparent until after several years of on-line plant operating and transient conditions. Sustained testing of CRBR steam generators under these conditions will provide data that can be used to establish criteria and performance expectations for steam generator units and related process system technology in the next liquid metal reactor evolution. The experience acquired in operating the project will also be important to the future of LMR commercialization insofar as it can be expected

to lead to the development of in-service inspection and maintenance techniques as well as standardized procedures for dealing with response to off-normal conditions in an LMR-sodium cycle environment.

The power addition will also provide an opportunity to evaluate and confirm the contribution of innovative component and process designs. For example, the project proposal includes a number of untested, technological innovations in the area of sodium piping design and sodium purification. Testing of these systems and others--such as new generator designs, sodium pipe bellows and alternate steam cycles--represent another potential source of benefits from the projected FFTF power addition. Given the eventual commercial development of breeder reactor technology in the U.S., these benefits and the ones identified in the previous paragraph would manifest themselves in the form of future reductions in the costs of constructing and operating commercial LMRs. The problems associated with quantifying these types of benefits in monetary units will be dealt with in Section 6.0.

A more immediate source of potential benefits from the FFTF power addition lies in the production of electricity. The gross electric power production of the single turbine-generator is approximately 108 MW. Roughly 7 MW will be used to supply internal loads to FFTF. The remainder, 101 MW, will be fed to the Bonneville Power Administration (BPA) grid through an existing 115 KV substation and transmission lines that pass through the Hanford Reservation near the site on which FFTF is now located. The project will be designed to generate electricity for a 20-year period. Provided that the cost of providing the additional 101 MW of electric power is sufficiently low to displace more costly power, the FFTF power addition will generate positive benefits. The economic rationale underlying these benefits and methods for valuing them will be discussed in more detail in Sections 4.0 and 6.0.

4.0 ECONOMIC FRAMEWORK

Benefit-cost analysis is a method of evaluating alternative public investment projects in order to achieve a more efficient allocation of resources within an economy. The essential difference between benefit-cost analysis and ordinary investment analysis as practiced by firms and individuals in the

private sector is the stress on selecting projects which bring the greatest improvement in societal welfare. As such, the objective of benefit-cost analysis is to identify all of the losses (costs) and gains (benefits) in economic welfare which are incurred by society as a whole if the particular project in question is undertaken. This is in contrast to ordinary investment analysis which looks only at the costs and benefits which affect the wealth or cash flow of the individual investor, although the two approaches may not always diverge.

4.1 Valuation of Welfare Changes

The effect of a hypothetical public project, which reduces the cost of producing additional units of a market good, on the welfare of consumers and producers is illustrated in Figure 2. The demand curve (DD') shows the quantity of the aggregate market good (Q) that purchasers choose to take from the market, per unit time, for each aggregate product price (P). The long-run market supply curve, without the project, is shown by the line OS_0 . This curve indicates the maximum output, per unit time, that producers in the market are willing to supply at each product price, assuming that all costs are variable.

FIGURE 2. Conceptual Analysis of the Benefits from a Public Investment

The long-run market supply curve is sometimes called the long-run marginal cost curve because each point on the curve OS_0 represents the marginal cost (increase in total cost) measured along the vertical axis that corresponds to a given output on the horizontal axis. Market equilibrium occurs at the point of intersection between the industry supply and demand curves (e.g., M_0), where Q_0 units of aggregate output are supplied in the market at price P_0 , which also corresponds to the marginal production cost, MC_0 .

We measure the net benefits of this market equilibrium by the sum of consumer surplus and producer surplus, which are represented by the triangles P_0DM_0 and P_0OM_0 , respectively. (For details, refer to Mishan 1976.)

We assume that the public investment will enable firms in the market to reduce the capital and operating costs of individual plants. This will reduce the long-run marginal costs of production in the market over a wide range of output, as shown in Figure 2 by a new market supply curve, OS_1 , which lies to the right of the original long-run marginal cost curve, OS_0 . Given that firms in the market can produce the same level of output at a lower marginal cost than would have been possible without the investment, a new market equilibrium is established at M_1 where Q_1 units of the product are supplied in the market at price P_1 . We measure the net benefits of this new market equilibrium by the sum of consumer surplus and producer surplus, which has now increased to the combined areas of triangle P_1DM_1 and P_1OM_1 . The net effect of the investment on the welfare of consumers and producers in the market can be measured approximately by the pie-shaped area OM_0M_1 . In Section 6.0 we will show how this area can be approximated for evaluating the net benefits of the electric power produced by FFTF and we will demonstrate the conditions under which the approximation is accurate.

4.2 Impact Analysis and Problems of Double Counting of Benefits

Benefit-cost analysis is sometimes confused with economic impact analysis. As noted in the introduction to this section, the former is concerned with identifying the effects of a public investment on the welfare of economic agents. Measurement of these changes in welfare in monetary terms is based on

theoretical principles which are beyond the scope of this report;^(a) however, an application of these principles in a specific example has been shown in Section 4.1. Economic impact analysis is a less discriminating tool which describes the effect of a public project on various indicators of economic activity and economic value, without reference to the relationship between changes in these indicators and changes in the welfare of economic agents.

Typically, impact analysis focuses on the effect of a public project on employment, wages, the value of the output produced by a particular industry, or any number of other measures of economic activity or value. Information supplied by this form of analysis may be helpful to decision-makers if objectives other than those of economic efficiency are to be served by the project. Unfortunately, it is sometimes the case that impact analysis is abused and legitimate benefits (e.g., those with welfare significance) are added to other measures of value to form a misleading picture of project benefits. This occurs, for example, whenever the cost of the inputs used in the construction of the project (such as wages or local spending for project needs) is added to legitimate project benefits.

In the analysis of the FFTF power addition, we assume that the standard of economic efficiency is the appropriate one for valuing project benefits and costs. Consequently, this report focuses only on the effects of the project on measures commonly regarded by economists to have welfare significance.

4.3 The Role of Discounting

Individual economic agents, be they producers or consumers, are not indifferent to the benefits of an investment that are realized fairly quickly as opposed to the benefits of a project that may not be realized for a much longer period of time. The latter benefits are less valuable to individual economic agents because they are not available for immediate consumption and/or reinvestment. Investors usually demand a premium in lieu of these foregone consumption or investment opportunities when they lend their money to other individuals or firms. This premium is reflected in various types of interest

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(a) For a thorough discussion of these principles see Just, Hueth, and Schmitz (1982), pp. 84-115.

rates. Accordingly, to allow for the cost associated with foregone consumption and investment opportunities, discount rates must be used to convert the value of future project benefits and costs to their equivalent present value.

Assuming for the moment that there is no inflation within the economy, this means that all project costs and benefits to be incurred in the future must be multiplied by a discount factor equal to $(1 + r_0)^{-t}$. In this expression, r_0 is the appropriate nominal rate of discount and t is equal to the (positive) number of years between the date benefits or costs are incurred and the date when the decision to commit resources to the project is to be made. Note that as t becomes larger, the discount factor and the present value of costs or benefits associated with that factor decline. Similarly, the larger the discount rate used in evaluating a public investment, the smaller will be the present value of the costs and/or benefits occurring in any future year. In cases where benefits and costs are subject to inflationary pressures, then the real rate of discount, r , is equal to:

$$\frac{1 + r_0}{1 + p} - 1 \quad (1)$$

where r_0 , as before, is the nominal rate of discount and p is the expected rate of inflation affecting the money values of the relevant benefits or costs being discounted. The corresponding real discount factor is simply $(1 + r)^{-t}$.

Selection of an appropriate discount rate for evaluating the costs and benefits of public investments has traditionally been a controversial topic in economics (Harberger 1968; Baumol 1968; Haveman 1968; Marglin 1963, 1968). Basically, there are two schools of thought on this subject. One view, commonly associated with the name of Stephen Marglin (1963, 1968), is referred to as the social time preference position. This view holds that providing for the future is a good with characteristics which individuals cannot own or by their actions appropriate for exclusive use (Mishan 1976). Consequently, the benefits and costs on which individual economic agents in the private sector base their saving-consumption and borrowing-investing decisions do not reflect the

social benefits and costs connected with providing for the future. Since private decisions do not correctly reflect the benefits associated with providing for the future, the level of private investment is viewed as sub-optimal. Under these conditions, Marglin argues that the public sector should increase its own investment by adopting a discount rate which is below private sector rates.

The second school of thought on this subject is known as the opportunity cost position. It holds that the costs and benefits associated with public sector investments should be discounted at a rate that reflects the opportunity cost of the consumption and/or investment in the private sector that would be displaced by the public investment. (This spending is displaced because the government is assumed to use tax dollars to fund the project.) This approach ensures that the social return on public investments is at least equal to the rate of return on the spending displaced in the private sector. Proponents of this view argue that resources will be used inefficiently if the discount rate used in evaluating public expenditures is less than the rate of return on the private sector expenditures that would be displaced by the project. Disagreements among the members of this school of thought are generally related to questions about what kind of expenditures get displaced by the public investment (Haveman 1968; Mishan 1976).

For the analysis of the FFTF power addition, we assume that funds will be allotted to the project only if the net return on this investment is greater than the alternative of not raising the funds (e.g., leaving the funds in the private sector). In doing so, we explicitly reject the social time preference position reflected by the use of real discount rates near or below 3 percent. The approach is viewed as unacceptable because it is by no means clear that society has the collective desire to transfer more income from current to future generations than it is currently doing. Moreover, if this is the collective desire of society, then it is by no means clear that discounting the benefits and costs of the FFTF power addition project is consistent with the objective of making future generations better off. We therefore adopt the position that economic efficiency is best served by discounting the benefits and costs of this project at the same rate that applies to the spending that

would be displaced by the project in the private sector. However, since BPA currently uses a 3 percent social rate of time preference to evaluate alternative sources of electrical power in the region, this rate was also included in the analysis.

Even if the opportunity cost position of discounting is adopted, it is not at all clear what discounting rate should be used. This is due in part to the fact that there is some disagreement over the actual computation of this rate (Haveman 1968; Mishan 1976; Feldstein 1972) and because the computations that have been advanced require so much information that they have rarely been used in standard benefit-cost calculations. To deal with these problems we adopt the commonly used technique of assessing the sensitivity of project benefits and costs to several different real discount rates--up to 12 percent. This approach is consistent with current U.S. Office of Management and Budget policy regarding discounting in the public sector (Presidential Executive Order 12291 1981).

4.4 Net Present Value Analysis and its Derivatives

The determination of whether a single public sector investment should be undertaken, as opposed to leaving the funds in the private sector, is relatively straightforward.

Assuming that the discount rate used in the analysis reflects the appropriate private rates of return on displaced spending, the project should be undertaken if its net present value is positive.^(a) That is equivalent to saying that the internal rate of return on the project is greater than the rate of discount and/or that the project has a positive net payback. To explain the relationship between these criteria, let

$t = 0, \dots, T$ be an index which measures the life of the project from the year in which the project is authorized ($t = 0$) to the year of its termination (T)

CC_t = capital costs of the project incurred in year t

(a) If the project is being compared with other public investments, the net present value measure is still the most appropriate tool for ranking the investments (Mishan 1976).

C_t = the operating and maintenance costs of the project incurred in year t

B_t = the money value equivalent of project benefits in year t .

As indicated in Section 4.3, the present value of costs and benefits of a project in any year are obtained by multiplying the relevant cost or benefit by the discount factor $(1 + r)^{-t}$, where r is the opportunity cost of displaced private spending. The discounted (present) values of costs and benefits are then summed to yield total present values of project costs and benefits as follows:

Present Value of Capital Costs (PVCC)

$$PVCC = \sum_{t=0}^T CC_t (1 + r)^{-t} \quad (2)$$

Present Value of Operating and Maintenance Costs (PVC)

$$PVC = \sum_{t=0}^T C_t (1 + r)^{-t} \quad (3)$$

Present Value of Benefits (PVB)

$$PVB = \sum_{t=0}^T B_t (1 + r)^{-t} \quad (4)$$

The net present value (NPV) of the project is simply equal to the difference between the present value of the project benefits and the sum of the present values of the capital, operating and maintenance costs of the project, or

$$NPV = PVB - (PVCC + PVC) \quad (5)$$

The internal rate of return (IRR) for the project is the rate of interest which equates the present value of benefits and costs. In other words, the IRR of the project is the rate, i , for which

$$\sum_{t=0}^T B_t(1+i)^{-t} = \sum_{t=0}^T (CC_t + C_t)(1+i)^{-t} \quad (6)$$

If the net present value of the project is greater than zero, then the internal rate of return reflected by i must be greater than the real discount rate, r . This simply means that the rate of return on the project is greater than the rate of return on the private spending that will be displaced by the project.

In addition, one can find the amount of time that it takes for a project to "break even" in a discounted payback sense: when the accumulated present value of project benefits (less operating costs) is sufficiently large to pay off the initial accumulated present value of the capital costs and then maintain a positive cash flow in all subsequent periods. Of all the different measures that can be used to compare the performance of public investments this is the least desirable since it penalizes projects which may have larger net benefits and a higher internal rate of return than a project which simply has a high initial payoff relative to project costs.

A final computation that is frequently made in benefit-cost studies is the levelization of project costs and/or benefits. The purpose of levelizing a present value flow of costs or benefits is to transform what is ordinarily an uneven flow of money values over the project life into an even flow of money values. Thus the levelized value of the capital cost of a project is simply the constant payment $\overline{CC}$ for which

$$PVCC = \sum_{t=0}^T CC_t(1+r)^{-t} = \sum_{t=0}^T \overline{CC}(1+r)^{-t} \quad (7)$$

The corresponding formulations for the levelized value of operating and maintenance costs, $\bar{C}$, and project benefits, $(\bar{B})$, are, respectively:

$$PVC = \sum_{t=0}^T C_t (1+r)^{-t} = \sum_{t=0}^T \bar{C} (1+r)^{-t} \quad (8)$$

$$PVB = \sum_{t=0}^T B_t (1+r)^{-t} = \sum_{t=0}^T \bar{B} (1+r)^{-t}$$

From the above expressions it can easily be seen that the levelized measure for project net benefits is the annual payment $\bar{NB}$ for which

$$NPV = \sum_{t=0}^T [\bar{B} - (\bar{C}C + \bar{C})] (1+r)^{-t} = \sum_{t=0}^T \bar{NB} (1+r)^{-t} \quad (9)$$

Because of the equivalence between present value totals and the totals obtained using levelized values, the two can be used interchangeably in benefit-cost calculations.

5.0 ESTIMATED COSTS OF THE FFTF POWER ADDITION

The undiscounted total capital costs of the FFTF power addition are estimated at approximately 120 million dollars, while operating and maintenance costs would add approximately 2 million dollars each year. These costs are quoted in constant 1984 dollars. This chapter documents the cost estimates. Cost associated with different activities, such as construction or engineering, are disaggregated so that the derivation of the total estimates is clear. An annual schedule of expected capital funding requirements during construction years is furnished for both the proposed nominal construction schedule and the proposed compressed construction schedule.

5.1 Capital Costs

Construction, engineering and other activities required to complete the FFTF power addition all have associated capital costs. Capital cost estimates

for the FFTF power addition are summarized by activity in Table 1. The figures are shown in thousands of constant 1984 dollars. The capital costs breakdown assumes the nominal construction schedule and is based on the work breakdown structure detailed in the Conceptual Design Report prepared by Kaiser Engineers (1983).

TABLE 1. Summary of Capital Cost Estimates for FFTF Power Addition
(Thousands of 1984 Dollars)

<u>Component</u>	<u>Component Cost (a)</u>	<u>Total Cost</u>
Engineering		21,915
Definitive Design	10,384	
System Analysis	3,068	
Field Engineer/Inspection	6,759	
Project Mgmt. (Design)	1,704	
Procurement	13,042	13,042
Construction		66,528
Security MOD's	112	
Water Line	1,471	
Site Prep	312	
Proj. Construction	56,100	
Project Mgmt. (Construction)	8,533	
Operating Funds During Construction	2,260	2,260
Other Project Funding, including opportunity costs:		15,800
Completed CRBR Components	600	
WHC Surplus FFTF Equipment	400	
Steam Generators:		
Cost Expended	2,000	
Cost Allowed for Completion	12,800	
<u>TOTAL ESTIMATED CAPITAL COST FOR FFTF POWER ADDITION</u>	<u>119,545</u>	<u>119,545</u>

(a) Assuming a nominal construction schedule

Source: Based on Kaiser Engineers 1983

The cost estimates in Table 1 include money for all management, labor, equipment and materials expected to be necessary to bring the FFTF power addition on line. In addition, the estimates include contingency allowances to reflect uncertainties predicting the costs of project completion. A hypothetical example of the use of contingency funds is one in which the completion of a particular task might take anywhere from three to five days. Project costs for this task might reasonably be estimated by assuming a task duration of four days. If the task actually takes five days to complete, then a contingency allowance of 25 percent $[(\text{actual requirements} - \text{estimated requirements}) / \text{estimated requirements}]$ might be required.

The transfer of completed CRBR components and existing Westinghouse Hanford Company (WHC) equipment to the FFTF power addition project would not cost DOE any money and involves only a book transfer of funds. Nevertheless, the use of these materials for the FFTF power addition makes them unavailable for alternative uses, such as scrap material. Benefit-cost analysis must take into consideration the value of these materials in their most valuable alternative use. The value of resources, such as the completed CRBR components, in their highest alternative use is referred to as their opportunity cost.

The estimated opportunity costs of completed CRBR components and WHC equipment are shown in Table 1. The figure of \$600,000 shown for completed CRBR components is one tenth of the original acquisition costs of roughly \$6 million. Information about CRBR surplus equipment sales, and scrap prices for 304 and 316 stainless steel and other high quality alloys, indicate that ten percent of acquisition costs falls within the expensive end of a range of alternative prices of equipment. Therefore, the estimate indicated is more likely to exceed, rather than fall below, the true opportunity cost of the equipment. The figure of \$400,000 for WHC surplus FFTF equipment is the value of that equipment currently on WHC books. The value shown for the WHC equipment, like that shown for the CRBR components, reflects opportunity costs. The \$2 million for steam generators shown in Table 1 is the estimated opportunity cost of the four, partially completed, CRBR steam generators to be used in the

FFTF power addition. This estimate was obtained using the same method shown above for valuing other CRBR components. The \$12.8 million allowed for completion of the fabrication of the CRBR steam generators is based on an estimate by Westinghouse Hanford Company (1983).

Estimated capital costs of the FFTF power addition are broken down by the year in which the funds are to be authorized in Table 2A. All estimates are quoted in thousands of constant 1984 dollars, and the totals match those explained in the discussion of Table 1. The schedule implied by Table 2A is based on the approved conceptual design (Kaiser Engineers 1983). However, a compressed schedule has been evaluated and is considered feasible by WHC and DOE. The compressed schedule is based on analyses which indicate that use of partially-fabricated CRBR steam generators, refinement of the sodium drain and fill sequence, optimization of the steam generator building construction technique and minimization of critical path management can reduce the construction schedule by a year. The estimated capital costs for the compressed schedule are shown in Table 2B. The capital costs associated with this schedule are slightly lower than those shown in Table 2A, due to reductions in supervision, quality assurance, project management and other overview requirements for the compressed schedule.

TABLE 2A. Estimated Capital Costs of FFTF Power Addition, by Year in Which Funds are Authorized: Nominal Construction Schedule

(Thousands of 1984 Dollars)

	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>TOTAL</u>
Capital Project	12,400	19,885	19,885	24,315	23,925	1,075	101,485
Surplus Equipment	3,000	-0-	-0-	-0-	-0-	-0-	3,000
Steam Generators	11,100	1,700	-0-	-0-	-0-	-0-	12,800
<u>Operating</u>	<u>90</u>	<u>80</u>	<u>80</u>	<u>70</u>	<u>70</u>	<u>1,870</u>	<u>2,260</u>
TOTAL	<u>26,590</u>	<u>21,665</u>	<u>19,965</u>	<u>24,385</u>	<u>23,995</u>	<u>2,945</u>	<u>119,545</u>

Source: Based on Kaiser Engineers 1983 and information provided by Westinghouse Hanford Company 1984.

TABLE 2B. Estimated Capital Costs of FFTF Power Addition, by Year in Which Funds are Authorized: Compressed Construction Schedule

	(Thousands of 1984 Dollars)					
	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>TOTAL</u>
Capital Project	12,700	29,400	34,900	22,800	1,200	101,000
Surplus Equipment	3,000	-0-	-0-	-0-	-0-	3,000
Steam Generators	11,100	1,700	-0-	-0-	-0-	12,800
<u>Operating</u>	<u>90</u>	<u>80</u>	<u>80</u>	<u>70</u>	<u>1,940</u>	<u>2,260</u>
TOTAL	<u>26,890</u>	<u>31,180</u>	<u>34,980</u>	<u>22,870</u>	<u>3,140</u>	<u>119,060</u>

Source: Based on Kaiser Engineers 1983 and information provided by Westinghouse Hanford Company 1984.

5.2 Annual Operating and Maintenance Costs

The estimated annual operating and maintenance costs of the FFTF power addition are broken down by activity in Table 3. The figures, presented in thousands of constant 1984 dollars, are based on Kaiser Engineers' detailed 1983 report regarding FFTF power generation. They include such costs as operating crews and miscellaneous supplies. They do not include costs of FFTF operation, because FFTF will be operated anyway to support its primary mission of fuel and LMR component testing.

TABLE 3. Estimated Annual Maintenance and Operating Costs of FFTF Power Addition

(Thousands of 1984 Dollars)	
Maintenance and Repair	1000
Water Supply	178
Chemicals and Miscellaneous Supplies	192
Operating Staff	663
<u>Electricity During Shutdowns (a)</u>	<u>30</u>
TOTAL	<u>2063</u>

(a) Calculated using \$0.0325/kWh in constant 1984 dollars.

Source: Based on Kaiser Engineers 1983

Maintenance and housekeeping functions require the purchase of about 330 kW of electricity during shutdowns. The cost of power during shutdowns is calculated by multiplying the price of electricity by estimated power requirements during shutdown periods each year:

$$\begin{aligned} & 330 \text{ kW @ } \$0.0325/\text{kWh for 32\% of the year} \\ & = 330 \text{ kW} \times 0.0325 \text{ dollars/kWh} \times .32 \times 24 \text{ hrs/day} \times 365 \text{ days/yr} \div 1000 \\ & = 30.1 \text{ thousand constant 1984 dollars per year.} \end{aligned}$$

The fraction, 0.32, shown in the above calculation is equal to one minus the capacity factor of the plant, which is conservatively assumed to be 0.68. The cost of electricity, \$0.0325/kWh, used in the above calculation reflects the public industrial retail rate for 1984 in the medium-low demand scenario estimated by the Northwest Power Planning Council (NWPPC 1983). NWPPC forecasts of electricity prices depend on the projected demand for electricity. A medium demand scenario is chosen for use in the present analysis in order to avoid extreme assumptions. Of two possible medium demand scenarios, medium low demand is chosen instead of medium high demand. This choice is conservative, in the sense that the medium low demand rate exceeds the medium high demand rate so that the corresponding cost estimate is slightly higher. The most important justification for using a single rate for electricity is that the amount of variation in the price of electricity is insignificant in comparison to other costs. Thus, the total estimated annual operating and maintenance costs will be about \$2,063,000 (constant 1984 dollars), no matter which of the relevant prices of electricity is used to estimate annual costs of electricity during shutdowns.

5.3 Environmental Costs

Costs and benefits would be associated with any impacts the FFTF power addition might have on the environment. In this section, possible environmental impacts are reviewed so that no associated costs are inappropriately neglected. The assessment is based on an environmental evaluation of the project by Kaiser Engineers and Westinghouse Hanford Company (1983). We conclude, as did Kaiser Engineers, that environmental impacts of the FFTF Power Addition are negligible. Environmental costs and benefits of the project are too small to affect overall estimates of project costs.

Only those environmental impacts specifically associated with construction or operation of the new facilities need be considered. Some new buildings are added in order to house the steam generators and turbines. However, this construction takes place on a government site which is already developed, and no pristine areas are affected. Water sprinkling controls fugitive dust during excavation. The power addition utilizes an existing substation and transmission line. Because it does not involve new high voltage power lines, the environmental impacts of such lines are irrelevant. The same irrelevance applies to radioactivity impacts, because no new radioactive materials are involved and current safety features of the FFTF reactor remain effective. In summary, the power addition incurs no significant environmental costs during construction.

Operation of the FFTF power addition somewhat alters the atmospheric effects of FFTF. The power addition converts heat, formerly rejected into the atmosphere during FFTF operation, into electricity. Therefore, any environmental impacts from the discharge of heated air from FFTF are reduced.

Operation of the FFTF power addition slightly affects water resources. All necessary water is assumed to be supplied from lines used at an existing nuclear power plant on the Hanford reservation, which in turn divert water from the Columbia River. The average daily gallonage required for operation of the FFTF power addition amounts to less than one hundredth of a percent of the average daily discharge Columbia River flow (USGS 1980; Kaiser Engineers 1983). The water is treated in order to avoid process system corrosion and fouling. Waste water is discharged to existing, but enlarged, leaching ponds near the 400 area. The elevation of the water table may change slightly in areas adjacent to the leaching ponds, but the potability of the groundwater will not be affected (Kaiser Engineers 1983). However, adequate monitoring of the groundwater will necessitate installation of two new groundwater monitoring wells near the leaching ponds. Both the installation costs of these wells, and the costs for enlarging the leaching ponds, were incorporated in cost estimates earlier in the analysis. No other significant costs are associated with the impact of the FFTF power addition on water resources.

6.0 THE BENEFITS OF THE FFTF POWER ADDITION

In Section 3.1, we identified two classes of potential benefits that could arise from the FFTF power addition. One of these was due to the production of electric power by FFTF and the other was related to testing and improving the technology, design and operating procedures for commercial LMRs as a part of the DOE breeder reactor program. This section of the report will show how it is technically possible to value both of these kinds of benefits and then provide estimates for the value of the benefits that can be attributed to the FFTF power addition.

6.1 The Benefits of FFTF Power Production

The FFTF power addition has the potential to displace other forms of electric power generation that may be needed to replace existing power generation resources in the region and/or to meet increases in the demand for electricity. This observation is based on the levelized cost of the power produced by FFTF in comparison to the levelized cost of power for alternative resources in 1990, as shown in Table 4. This table summarizes the information used by BPA to construct its supply curve(s) for new electric power generation resources in the region (BPA 1983). Although this table shows that the accounting costs of FFTF are less than the accounting costs of most of the other resources, it is also true that the economic costs of FFTF are lower than the economic costs of most of these other resources.

The benefits of the power produced by FFTF can be illustrated with the aid of Figure 3. This figure contains a simplified diagrammatic representation of the long-run supply-demand equilibrium for electricity in the regional market. The series of solid steps in this diagram, labeled C_0S_0 , are intended to represent the levelized long-run marginal cost schedule for electricity produced by discrete facilities. Each horizontal step in this schedule represents an additional (in terms of marginal cost) electric power generation resource. The height of the horizontal step from the horizontal axis measures the long-run marginal cost of generating electricity, while the horizontal width of each step measures the amount of electricity that can be generated at this marginal cost. In fact, the schedule C_0S_0 is nothing more than a discontinuous version of the long-run supply curve shown in Figure 2 in Section 4.1.

TABLE 4. Summary of BPA Regional Supply Curve for New Electric Power Generation Resources, 1990

(1982 dollars)

Resource Category	Levelized Cost ^(a) (Mills/kWh)	Cumulative Energy Available (Avg. MW)
Geothermal	70.3	38
Hydro	17.3 - 49	603
Industrial Cogeneration	33.1 - 82.8	496
Biomass	69.3	30
Wind	56.1	109
Coal	55.4	2240
Combustion Turbine	69.0	as needed
Nuclear ^(b)	--	NA
FFTF ^(c)	21	101

(a) Accounting costs, rather than economic costs, are shown in this column.

(b) New nuclear plants are not currently used in BPA resource planning analyses

(c) Calculated using BPA procedures

Source: BPA 1983

The lines shown as DD and D'D' may also be recognizable from Figure 2 as segments of two different demand curves for electricity in the market. For the moment, we will assume that the relevant demand curve for electricity is represented by the segment DD. Accordingly, the long-run market equilibrium for electricity is characterized by a market clearing price P_0 and a level of electricity output equal to Q_0 MW. Purchase of resources which cost more than P_0 dollars per MW could not be justified on the grounds of economic efficiency since the marginal cost of the next set of resources is above the market clearing price.

Now let us assume that, through a public sector investment in FFTF, a small amount of additional generating capacity (equal to A megawatts) is made available at a marginal cost of MC_a dollars, where $MC_a < MC_0$, the marginal cost of the last MW of electricity produced in the market. Under these conditions,

FIGURE 3. Graphic Representation of the Effect of a Public Investment in Electrical Generating Capacity on Consumer and Producer Welfare

economic efficiency is best served by allowing the cheaper generating capacity to displace more expensive forms of generating capacity in the market. When that happens the relevant portion of the supply schedule is displaced to the right by an amount equal to the additional capacity, A. The new supply schedule, above MC_a, is shown by the dashed lines to the right of the old supply schedule.

Given the market demand curve DD for electricity, the additional generating capacity is too small to affect the market equilibrium. Consequently, the market price, P_0 , and the equilibrium output of electricity, Q_0 , in the market do not change. However, there is a welfare gain as a result of the public investment. This welfare gain is equal to the cost saving created by the additional capacity. This saving, or "avoided cost," is shown by the portion of the shaded area which lies between the two supply schedules, above MC_a up to MC_0 . This welfare gain can be expressed in equivalent terms as the product of the additional generating capacity and the difference between the market price and the marginal cost of the new generating capacity, or

$$A \cdot (P_0 - MC_a) = A \cdot (MC_0 - MC_a) \quad (10)$$

In this case, the estimated levelized avoided cost is an exact measure of the welfare gain (e.g., net benefits) associated with the public sector investment. However, if the market demand curve is $D'D'$ instead of DD, then the levelized avoided cost measure is no longer exact. For the demand curve $D'D'$, the initial market equilibrium is represented by the equilibrium price-quantity combination P'_0, MC'_0 . In this case, the public investment does have an impact on the market equilibrium. The market clearing price falls from P'_0 to P_1 and the equilibrium level of output increases from Q'_0 to Q_1 . Under these conditions, the net benefits of the public investment are shown by the entire shaded area, which lies between the two supply schedules, from MC_a to MC'_0 . However, the estimated levelized avoided cost associated with this consists of the shaded area and the small unshaded area B. Thus, this levelized avoided cost measure over-estimates the true welfare effects of the project by an amount that can be approximated by the area B.

For this preliminary study the levelized avoided cost measure was selected as an appropriate measure for providing a first approximation to the net benefits of the FFTF power addition. This measure is attractive for at least three reasons. First, because of FFTF's small size in relation to the projected regional power demands, the potential overstatement of net benefits is likely to be small. Second, estimates of the levelized marginal cost of supplying electricity in future years are currently available for the region. Finally,

because of the equivalence between levelized and net present value totals (shown earlier in Section 4.4), the total levelized avoided cost of power due to the addition of FFTF's output is equal to the net present value of displaced capacity and associated operating costs. That is:

$$\begin{aligned} \text{NPV} &= \sum_{t=0}^T (\text{MC}_{0t} \cdot A \cdot \text{CF} \cdot k - \text{CC}_t - C_t)(1+r)^{-t} \\ &= \sum_{t=0}^T (\text{MC}_{0t} - \text{MC}_a)(A \cdot \text{CF} \cdot k)(1+r)^{-t} \end{aligned} \quad (11)$$

where:

NPV = Net present value in millions of dollars

A = The average kW of generating capacity of FFTF in a year,
(e.g., 101,061 kW)

CF = The capacity factor of FFTF

k = A constant equal to 8760, the number of hours in a year

t = 0, ..., T an index where 0 represents 1985 and T is the year in which the project is terminated

CC_t = The capital cost of FFTF in year t

C_t = The operating and maintenance cost of FFTF in year t

r = The real discount rate

MC_{0t} = The levelized, marginal cost of power in the market in \$/kWh in year t

MC_a = The levelized marginal cost of FFTF in \$/kWh.

Estimates of the levelized marginal cost of supplying electricity in the Pacific Northwest for the period 1991-2003 (e.g., MC_{0t}) were generated using a linear programming model currently being developed for BPA for use in generating regional supply curves for electricity. The results of the benefit-cost calculations using these marginal cost estimates should be viewed as preliminary because subsequent experience with the model may lead to revisions of these estimates. The marginal cost estimates are shown in constant 1984

dollars in Table 5.^(a) The estimates for the years 2004-2010 are a simple arithmetic average of the estimates for the last 5 years of the original series, which only extended to 2003. Table 5 also shows the future (undiscounted) value of the benefits of FFTF power production computed using these marginal cost estimates. The marginal cost estimates shown in Table 5 are of particular significance to the question of whether or not FFTF power will ever be needed in the region. Given: 1) that the 101 MW of FFTF represents a "marginal" addition to the regional base of about 20,000 average MW^(b) and 2) that the estimated marginal cost for 1991, and for all subsequent years, is above the levelized cost of FFTF, long-run economic efficiency objectives justify the addition of the lower-priced FFTF power.

6.2 Programmatic Benefits

The benefits of FFTF related to testing and improving the technology, design and operating procedures of commercial LMR's can, in theory, be valued in terms of the reduction in the long-run costs of constructing and operating these plants in the future. These benefits which will largely accrue to firms in the private sector are a legitimate by-product of the project, even if they cannot be appropriated directly by the federal government. Indeed, the fact that the benefits of "learning by doing" are often very difficult to appropriate by the originators of these benefits may lead to under-investment in this form of activity by the private sector (Arrow 1962). In that case, public sector investment in the commercialization of new technologies may represent a legitimate means of overcoming this form of market failure (Bator 1958).

In the present case, the valuation of these benefits of the FFTF power addition is complicated by the very great uncertainty currently associated with the future of commercial LMR power plants and by the foreseeably long amount of time that will pass before this technology is commercialized. The latter factor is particularly important for two reasons. The first is that, even if

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- (a) The estimated marginal costs shown in Table 5 are the shadow prices on the load demand constraint in the linear programming model; as such they represent the additional levelized cost of supplying another MW of power in the region in a particular year.
  - (b) Total Northwest regional energy resource capabilities as estimated for contract year 1991-92 by PNUCC (1984).

TABLE 5. Estimates of the Levelized Marginal Cost of Supplying Electricity in the Pacific Northwest and the Future Value of Project Benefits, by Year

(Constant 1984 Dollars)

Year	Levelized Marginal Cost ^(a) (\$/kWh)	Future Value ^(b) of Benefits (millions of dollars)
1990 ^(c)	.034	20.47
1991	.042	25.28
1992	.042	25.28
1993	.049	29.50
1994	.055	33.11
1995	.056	33.71
1996	.043	25.89
1997	.037	22.27
1998	.058	34.92
1999	.061	36.72
2000	.063	37.93
2001	.041	24.68
2002	.042	25.28
2003	.054	32.51
2004	.054	32.51
2005	.054	32.51
2006	.054	32.51
2007	.054	32.51
2008	.054	32.51
2009	.054	32.51
2010	.054	32.51

(a) Source: Marc Hellman, Oregon Public Utilities Commission, July 6, 1984

(b) Assuming a capacity factor of .68

(c) 1990 benefits apply only to the compressed construction schedule.

one knew how the experience of operating the FFTF power addition would affect industry costs in the future, the effect of discounting on the present value of these future benefits would be severe. The second reason is that if LMR commercialization does not become a reality for a long period of time, the potential benefits of operating FFTF may be further reduced by technological changes which take place in the interim, after FFTF is terminated. This is the case of inventing the cart before the horse. Thus, even though the cost of creating these programmatic benefits is very low, there is some risk that these benefits will be generated too early to be of much value to the commercialization of LMR power plants. In that case, it may make more sense and cost society less money to wait.

For the reasons just cited, no attempt was made to value the programmatic benefits of the FFTF power addition. To do this would require information about the expected effects of operating the FFTF power addition on future industry costs and about the future of the LMR as a source of commercial electric power.

7.0 ECONOMIC ANALYSIS OF THE FFTF POWER ADDITION

In this section of the report we present the numerical results for the net present value, the internal rate of return and the payback period/date of the FFTF power addition. However, before presenting the actual results of these computations, we will review the range of input values used to arrive at those results. This information is contained in Table 6.

TABLE 6. Summary of Values Used in the Benefit-Cost Calculation

<u>Item</u>	<u>Values</u>
Monetary Units	constant 1984 dollars
Base year for discounting (t=0)	1985
Project Construction Period	1986-1991
Compressed Construction Period	1986-1990
Start of Power Production	1990, 1991
Project Life	10, 15, 20 years
Real Discount Rates	3, 8, 10, 12 percent
Capacity Factors	60, 68, 80 percent

In performing the economic analysis, all monetary units were expressed in constant 1984 dollars. All estimates of future costs and benefits (e.g., those which occur after 1984) were discounted back to 1985, which is the year in which the major decisions regarding the future of the FFTF power addition will be made. Two project construction periods were used in the analysis: 1986-1991 and 1986-1990. The present value of the capital costs of the project were calculated by discounting the expenditures during this period from the years in which they were committed (see Table 2 in Section 5.1) to 1985. The project was assumed to start generating electricity in 1991 for the nominal construction schedule and in 1990 for the compressed construction schedule. The life of the project is expected to be 20 years; however, the analysis was conducted using 10, 15, and 20 year project lifetimes for sensitivity purposes. The present value of the benefits of power production and the associated operating and maintenance costs were calculated by discounting these values from the year in which they occurred to 1985. The relevant information for operating and maintenance costs is presented in Table 3 in Section 5.2; the benefit estimates are shown, by year, in Table 5 in Section 6.1. Discount rates used in the analysis were 3, 8, 10 and 12 percent, real. In addition, the capacity factor (which affects the estimates of both benefits and operating and maintenance costs) was varied among 60, 68 and 80 percent. The 68 percent figure is considered to be achievable by plant operators based on present reactor performance, while the 80 percent target is based on the use of long-life cores, which are under development and scheduled for demonstration prior to the power addition.

The results of the net present value analysis are summarized in Tables 7A and 7B. The year-by-year results of the analysis for all of the various cases are shown in Appendix A. Listings of the computer programs used to obtain the results shown here and in Appendix A are presented in Appendix B. In all but two extreme cases, the net present value of the project is greater than zero, ranging up to \$133.8 million, not including the estimates obtained using a 3 percent real discount rate. (As mentioned previously in the report, this discount rate is currently used by BPA to evaluate alternative sources of electrical power in the region.) In the two worst cases tested, with real discount rates of 12%, capacity factors of .60 and project lifetimes of

TABLE 7A. Estimates of Net Present Value (NPV) for the FFTF Power Addition for 3 Different Capacity Factors, with Real Discount Rates of 3, 8, 10 and 12%: Nominal Construction Schedule

Capacity Factor	NPV in Millions of 1984 Dollars											
	3%			8%			10%			12%		
	10 yr	15 yr	20 yr	10 yr	15 yr	20 yr	10 yr	15 yr	20 yr	10 yr	15 yr	20 yr
0.60	71.5	141.6	209.1	15.4	45.2	68.0	1.6	23.0	38.0	-9.0	6.4	16.4
0.68	97.7	177.9	255.1	31.5	65.6	91.6	14.9	39.4	56.6	2.1	19.8	31.2
0.80	137.0	232.5	324.3	55.5	96.1	127.1	34.9	64.1	84.5	18.8	39.9	53.5

TABLE 7B. Estimates of Net Present Value (NPV) for the FFTF Power Addition for 3 Different Capacity Factors, with Real Discount Rates of 3, 8, 10 and 12%: Compressed Construction Schedule

Capacity Factor	NPV in Millions of 1984 Dollars											
	3%			8%			10%			12%		
	10 yr	15 yr	20 yr	10 yr	15 yr	20 yr	10 yr	15 yr	20 yr	10 yr	15 yr	20 yr
0.60	64.1	139.6	209.1	13.3	47.3	71.9	0.3	25.3	41.8	-9.9	8.6	19.7
0.68	89.5	175.9	255.4	29.6	68.5	96.7	14.1	42.7	61.5	1.9	23.0	35.7
0.80	127.7	230.5	325.0	54.1	100.3	133.8	34.8	68.7	91.2	19.4	44.6	59.7

10 years, the net present value of the FFTF power addition is negative: -9.0 million for the nominal construction schedule and -9.9 million for the compressed construction schedule. Note also that the estimated NPV of the project is relatively insensitive to a one-year reduction in the construction schedule. In general, the results shown in Table 7 are as expected: increasing the capacity factor and project life both increase the net present value of project benefits, while an increase in the real discount rate reduces the present value of these net benefits. Provided that the real discount rates used in the analysis reflect the rates of return of displaced spending in the private sector, the results shown here are an indication that the FFTF is a more efficient alternative than leaving project funds in the private sector.

The results for the internal rate of return (IRR) calculations are summarized in Tables 8A and 8B. The results range from a low of 10 to a high of 19 percent, real. Assuming a long-run expected rate of inflation of approximately 6 percent, the corresponding nominal, internal rates of return range from 17 to 26 percent. (Once again the results are not very sensitive to

TABLE 8A. Real Internal Rates of Return (IRR) of the FFTF Power Addition Assuming Nominal Construction Schedule, and Capacity Factor Varying Among 0.60, 0.68 and 0.80

<u>Capacity Factor</u>	<u>IRR (%)</u>		
	<u>Project Life</u>		
	<u>10 Years</u>	<u>15 Years</u>	<u>20 Years</u>
0.60	10	13	14
0.68	12	15	16
0.80	15	17	18

TABLE 8B. Real Internal Rates of Return (IRR) of the FFTF Power Addition Assuming Compressed Construction Schedule, and Capacity Factor Varying Among 0.60, 0.68 and 0.80

<u>Capacity Factor</u>	<u>IRR (%)</u>		
	<u>Project Life</u>		
	<u>10 Years</u>	<u>15 Years</u>	<u>20 Years</u>
0.60	10	13	14.5
0.68	12	15	16.5
0.80	15	18	19

the one-year reduction in the construction schedule.) These nominal rates can be compared with the nominal rates of return on the corporate bonds of private utilities as reflected by the June 1984 "Moody's Average" for Aaa and Aa bonds (Wall Street Journal 1984), which fluctuated narrowly around the 15 percent figure (8 percent real). This evidence suggests that FFTF is a better investment than the average of investments reflected by these bonds, although one must realize that many different kinds of consumption and investment spending would be displaced by the funds invested in FFTF (not just investment in private utilities). More importantly, Tables 7A and 7B show that, as long as the real rate of return on the spending that would be displaced by the taxes raised to pay for FFTF is below 10-19 percent per annum, society as a whole could be made better off by funding the FFTF power addition-as opposed to leaving the funds for its construction in the private sector.

Finally, Tables 9A and 9B show the year in which the FFTF power addition will "break even" for each of the three different discount rates used in the analysis. The results show that the payback period ranges from 4 to 12 years

TABLE 9A. Payback Data for the FFTF Power Addition for Three Capacity Factors with Real Discount Rates of 3, 8, 10 and 12%:
Nominal Construction Schedule

Capacity Factor	Year of Payback			
	3%	8%	10%	12%
0.60	1997	1999	2000	2003
0.68	1996	1998	1999	2000
0.80	1995	1996	1997	1998

TABLE 9B. Payback Data for the FFTF Power Addition for Three Capacity Factors with Real Discount Rates of 3, 8, 10 and 12%:
Compressed Construction Schedule

Capacity Factor	Year of Payback			
	3%	8%	10%	12%
0.60	1996	1998	1999	2002
0.68	1995	1997	1998	1999
0.80	1994	1995	1996	1997

and is generally not very sensitive to the different values used in the analysis. Reducing the construction schedule by one year does not affect the length of the payback period. These discounted payback results should be used very carefully by decision makers since they are not "simple" payback figures and because comparing projects on the basis of payback penalizes projects with high net present values which may have long payback periods. Other things being equal, the net present value criterion utilized in Tables 7A and 7B is the most appropriate one for comparing different public investments or for comparing a public investment to a private sector alternative.

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APPENDIX A

YEAR BY YEAR RESULTS OF THE NET PRESENT VALUE ANALYSIS

Table A.1 presents the results of the net present value analysis, by year, for the nominal construction schedule. Each page of Table A.1 shows a different sensitivity test. The first 9 sensitivity tests correspond to a 3 percent real discount rate. Capacity factors of 0.60, 0.68 and 0.80 are each held constant while the assumed project life varies among 10, 15 and 20 years. Subsequent groupings of 9 sensitivity tests each show year by year results for discount rates of 8, 10 and 12 percent.

Table A.2 presents the results of the net present value analysis, by year, for the compressed construction schedule. Each page of Table A.2 shows a different sensitivity test, in the same order and using the same values as for Table A.1.

TABLE A.1. Year by Year Results of the Net Present Value Analysis:
Nominal Construction Schedule

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	18.68378	1.733243	16.95054	-92.38759
1992	18.13959	1.682761	16.45683	-75.93076
1993	20.54646	1.633748	18.91272	-57.01805
1994	22.39064	1.586163	20.80448	-36.21357
1995	22.13373	1.539964	20.59377	-15.61981
1996	16.50053	1.495111	15.00542	-.6143875
1997	13.78459	1.451564	12.33303	11.71864
1998	20.97891	1.409285	19.56962	31.28826
1999	21.42138	1.368238	20.05315	51.34141
2000	21.47935	1.328387	20.15096	71.49236

Net Present Value = 71.49236 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	18.68378	1.733243	16.95054	-92.38759
1992	18.13959	1.682761	16.45683	-75.93076
1993	20.54646	1.633748	18.91272	-57.01805
1994	22.39064	1.586163	20.80448	-36.21357
1995	22.13373	1.539964	20.59377	-15.61981
1996	16.50053	1.495111	15.00542	-.6143875
1997	13.78459	1.451564	12.33303	11.71864
1998	20.97891	1.409285	19.56962	31.28826
1999	21.42138	1.368238	20.05315	51.34141
2000	21.47935	1.328387	20.15096	71.49236
2001	13.57148	1.289696	12.28178	83.77415
2002	13.49756	1.252132	12.24543	96.01957
2003	16.84855	1.215662	15.63289	111.6525
2004	16.35782	1.180254	15.17756	126.83
2005	15.88138	1.145878	14.7355	141.5655

Net Present Value = 141.5655 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	18.68378	1.733243	16.95054	-92.38759
1992	18.13959	1.682761	16.45683	-75.93076
1993	20.54646	1.633748	18.91272	-57.01805
1994	22.39064	1.586163	20.80448	-36.21357
1995	22.13373	1.539964	20.59377	-15.61981
1996	16.50053	1.495111	15.00542	-.6143875
1997	13.78459	1.451564	12.33303	11.71864
1998	20.97891	1.409285	19.56962	31.28826
1999	21.42138	1.368238	20.05315	51.34141
2000	21.47935	1.328387	20.15096	71.49236
2001	13.57148	1.289696	12.28178	83.77415
2002	13.49756	1.252132	12.24543	96.01957
2003	16.84855	1.215662	15.63289	111.6525
2004	16.35782	1.180254	15.17756	126.83
2005	15.88138	1.145878	14.7355	141.5655
2006	15.41881	1.112503	14.30631	155.8718
2007	14.96972	1.0801	13.88962	169.7615
2008	14.53371	1.048641	13.48507	183.2465
2009	14.1104	1.018098	13.0923	196.3388
2010	13.69941	.9884445	12.71097	209.0498

Net Present Value = 209.0498 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	21.17495	1.726948	19.448	-89.89012
1992	20.55821	1.676649	18.88156	-71.00857
1993	23.28599	1.627815	21.65818	-49.35039
1994	25.37606	1.580402	23.79566	-25.55474
1995	25.08489	1.534371	23.55052	-2.004219
1996	18.7006	1.489681	17.21092	15.2067
1997	15.62254	1.446292	14.17624	29.38294
1998	23.7761	1.404167	22.37193	51.75488
1999	24.27757	1.363269	22.9143	74.66917
2000	24.34326	1.323562	23.01969	97.68887

Net Present Value = 97.68887 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	21.17495	1.726948	19.448	-89.89012
1992	20.55821	1.676649	18.88156	-71.00857
1993	23.28599	1.627815	21.65818	-49.35039
1994	25.37606	1.580402	23.79566	-25.55474
1995	25.08489	1.534371	23.55052	-2.004219
1996	18.7006	1.489681	17.21092	15.2067
1997	15.62254	1.446292	14.17624	29.38294
1998	23.7761	1.404167	22.37193	51.75488
1999	24.27757	1.363269	22.9143	74.66917
2000	24.34326	1.323562	23.01969	97.68887
2001	15.38101	1.285012	14.096	111.7849
2002	15.29724	1.247584	14.04965	125.8345
2003	19.09502	1.211247	17.88378	143.7183
2004	18.53886	1.175968	17.36289	161.0812
2005	17.99889	1.141716	16.85718	177.9384

Net Present Value = 177.9384 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	21.17495	1.726948	19.448	-89.89012
1992	20.55821	1.676649	18.88156	-71.00857
1993	23.28599	1.627815	21.65818	-49.35039
1994	25.37606	1.580402	23.79566	-25.55474
1995	25.08489	1.534371	23.55052	-2.004219
1996	18.7006	1.489681	17.21092	15.2067
1997	15.62254	1.446292	14.17624	29.38294
1998	23.7761	1.404167	22.37193	51.75488
1999	24.27757	1.363269	22.9143	74.66917
2000	24.34326	1.323562	23.01969	97.68887
2001	15.38101	1.285012	14.096	111.7849
2002	15.29724	1.247584	14.04965	125.8345
2003	19.09502	1.211247	17.88378	143.7183
2004	18.53886	1.175968	17.36289	161.0812
2005	17.99889	1.141716	16.85718	177.9384
2006	17.47465	1.108463	16.36619	194.3045
2007	16.96568	1.076177	15.8895	210.194
2008	16.47154	1.044832	15.4267	225.6207
2009	15.99178	1.0144	14.97738	240.5981
2010	15.526	.9848546	14.54115	255.1393

Net Present Value = 255.1393 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	24.91171	1.717506	23.1942	-86.14393
1992	24.18612	1.667481	22.51864	-63.62529
1993	27.39529	1.618914	25.77637	-37.84892
1994	29.85418	1.571761	28.28242	-9.56649
1995	29.51164	1.525982	27.98566	18.41917
1996	22.0007	1.481536	20.51917	38.93833
1997	18.37945	1.438384	16.94107	55.8794
1998	27.97188	1.396489	26.57539	82.4548
1999	28.56184	1.355815	27.20603	109.6608
2000	28.63913	1.316325	27.3228	136.9836

Net Present Value = 136.9836 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	24.91171	1.717506	23.1942	-86.14393
1992	24.18612	1.667481	22.51864	-63.62529
1993	27.39529	1.618914	25.77637	-37.84892
1994	29.85418	1.571761	28.28242	-9.56649
1995	29.51164	1.525982	27.98566	18.41917
1996	22.0007	1.481536	20.51917	38.93833
1997	18.37945	1.438384	16.94107	55.8794
1998	27.97188	1.396489	26.57539	82.4548
1999	28.56184	1.355815	27.20603	109.6608
2000	28.63913	1.316325	27.3228	136.9836
2001	18.0953	1.277986	16.81731	153.8009
2002	17.99675	1.240763	16.75599	170.5569
2003	22.46473	1.204624	21.26011	191.817
2004	21.81042	1.169538	20.64088	212.4579
2005	21.17517	1.135474	20.03969	232.4976

Net Present Value = 232.4976 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	24.91171	1.717506	23.1942	-86.14393
1992	24.18612	1.667481	22.51864	-63.62529
1993	27.39529	1.618914	25.77637	-37.84892
1994	29.85418	1.571761	28.28242	-9.56649
1995	29.51164	1.525982	27.98566	18.41917
1996	22.0007	1.481536	20.51917	38.93833
1997	18.37945	1.438384	16.94107	55.8794
1998	27.97188	1.396489	26.57539	82.4548
1999	28.56184	1.355815	27.20603	109.6608
2000	28.63913	1.316325	27.3228	136.9836
2001	18.0953	1.277986	16.81731	153.8009
2002	17.99675	1.240763	16.75599	170.5569
2003	22.46473	1.204624	21.26011	191.817
2004	21.81042	1.169538	20.64088	212.4579
2005	21.17517	1.135474	20.03969	232.4976
2006	20.55842	1.102402	19.45601	251.9536
2007	19.95963	1.070293	18.88933	270.843
2008	19.37828	1.039119	18.33916	289.1821
2009	18.81386	1.008854	17.80501	306.9871
2010	18.26589	.9794696	17.28642	324.2735

Net Present Value = 324.2735 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 109.3381
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .8
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	14.05871	1.304188	12.75452	-82.39909
1992	13.01732	1.207582	11.80974	-70.58935
1993	14.06192	1.118131	12.94379	-57.64556
1994	14.61462	1.035306	13.57931	-44.06625
1995	13.77809	.958617	12.81948	-31.24677
1996	9.795932	.8876084	8.908324	-22.33845
1997	7.804684	.8218596	6.982825	-15.35562
1998	11.32812	.760981	10.56714	-4.788483
1999	11.03153	.7046121	10.32692	5.538437
2000	10.54928	.6524185	9.896861	15.4353

Net Present Value = 15.4353 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	14.05871	1.304188	12.75452	-82.39909
1992	13.01732	1.207582	11.80974	-70.58935
1993	14.06192	1.118131	12.94379	-57.64556
1994	14.61462	1.035306	13.57931	-44.06625
1995	13.77809	.958617	12.81948	-31.24677
1996	9.795932	.8876084	8.908324	-22.33845
1997	7.804684	.8218596	6.982825	-15.35562
1998	11.32812	.760981	10.56714	-4.788483
1999	11.03153	.7046121	10.32692	5.538437
2000	10.54928	.6524185	9.896861	15.4353
2001	6.356856	.6040913	5.752764	21.18806
2002	6.029537	.5593437	5.470193	26.65825
2003	7.178021	.5179109	6.66011	33.31836
2004	6.646316	.4795471	6.166769	39.48512
2005	6.153995	.444025	5.70997	45.1951

Net Present Value = 45.1951 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	14.05871	1.304188	12.75452	-82.39909
1992	13.01732	1.207582	11.80974	-70.58935
1993	14.06192	1.118131	12.94379	-57.64556
1994	14.61462	1.035306	13.57931	-44.06625
1995	13.77809	.958617	12.81948	-31.24677
1996	9.795932	.8876084	8.908324	-22.33845
1997	7.804684	.8218596	6.982825	-15.35562
1998	11.32812	.760981	10.56714	-4.788483
1999	11.03153	.7046121	10.32692	5.538437
2000	10.54928	.6524185	9.896861	15.4353
2001	6.356856	.6040913	5.752764	21.18806
2002	6.029537	.5593437	5.470193	26.65825
2003	7.178021	.5179109	6.66011	33.31836
2004	6.646316	.4795471	6.166769	39.48512
2005	6.153995	.444025	5.70997	45.1951
2006	5.698144	.4111343	5.28701	50.4821
2007	5.276059	.3806799	4.895379	55.37749
2008	4.88524	.3524814	4.532759	59.91025
2009	4.52337	.3263716	4.196998	64.10724
2010	4.188306	.3021959	3.886109	67.99335

Net Present Value = 67.99335 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	15.9332	1.299452	14.63375	-80.51986
1992	14.75297	1.203196	13.54977	-66.9701
1993	15.93684	1.11407	14.82277	-52.14732
1994	16.56324	1.031546	15.53169	-36.61563
1995	15.61517	.9551354	14.66004	-21.95559
1996	11.10206	.8843847	10.21767	-11.73792
1997	8.845308	.8188747	8.026433	-3.711479
1998	12.83853	.7582173	12.08032	8.368836
1999	12.5024	.702053	11.80035	20.16919
2000	11.95585	.650049	11.3058	31.47499

Net Present Value = 31.47499 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	15.9332	1.299452	14.63375	-80.51986
1992	14.75297	1.203196	13.54977	-66.9701
1993	15.93684	1.11407	14.82277	-52.14732
1994	16.56324	1.031546	15.53169	-36.61563
1995	15.61517	.9551354	14.66004	-21.95559
1996	11.10206	.8843847	10.21767	-11.73792
1997	8.845308	.8188747	8.026433	-3.711479
1998	12.83853	.7582173	12.08032	8.368836
1999	12.5024	.702053	11.80035	20.16919
2000	11.95585	.650049	11.3058	31.47499
2001	7.204437	.6018973	6.60254	38.07753
2002	6.833475	.5573123	6.276163	44.3537
2003	8.13509	.5160299	7.61906	51.97277
2004	7.532491	.4778055	7.054685	59.02745
2005	6.974528	.4424124	6.532115	65.55957

Net Present Value = 65.55957 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	15.9332	1.299452	14.63375	-80.51986
1992	14.75297	1.203196	13.54977	-66.9701
1993	15.93684	1.11407	14.82277	-52.14732
1994	16.56324	1.031546	15.53169	-36.61563
1995	15.61517	.9551354	14.66004	-21.95559
1996	11.10206	.8843847	10.21767	-11.73792
1997	8.845308	.8188747	8.026433	-3.711479
1998	12.83853	.7582173	12.08032	8.368836
1999	12.5024	.702053	11.80035	20.16919
2000	11.95585	.650049	11.3058	31.47499
2001	7.204437	.6018973	6.60254	38.07753
2002	6.833475	.5573123	6.276163	44.3537
2003	8.13509	.5160299	7.61906	51.97277
2004	7.532491	.4778055	7.054685	59.02745
2005	6.974528	.4424124	6.532115	65.55957
2006	6.457896	.4096411	6.048255	71.60782
2007	5.979533	.3792973	5.600236	77.20806
2008	5.536605	.3512012	5.185404	82.39346
2009	5.126486	.3251863	4.801299	87.19476
2010	4.746746	.3010984	4.445647	91.64041

Net Present Value = 91.64041 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	18.74495	1.292346	17.4526	-77.70101
1992	17.35643	1.196617	16.15981	-61.5412
1993	18.74923	1.107979	17.64125	-43.89995
1994	19.48616	1.025906	18.46025	-25.4397
1995	18.37079	.9499129	17.42088	-8.018815
1996	13.06124	.879549	12.18169	4.16288
1997	10.40624	.8143972	9.591848	13.75473
1998	15.10416	.7540715	14.35009	28.10481
1999	14.70871	.6982143	14.0105	42.11531
2000	14.0657	.6464947	13.41921	55.53452

Net Present Value = 55.53452 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	18.74495	1.292346	17.4526	-77.70101
1992	17.35643	1.196617	16.15981	-61.5412
1993	18.74923	1.107979	17.64125	-43.89995
1994	19.48616	1.025906	18.46025	-25.4397
1995	18.37079	.9499129	17.42088	-8.018815
1996	13.06124	.879549	12.18169	4.16288
1997	10.40624	.8143972	9.591848	13.75473
1998	15.10416	.7540715	14.35009	28.10481
1999	14.70871	.6982143	14.0105	42.11531
2000	14.0657	.6464947	13.41921	55.53452
2001	8.475808	.5986062	7.877201	63.41172
2002	8.039383	.554265	7.485118	70.89684
2003	9.570694	.5132083	9.057486	79.95431
2004	8.861754	.4751929	8.386561	88.34088
2005	8.205327	.4399934	7.765334	96.10622

Net Present Value = 96.10622 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	18.74495	1.292346	17.4526	-77.70101
1992	17.35643	1.196617	16.15981	-61.5412
1993	18.74923	1.107979	17.64125	-43.89995
1994	19.48616	1.025906	18.46025	-25.4397
1995	18.37079	.9499129	17.42088	-8.018815
1996	13.06124	.879549	12.18169	4.16288
1997	10.40624	.8143972	9.591848	13.75473
1998	15.10416	.7540715	14.35009	28.10481
1999	14.70871	.6982143	14.0105	42.11531
2000	14.0657	.6464947	13.41921	55.53452
2001	8.475808	.5986062	7.877201	63.41172
2002	8.039383	.554265	7.485118	70.89684
2003	9.570694	.5132083	9.057486	79.95431
2004	8.861754	.4751929	8.386561	88.34088
2005	8.205327	.4399934	7.765334	96.10622
2006	7.597525	.4074013	7.190124	103.2963
2007	7.034745	.3772234	6.657521	109.9539
2008	6.513653	.3492809	6.164372	116.1182
2009	6.03116	.3234082	5.707752	121.826
2010	5.584407	.299452	5.284955	127.1109

Net Present Value = 127.1109 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 95.15361
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .8
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	12.59308	1.168226	11.42485	-78.8695
1992	11.44825	1.062023	10.38623	-68.48327
1993	12.14209	.9654756	11.17661	-57.30666
1994	12.38989	.8777052	11.51218	-45.79448
1995	11.46832	.7979137	10.67041	-35.12407
1996	8.005485	.7253761	7.280109	-27.84396
1997	6.262219	.6594328	5.602786	-22.24117
1998	8.924046	.5994843	8.324561	-13.91661
1999	8.532394	.5449858	7.987409	-5.929199
2000	8.011042	.4954416	7.5156	1.586403

Net Present Value = 1.586403 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	12.59308	1.168226	11.42485	-78.8695
1992	11.44825	1.062023	10.38623	-68.48327
1993	12.14209	.9654756	11.17661	-57.30666
1994	12.38989	.8777052	11.51218	-45.79448
1995	11.46832	.7979137	10.67041	-35.12407
1996	8.005485	.7253761	7.280109	-27.84396
1997	6.262219	.6594328	5.602786	-22.24117
1998	8.924046	.5994843	8.324561	-13.91661
1999	8.532394	.5449858	7.987409	-5.929199
2000	8.011042	.4954416	7.5156	1.586403
2001	4.739577	.4504015	4.289175	5.87558
2002	4.413797	.4094559	4.004341	9.879921
2003	5.158983	.3722326	4.786751	14.66667
2004	4.689985	.3383933	4.351591	19.01827
2005	4.263623	.3076302	3.955992	22.97426

Net Present Value = 22.97426 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	12.59308	1.168226	11.42485	-78.8695
1992	11.44825	1.062023	10.38623	-68.48327
1993	12.14209	.9654756	11.17661	-57.30666
1994	12.38989	.8777052	11.51218	-45.79448
1995	11.46832	.7979137	10.67041	-35.12407
1996	8.005485	.7253761	7.280109	-27.84396
1997	6.262219	.6594328	5.602786	-22.24117
1998	8.924046	.5994843	8.324561	-13.91661
1999	8.532394	.5449858	7.987409	-5.929199
2000	8.011042	.4954416	7.5156	1.586403
2001	4.739577	.4504015	4.289175	5.87558
2002	4.413797	.4094559	4.004341	9.879921
2003	5.158983	.3722326	4.786751	14.66667
2004	4.689985	.3383933	4.351591	19.01827
2005	4.263623	.3076302	3.955992	22.97426
2006	3.87602	.2796638	3.596356	26.57062
2007	3.523655	.2542399	3.269415	29.84004
2008	3.203322	.2311271	2.972195	32.81223
2009	2.912111	.2101156	2.701995	35.51423
2010	2.647374	.1910142	2.45636	37.97059

Net Present Value = 37.97059 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	14.27216	1.163983	13.10817	-77.18618
1992	12.97469	1.058166	11.91652	-65.26966
1993	13.76103	.9619692	12.79906	-52.4706
1994	14.04187	.8745174	13.16735	-39.30325
1995	12.99743	.7950158	12.20242	-27.10083
1996	9.072882	.7227417	8.350141	-18.75069
1997	7.097181	.6570378	6.440143	-12.31055
1998	10.11392	.5973071	9.51661	-2.793938
1999	9.670048	.5430065	9.127041	6.333107
2000	9.07918	.4936423	8.585537	14.91865

Net Present Value = 14.91865 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	14.27216	1.163983	13.10817	-77.18618
1992	12.97469	1.058166	11.91652	-65.26966
1993	13.76103	.9619692	12.79906	-52.4706
1994	14.04187	.8745174	13.16735	-39.30325
1995	12.99743	.7950158	12.20242	-27.10083
1996	9.072882	.7227417	8.350141	-18.75069
1997	7.097181	.6570378	6.440143	-12.31055
1998	10.11392	.5973071	9.51661	-2.793938
1999	9.670048	.5430065	9.127041	6.333107
2000	9.07918	.4936423	8.585537	14.91865
2001	5.371521	.4487657	4.922755	19.8414
2002	5.002303	.4079688	4.594334	24.43574
2003	5.846847	.3708807	5.475967	29.91171
2004	5.315315	.3371643	4.978151	34.88986
2005	4.832105	.306513	4.525592	39.41544

Net Present Value = 39.41544 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE

1991	14.27216	1.163983	13.10817	-77.18618
1992	12.97469	1.058166	11.91652	-65.26966
1993	13.76103	.9619692	12.79906	-52.4706
1994	14.04187	.8745174	13.16735	-39.30325
1995	12.99743	.7950158	12.20242	-27.10083
1996	9.072882	.7227417	8.350141	-18.75069
1997	7.097181	.6570378	6.440143	-12.31055
1998	10.11392	.5973071	9.51661	-2.793938
1999	9.670048	.5430065	9.127041	6.333107
2000	9.07918	.4936423	8.585537	14.91865
2001	5.371521	.4487657	4.922755	19.8414
2002	5.002303	.4079688	4.594334	24.43574
2003	5.846847	.3708807	5.475967	29.91171
2004	5.315315	.3371643	4.978151	34.88986
2005	4.832105	.306513	4.525592	39.41544
2006	4.392823	.2786482	4.114174	43.52963
2007	3.993475	.2533165	3.740159	47.26979
2008	3.630432	.2302877	3.400144	50.66993
2009	3.300393	.2093525	3.09104	53.76097
2010	3.000357	.1903204	2.810037	56.57101

Net Present Value = 56.57101 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	16.79077	1.157618	15.63315	-74.6612
1992	15.26434	1.05238	14.21196	-60.44924
1993	16.18945	.9567092	15.23274	-45.2165
1994	16.51985	.8697357	15.65011	-29.56639
1995	15.2911	.7906688	14.50043	-15.06596
1996	10.67398	.7187898	9.95519	-5.110771
1997	8.349624	.6534453	7.696179	2.585411
1998	11.89873	.5940411	11.30469	13.8901
1999	11.37653	.5400374	10.83649	24.72659
2000	10.68139	.4909431	10.19045	34.91703

Net Present Value = 34.91703 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	16.79077	1.157618	15.63315	-74.6612
1992	15.26434	1.05238	14.21196	-60.44924
1993	16.18945	.9567092	15.23274	-45.2165
1994	16.51985	.8697357	15.65011	-29.56639
1995	15.2911	.7906688	14.50043	-15.06596
1996	10.67398	.7187898	9.95519	-5.110771
1997	8.349624	.6534453	7.696179	2.585411
1998	11.89873	.5940411	11.30469	13.8901
1999	11.37653	.5400374	10.83649	24.72659
2000	10.68139	.4909431	10.19045	34.91703
2001	6.319436	.4463119	5.873124	40.79015
2002	5.885062	.4057381	5.479325	46.26948
2003	6.878644	.3688528	6.509792	52.77928
2004	6.253312	.3353207	5.917992	58.69726
2005	5.684829	.304837	5.379993	64.07725

Net Present Value = 64.07725 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	16.79077	1.157618	15.63315	-74.6612
1992	15.26434	1.05238	14.21196	-60.44924
1993	16.18945	.9567092	15.23274	-45.2165
1994	16.51985	.8697357	15.65011	-29.56639
1995	15.2911	.7906688	14.50043	-15.06596
1996	10.67398	.7187898	9.95519	-5.110771
1997	8.349624	.6534453	7.696179	2.585411
1998	11.89873	.5940411	11.30469	13.8901
1999	11.37653	.5400374	10.83649	24.72659
2000	10.68139	.4909431	10.19045	34.91703
2001	6.319436	.4463119	5.873124	40.79015
2002	5.885062	.4057381	5.479325	46.26948
2003	6.878644	.3688528	6.509792	52.77928
2004	6.253312	.3353207	5.917992	58.69726
2005	5.684829	.304837	5.379993	64.07725
2006	5.168027	.2771245	4.890902	68.96815
2007	4.698206	.2519314	4.446275	73.41442
2008	4.271096	.2290285	4.042068	77.45649
2009	3.882815	.2082078	3.674607	81.1311
2010	3.529832	.1892798	3.340552	84.47164

Net Present Value = 84.47164 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.29435
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .8
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	11.30264	1.048515	10.25413	-75.57339
1992	10.09164	.9361742	9.155469	-66.41793
1993	10.51213	.83587	9.676259	-56.74166
1994	10.53512	.7463124	9.788803	-46.95286
1995	9.577378	.6663504	8.911028	-38.04183
1996	6.566123	.5949557	5.971168	-32.07066
1997	5.044571	.5312105	4.513361	-27.55731
1998	7.060452	.474295	6.586157	-20.97115
1999	6.630043	.4234777	6.206565	-14.76458
2000	6.113769	.3781051	5.735664	-9.028916

Net Present Value = -9.028916 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	11.30264	1.048515	10.25413	-75.57339
1992	10.09164	.9361742	9.155469	-66.41793
1993	10.51213	.83587	9.676259	-56.74166
1994	10.53512	.7463124	9.788803	-46.95286
1995	9.577378	.6663504	8.911028	-38.04183
1996	6.566123	.5949557	5.971168	-32.07066
1997	5.044571	.5312105	4.513361	-27.55731
1998	7.060452	.474295	6.586157	-20.97115
1999	6.630043	.4234777	6.206565	-14.76458
2000	6.113769	.3781051	5.735664	-9.028916
2001	3.552502	.3375938	3.214908	-5.814011
2002	3.249239	.3014231	2.947816	-2.866196
2003	3.729994	.2691277	3.460867	.5946732
2004	3.330352	.2402926	3.090059	3.684731
2005	2.973529	.214547	2.758982	6.443711

Net Present Value = 6.443711 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	11.30264	1.048515	10.25413	-75.57339
1992	10.09164	.9361742	9.155469	-66.41793
1993	10.51213	.83587	9.676259	-56.74166
1994	10.53512	.7463124	9.788803	-46.95286
1995	9.577378	.6663504	8.911028	-38.04183
1996	6.566123	.5949557	5.971168	-32.07066
1997	5.044571	.5312105	4.513361	-27.55731
1998	7.060452	.474295	6.586157	-20.97115
1999	6.630043	.4234777	6.206565	-14.76458
2000	6.113769	.3781051	5.735664	-9.028916
2001	3.552502	.3375938	3.214908	-5.814011
2002	3.249239	.3014231	2.947816	-2.866196
2003	3.729994	.2691277	3.460867	.5946732
2004	3.330352	.2402926	3.090059	3.684731
2005	2.973529	.214547	2.758982	6.443711
2006	2.654936	.1915598	2.463376	8.907089
2007	2.370479	.1710355	2.199443	11.10653
2008	2.116499	.1527103	1.963789	13.07032
2009	1.889731	.1363485	1.753383	14.8237
2010	1.68726	.1217397	1.56552	16.38922

Net Present Value = 16.38922 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE.
1991	12.80966	1.044707	11.76495	-74.06256
1992	11.4372	.9327742	10.50442	-63.55814
1993	11.91375	.8328341	11.08091	-52.47723
1994	11.9398	.743602	11.1962	-41.28103
1995	10.85436	.6639303	10.19043	-31.0906
1996	7.441606	.5927949	6.848811	-24.24179
1997	5.717181	.5292811	5.187899	-19.05389
1998	8.001845	.4725725	7.529272	-11.52461
1999	7.514049	.4219397	7.092109	-4.432503
2000	6.928938	.3767319	6.552206	2.119705

Net Present Value = 2.119705 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	12.80966	1.044707	11.76495	-74.06256
1992	11.4372	.9327742	10.50442	-63.55814
1993	11.91375	.8328341	11.08091	-52.47723
1994	11.9398	.743602	11.1962	-41.28103
1995	10.85436	.6639303	10.19043	-31.0906
1996	7.441606	.5927949	6.848811	-24.24179
1997	5.717181	.5292811	5.187899	-19.05389
1998	8.001845	.4725725	7.529272	-11.52461
1999	7.514049	.4219397	7.092109	-4.432503
2000	6.928938	.3767319	6.552206	2.119705
2001	4.026169	.3363677	3.689801	5.80951
2002	3.682471	.3003283	3.382143	9.191651
2003	4.227327	.2681503	3.959176	13.15083
2004	3.774399	.2394199	3.534979	16.68581
2005	3.369999	.2137678	3.156231	19.84204

Net Present Value = 19.84204 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	12.80966	1.044707	11.76495	-74.06256
1992	11.4372	.9327742	10.50442	-63.55814
1993	11.91375	.8328341	11.08091	-52.47723
1994	11.9398	.743602	11.1962	-41.28103
1995	10.85436	.6639303	10.19043	-31.0906
1996	7.441606	.5927949	6.848811	-24.24179
1997	5.717181	.5292811	5.187899	-19.05389
1998	8.001845	.4725725	7.529272	-11.52461
1999	7.514049	.4219397	7.092109	-4.432503
2000	6.928938	.3767319	6.552206	2.119705
2001	4.026169	.3363677	3.689801	5.80951
2002	3.682471	.3003283	3.382143	9.191651
2003	4.227327	.2681503	3.959176	13.15083
2004	3.774399	.2394199	3.534979	16.68581
2005	3.369999	.2137678	3.156231	19.84204
2006	3.008928	.1908641	2.818064	22.6601
2007	2.686542	.1704144	2.516128	25.17623
2008	2.398699	.1521557	2.246543	27.42278
2009	2.141695	.1358533	2.005842	29.42862
2010	1.912228	.1212976	1.79093	31.21955

Net Present Value = 31.21955 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE

1991	15.07019	1.038995	14.03119	-71.79632
1992	13.45553	.9276739	12.52785	-59.26847
1993	14.01617	.8282803	13.18789	-46.08058
1994	14.04682	.739536	13.30728	-32.7733
1995	12.76984	.6603	12.10954	-20.66376
1996	8.754831	.5895536	8.165278	-12.49848
1997	6.726094	.5263871	6.199707	-6.298775
1998	9.413935	.4699885	8.943946	2.645172
1999	8.840056	.4196326	8.420424	11.0656
2000	8.151691	.3746719	7.77702	18.84262

Net Present Value = 18.84262 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	15.07019	1.038995	14.03119	-71.79632
1992	13.45553	.9276739	12.52785	-59.26847
1993	14.01617	.8282803	13.18789	-46.08058
1994	14.04682	.739536	13.30728	-32.7733
1995	12.76984	.6603	12.10954	-20.66376
1996	8.754831	.5895536	8.165278	-12.49848
1997	6.726094	.5263871	6.199707	-6.298775
1998	9.413935	.4699885	8.943946	2.645172
1999	8.840056	.4196326	8.420424	11.0656
2000	8.151691	.3746719	7.77702	18.84262
2001	4.736669	.3345285	4.402141	23.24476
2002	4.332319	.2986862	4.033632	27.27839
2003	4.973326	.2666841	4.706641	31.98503
2004	4.440469	.2381108	4.202358	36.18739
2005	3.964705	.2125989	3.752106	39.93949

Net Present Value = 39.93949 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.1. (contd)

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1991	15.07019	1.038995	14.03119	-71.79632
1992	13.45553	.9276739	12.52785	-59.26847
1993	14.01617	.8282803	13.18789	-46.08058
1994	14.04682	.739536	13.30728	-32.7733
1995	12.76984	.6603	12.10954	-20.66376
1996	8.754831	.5895536	8.165278	-12.49848
1997	6.726094	.5263871	6.199707	-6.298775
1998	9.413935	.4699885	8.943946	2.645172
1999	8.840056	.4196326	8.420424	11.0656
2000	8.151691	.3746719	7.77702	18.84262
2001	4.736669	.3345285	4.402141	23.24476
2002	4.332319	.2986862	4.033632	27.27839
2003	4.973326	.2666841	4.706641	31.98503
2004	4.440469	.2381108	4.202358	36.18739
2005	3.964705	.2125989	3.752106	39.93949
2006	3.539915	.1898205	3.350094	43.28958
2007	3.160638	.1694826	2.991156	46.28073
2008	2.821998	.1513237	2.670675	48.9514
2009	2.519642	.1351105	2.384531	51.33594
2010	2.24968	.1206344	2.129046	53.46498

Net Present Value = 53.46498 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 85.82751
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .8
Number of Years in Operation = 20

TABLE A.2. Year by Year Results of the Net Present Value Analysis:
Compressed Construction Schedule

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	15.71617	1.785241	13.93093	-96.60596
1991	18.68378	1.733243	16.95054	-79.65542
1992	18.13959	1.682761	16.45683	-63.19859
1993	20.54646	1.633748	18.91272	-44.28588
1994	22.39064	1.586163	20.80448	-23.4814
1995	22.13373	1.539964	20.59377	-2.887634
1996	16.50053	1.495111	15.00542	12.11778
1997	13.78459	1.451564	12.33303	24.45081
1998	20.97891	1.409285	19.56962	44.02044
1999	21.42138	1.368238	20.05315	64.07359

Net Present Value = 64.07359 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	15.71617	1.785241	13.93093	-96.60596
1991	18.68378	1.733243	16.95054	-79.65542
1992	18.13959	1.682761	16.45683	-63.19859
1993	20.54646	1.633748	18.91272	-44.28588
1994	22.39064	1.586163	20.80448	-23.4814
1995	22.13373	1.539964	20.59377	-2.887634
1996	16.50053	1.495111	15.00542	12.11778
1997	13.78459	1.451564	12.33303	24.45081
1998	20.97891	1.409285	19.56962	44.02044
1999	21.42138	1.368238	20.05315	64.07359
2000	21.47935	1.328387	20.15096	84.22454
2001	13.57148	1.289696	12.28178	96.50632
2002	13.49756	1.252132	12.24543	108.7518
2003	16.84855	1.215662	15.63289	124.3846
2004	16.35782	1.180254	15.17756	139.5622

Net Present Value = 139.5622 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	15.71617	1.785241	13.93093	-96.60596
1991	18.68378	1.733243	16.95054	-79.65542
1992	18.13959	1.682761	16.45683	-63.19859
1993	20.54646	1.633748	18.91272	-44.28588
1994	22.39064	1.586163	20.80448	-23.4814
1995	22.13373	1.539964	20.59377	-2.887634
1996	16.50053	1.495111	15.00542	12.11778
1997	13.78459	1.451564	12.33303	24.45081
1998	20.97891	1.409285	19.56962	44.02044
1999	21.42138	1.368238	20.05315	64.07359
2000	21.47935	1.328387	20.15096	84.22454
2001	13.57148	1.289696	12.28178	96.50632
2002	13.49756	1.252132	12.24543	108.7518
2003	16.84855	1.215662	15.63289	124.3846
2004	16.35782	1.180254	15.17756	139.5622
2005	15.88138	1.145878	14.7355	154.2977
2006	15.41881	1.112503	14.30631	168.604
2007	14.96972	1.0801	13.88962	182.4936
2008	14.53371	1.048641	13.48507	195.9787
2009	14.1104	1.018098	13.0923	209.071

Net Present Value = 209.071 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	17.81166	1.778757	16.03291	-94.50398
1991	21.17495	1.726948	19.448	-75.05599
1992	20.55821	1.676649	18.88156	-56.17443
1993	23.28599	1.627815	21.65818	-34.51624
1994	25.37606	1.580402	23.79566	-10.72059
1995	25.08489	1.534371	23.55052	12.82993
1996	18.7006	1.489681	17.21092	30.04086
1997	15.62254	1.446292	14.17624	44.2171
1998	23.7761	1.404167	22.37193	66.58903
1999	24.27757	1.363269	22.9143	89.50332

Net Present Value = 89.50332 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	17.81166	1.778757	16.03291	-94.50398
1991	21.17495	1.726948	19.448	-75.05599
1992	20.55821	1.676649	18.88156	-56.17443
1993	23.28599	1.627815	21.65818	-34.51624
1994	25.37606	1.580402	23.79566	-10.72059
1995	25.08489	1.534371	23.55052	12.82993
1996	18.7006	1.489681	17.21092	30.04086
1997	15.62254	1.446292	14.17624	44.2171
1998	23.7761	1.404167	22.37193	66.58903
1999	24.27757	1.363269	22.9143	89.50332
2000	24.34326	1.323562	23.01969	112.523
2001	15.38101	1.285012	14.096	126.619
2002	15.29724	1.247584	14.04965	140.6687
2003	19.09502	1.211247	17.88378	158.5524
2004	18.53886	1.175968	17.36289	175.9153

Net Present Value = 175.9153 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	17.81166	1.778757	16.03291	-94.50398
1991	21.17495	1.726948	19.448	-75.05599
1992	20.55821	1.676649	18.88156	-56.17443
1993	23.28599	1.627815	21.65818	-34.51624
1994	25.37606	1.580402	23.79566	-10.72059
1995	25.08489	1.534371	23.55052	12.82993
1996	18.7006	1.489681	17.21092	30.04086
1997	15.62254	1.446292	14.17624	44.2171
1998	23.7761	1.404167	22.37193	66.58903
1999	24.27757	1.363269	22.9143	89.50332
2000	24.34326	1.323562	23.01969	112.523
2001	15.38101	1.285012	14.096	126.619
2002	15.29724	1.247584	14.04965	140.6687
2003	19.09502	1.211247	17.88378	158.5524
2004	18.53886	1.175968	17.36289	175.9153
2005	17.99889	1.141716	16.85718	192.7725
2006	17.47465	1.108463	16.36619	209.1387
2007	16.96568	1.076177	15.8895	225.0282
2008	16.47154	1.044832	15.4267	240.4549
2009	15.99178	1.0144	14.97738	255.4323

Net Present Value = 255.4323 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	20.9549	1.769031	19.18587	-91.35102
1991	24.91171	1.717506	23.1942	-68.15683
1992	24.18612	1.667481	22.51864	-45.63818
1993	27.39529	1.618914	25.77637	-19.86181
1994	29.85418	1.571761	28.28242	8.420616
1995	29.51164	1.525982	27.98566	36.40627
1996	22.0007	1.481536	20.51917	56.92544
1997	18.37945	1.438384	16.94107	73.86651
1998	27.97188	1.396489	26.57539	100.4419
1999	28.56184	1.355815	27.20603	127.6479

Net Present Value = 127.6479 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	20.9549	1.769031	19.18587	-91.35102
1991	24.91171	1.717506	23.1942	-68.15683
1992	24.18612	1.667481	22.51864	-45.63818
1993	27.39529	1.618914	25.77637	-19.86181
1994	29.85418	1.571761	28.28242	8.420616
1995	29.51164	1.525982	27.98566	36.40627
1996	22.0007	1.481536	20.51917	56.92544
1997	18.37945	1.438384	16.94107	73.86651
1998	27.97188	1.396489	26.57539	100.4419
1999	28.56184	1.355815	27.20603	127.6479
2000	28.63913	1.316325	27.3228	154.9707
2001	18.0953	1.277986	16.81731	171.7881
2002	17.99675	1.240763	16.75599	188.544
2003	22.46473	1.204624	21.26011	209.8042
2004	21.81042	1.169538	20.64088	230.445

Net Present Value = 230.445 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	20.9549	1.769031	19.18587	-91.35102
1991	24.91171	1.717506	23.1942	-68.15683
1992	24.18612	1.667481	22.51864	-45.63818
1993	27.39529	1.618914	25.77637	-19.86181
1994	29.85418	1.571761	28.28242	8.420616
1995	29.51164	1.525982	27.98566	36.40627
1996	22.0007	1.481536	20.51917	56.92544
1997	18.37945	1.438384	16.94107	73.86651
1998	27.97188	1.396489	26.57539	100.4419
1999	28.56184	1.355815	27.20603	127.6479
2000	28.63913	1.316325	27.3228	154.9707
2001	18.0953	1.277986	16.81731	171.7881
2002	17.99675	1.240763	16.75599	188.544
2003	22.46473	1.204624	21.26011	209.8042
2004	21.81042	1.169538	20.64088	230.445
2005	21.17517	1.135474	20.03969	250.4847
2006	20.55842	1.102402	19.45601	269.9407
2007	19.95963	1.070293	18.88933	288.8301
2008	19.37828	1.039119	18.33916	307.1692
2009	18.81386	1.008854	17.80501	324.9742

Net Present Value = 324.9742 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 110.5369
Reference Year for Discounting is 1985
Discount Rate = 3 %
Capacity Factor = .8
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	12.39978	1.408523	10.99126	-87.35413
1991	14.05871	1.304188	12.75452	-74.59961
1992	13.01732	1.207582	11.80974	-62.78987
1993	14.06192	1.118131	12.94379	-49.84608
1994	14.61462	1.035306	13.57931	-36.26676
1995	13.77809	.958617	12.81948	-23.44729
1996	9.795932	.8876084	8.908324	-14.53896
1997	7.804684	.8218596	6.982825	-7.556137
1998	11.32812	.760981	10.56714	3.011002
1999	11.03153	.7046121	10.32692	13.33792

Net Present Value = 13.33792 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	12.39978	1.408523	10.99126	-87.35413
1991	14.05871	1.304188	12.75452	-74.59961
1992	13.01732	1.207582	11.80974	-62.78987
1993	14.06192	1.118131	12.94379	-49.84608
1994	14.61462	1.035306	13.57931	-36.26676
1995	13.77809	.958617	12.81948	-23.44729
1996	9.795932	.8876084	8.908324	-14.53896
1997	7.804684	.8218596	6.982825	-7.556137
1998	11.32812	.760981	10.56714	3.011002
1999	11.03153	.7046121	10.32692	13.33792
2000	10.54928	.6524185	9.896861	23.23478
2001	6.356856	.6040913	5.752764	28.98754
2002	6.029537	.5593437	5.470193	34.45774
2003	7.178021	.5179109	6.66011	41.11785
2004	6.646316	.4795471	6.166769	47.28462

Net Present Value = 47.28462 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	12.39978	1.408523	10.99126	-87.35413
1991	14.05871	1.304188	12.75452	-74.59961
1992	13.01732	1.207582	11.80974	-62.78987
1993	14.06192	1.118131	12.94379	-49.84608
1994	14.61462	1.035306	13.57931	-36.26676
1995	13.77809	.958617	12.81948	-23.44729
1996	9.795932	.8876084	8.908324	-14.53896
1997	7.804684	.8218596	6.982825	-7.556137
1998	11.32812	.760981	10.56714	3.011002
1999	11.03153	.7046121	10.32692	13.33792
2000	10.54928	.6524185	9.896861	23.23478
2001	6.356856	.6040913	5.752764	28.98754
2002	6.029537	.5593437	5.470193	34.45774
2003	7.178021	.5179109	6.66011	41.11785
2004	6.646316	.4795471	6.166769	47.28462
2005	6.153995	.444025	5.70997	52.99459
2006	5.698144	.4111343	5.28701	58.2816
2007	5.276059	.3806799	4.895379	63.17698
2008	4.88524	.3524814	4.532759	67.70974
2009	4.52337	.3263716	4.196998	71.90673

Net Present Value = 71.90673 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	14.05309	1.403408	12.64968	-85.69571
1991	15.9332	1.299452	14.63375	-71.06196
1992	14.75297	1.203196	13.54977	-57.51219
1993	15.93684	1.11407	14.82277	-42.68942
1994	16.56324	1.031546	15.53169	-27.15772
1995	15.61517	.9551354	14.66004	-12.49769
1996	11.10206	.8843847	10.21767	-2.280014
1997	8.845308	.8188747	8.026433	5.746422
1998	12.83853	.7582173	12.08032	17.82674
1999	12.5024	.702053	11.80035	29.62708

Net Present Value = 29.62708 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	14.05309	1.403408	12.64968	-85.69571
1991	15.9332	1.299452	14.63375	-71.06196
1992	14.75297	1.203196	13.54977	-57.51219
1993	15.93684	1.11407	14.82277	-42.68942
1994	16.56324	1.031546	15.53169	-27.15772
1995	15.61517	.9551354	14.66004	-12.49769
1996	11.10206	.8843847	10.21767	-2.280014
1997	8.845308	.8188747	8.026433	5.746422
1998	12.83853	.7582173	12.08032	17.82674
1999	12.5024	.702053	11.80035	29.62708
2000	11.95585	.650049	11.3058	40.93289
2001	7.204437	.6018973	6.60254	47.53543
2002	6.833475	.5573123	6.276163	53.81159
2003	8.13509	.5160299	7.61906	61.43066
2004	7.532491	.4778055	7.054685	68.48535

Net Present Value = 68.48535 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	14.05309	1.403408	12.64968	-85.69571
1991	15.9332	1.299452	14.63375	-71.06196
1992	14.75297	1.203196	13.54977	-57.51219
1993	15.93684	1.11407	14.82277	-42.68942
1994	16.56324	1.031546	15.53169	-27.15772
1995	15.61517	.9551354	14.66004	-12.49769
1996	11.10206	.8843847	10.21767	-2.280014
1997	8.845308	.8188747	8.026433	5.746422
1998	12.83853	.7582173	12.08032	17.82674
1999	12.5024	.702053	11.80035	29.62708
2000	11.95585	.650049	11.3058	40.93289
2001	7.204437	.6018973	6.60254	47.53543
2002	6.833475	.5573123	6.276163	53.81159
2003	8.13509	.5160299	7.61906	61.43066
2004	7.532491	.4778055	7.054685	68.48535
2005	6.974528	.4424124	6.532115	75.01746
2006	6.457896	.4096411	6.048255	81.06571
2007	5.979533	.3792973	5.600236	86.66595
2008	5.536605	.3512012	5.185404	91.85136
2009	5.126486	.3251863	4.801299	96.65266

Net Present Value = 96.65266 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	16.53304	1.395734	15.13731	-83.20808
1991	18.74495	1.292346	17.4526	-65.75548
1992	17.35643	1.196617	16.15981	-49.59567
1993	18.74923	1.107979	17.64125	-31.95442
1994	19.48616	1.025906	18.46025	-13.49416
1995	18.37079	.9499129	17.42088	3.92672
1996	13.06124	.879549	12.18169	16.10841
1997	10.40624	.8143972	9.591848	25.70027
1998	15.10416	.7540715	14.35009	40.05035
1999	14.70871	.6982143	14.0105	54.06085

Net Present Value = 54.06085 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	16.53304	1.395734	15.13731	-83.20808
1991	18.74495	1.292346	17.4526	-65.75548
1992	17.35643	1.196617	16.15981	-49.59567
1993	18.74923	1.107979	17.64125	-31.95442
1994	19.48616	1.025906	18.46025	-13.49416
1995	18.37079	.9499129	17.42088	3.92672
1996	13.06124	.879549	12.18169	16.10841
1997	10.40624	.8143972	9.591848	25.70027
1998	15.10416	.7540715	14.35009	40.05035
1999	14.70871	.6982143	14.0105	54.06085
2000	14.0657	.6464947	13.41921	67.48005
2001	8.475808	.5986062	7.877201	75.35725
2002	8.039383	.554265	7.485118	82.84237
2003	9.570694	.5132083	9.057486	91.89985
2004	8.861754	.4751929	8.386561	100.2864

Net Present Value = 100.2864 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
Reference Year for Discounting is 1985
Discount Rate = 8 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	16.53304	1.395734	15.13731	-83.20808
1991	18.74495	1.292346	17.4526	-65.75548
1992	17.35643	1.196617	16.15981	-49.59567
1993	18.74923	1.107979	17.64125	-31.95442
1994	19.48616	1.025906	18.46025	-13.49416
1995	18.37079	.9499129	17.42088	3.92672
1996	13.06124	.879549	12.18169	16.10841
1997	10.40624	.8143972	9.591848	25.70027
1998	15.10416	.7540715	14.35009	40.05035
1999	14.70871	.6982143	14.0105	54.06085
2000	14.0657	.6464947	13.41921	67.48005
2001	8.475808	.5986062	7.877201	75.35725
2002	8.039383	.554265	7.485118	82.84237
2003	9.570694	.5132083	9.057486	91.89985
2004	8.861754	.4751929	8.386561	100.2864
2005	8.205327	.4399934	7.765334	108.0518
2006	7.597525	.4074013	7.190124	115.2419
2007	7.034745	.3772234	6.657521	121.8994
2008	6.513653	.3492809	6.164372	128.0638
2009	6.03116	.3234082	5.707752	133.7715

Net Present Value = 133.7715 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 98.34539
 Reference Year for Discounting is 1985
 Discount Rate = 8 %
 Capacity Factor = .8
 Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	11.31278	1.285048	10.02774	-84.03751
1991	12.59308	1.168226	11.42485	-72.61266
1992	11.44825	1.062023	10.38623	-62.22644
1993	12.14209	.9654756	11.17661	-51.04982
1994	12.38989	.8777052	11.51218	-39.53764
1995	11.46832	.7979137	10.67041	-28.86723
1996	8.005485	.7253761	7.280109	-21.58713
1997	6.262219	.6594328	5.602786	-15.98435
1998	8.924046	.5994843	8.324561	-7.659783
1999	8.532394	.5449858	7.987409	.3276291

Net Present Value = .3276291 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	11.31278	1.285048	10.02774	-84.03751
1991	12.59308	1.168226	11.42485	-72.61266
1992	11.44825	1.062023	10.38623	-62.22644
1993	12.14209	.9654756	11.17661	-51.04982
1994	12.38989	.8777052	11.51218	-39.53764
1995	11.46832	.7979137	10.67041	-28.86723
1996	8.005485	.7253761	7.280109	-21.58713
1997	6.262219	.6594328	5.602786	-15.98435
1998	8.924046	.5994843	8.324561	-7.659783
1999	8.532394	.5449858	7.987409	.3276291
2000	8.011042	.4954416	7.5156	7.843231
2001	4.739577	.4504015	4.289175	12.13241
2002	4.413797	.4094559	4.004341	16.13675
2003	5.158983	.3722326	4.786751	20.9235
2004	4.689985	.3383933	4.351591	25.27509

Net Present Value = 25.27509 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	11.31278	1.285048	10.02774	-84.03751
1991	12.59308	1.168226	11.42485	-72.61266
1992	11.44825	1.062023	10.38623	-62.22644
1993	12.14209	.9654756	11.17661	-51.04982
1994	12.38989	.8777052	11.51218	-39.53764
1995	11.46832	.7979137	10.67041	-28.86723
1996	8.005485	.7253761	7.280109	-21.58713
1997	6.262219	.6594328	5.602786	-15.98435
1998	8.924046	.5994843	8.324561	-7.659783
1999	8.532394	.5449858	7.987409	.3276291
2000	8.011042	.4954416	7.5156	7.843231
2001	4.739577	.4504015	4.289175	12.13241
2002	4.413797	.4094559	4.004341	16.13675
2003	5.158983	.3722326	4.786751	20.9235
2004	4.689985	.3383933	4.351591	25.27509
2005	4.263623	.3076302	3.955992	29.23109
2006	3.87602	.2796638	3.596356	32.82745
2007	3.523655	.2542399	3.269415	36.09686
2008	3.203322	.2311271	2.972195	39.06906
2009	2.912111	.2101156	2.701995	41.77106

Net Present Value = 41.77106 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	12.82115	1.280381	11.54077	-82.52448
1991	14.27216	1.163983	13.10817	-69.41631
1992	12.97469	1.058166	11.91652	-57.49979
1993	13.76103	.9619692	12.79906	-44.70072
1994	14.04187	.8745174	13.16735	-31.53337
1995	12.99743	.7950158	12.20242	-19.33096
1996	9.072882	.7227417	8.350141	-10.98081
1997	7.097181	.6570378	6.440143	-4.540673
1998	10.11392	.5973071	9.51661	4.975937
1999	9.670048	.5430065	9.127041	14.10298

Net Present Value = 14.10298 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	12.82115	1.280381	11.54077	-82.52448
1991	14.27216	1.163983	13.10817	-69.41631
1992	12.97469	1.058166	11.91652	-57.49979
1993	13.76103	.9619692	12.79906	-44.70072
1994	14.04187	.8745174	13.16735	-31.53337
1995	12.99743	.7950158	12.20242	-19.33096
1996	9.072882	.7227417	8.350141	-10.98081
1997	7.097181	.6570378	6.440143	-4.540673
1998	10.11392	.5973071	9.51661	4.975937
1999	9.670048	.5430065	9.127041	14.10298
2000	9.07918	.4936423	8.585537	22.68852
2001	5.371521	.4487657	4.922755	27.61128
2002	5.002303	.4079688	4.594334	32.20561
2003	5.846847	.3708807	5.475967	37.68158
2004	5.315315	.3371643	4.978151	42.65973

Net Present Value = 42.65973 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	12.82115	1.280381	11.54077	-82.52448
1991	14.27216	1.163983	13.10817	-69.41631
1992	12.97469	1.058166	11.91652	-57.49979
1993	13.76103	.9619692	12.79906	-44.70072
1994	14.04187	.8745174	13.16735	-31.53337
1995	12.99743	.7950158	12.20242	-19.33096
1996	9.072882	.7227417	8.350141	-10.98081
1997	7.097181	.6570378	6.440143	-4.540673
1998	10.11392	.5973071	9.51661	4.975937
1999	9.670048	.5430065	9.127041	14.10298
2000	9.07918	.4936423	8.585537	22.68852
2001	5.371521	.4487657	4.922755	27.61128
2002	5.002303	.4079688	4.594334	32.20561
2003	5.846847	.3708807	5.475967	37.68158
2004	5.315315	.3371643	4.978151	42.65973
2005	4.832105	.306513	4.525592	47.18532
2006	4.392823	.2786482	4.114174	51.2995
2007	3.993475	.2533165	3.740159	55.03966
2008	3.630432	.2302877	3.400144	58.43981
2009	3.300393	.2093525	3.09104	61.53084

Net Present Value = 61.53084 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	15.08371	1.27338	13.81033	-80.25492
1991	16.79077	1.157618	15.63315	-64.62176
1992	15.26434	1.05238	14.21196	-50.40981
1993	16.18945	.9567092	15.23274	-35.17707
1994	16.51985	.8697357	15.65011	-19.52696
1995	15.2911	.7906688	14.50043	-5.026535
1996	10.67398	.7187898	9.95519	4.928658
1997	8.349624	.6534453	7.696179	12.62483
1998	11.89873	.5940411	11.30469	23.92952
1999	11.37653	.5400374	10.83649	34.76601

Net Present Value = 34.76601 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	15.08371	1.27338	13.81033	-80.25492
1991	16.79077	1.157618	15.63315	-64.62176
1992	15.26434	1.05238	14.21196	-50.40981
1993	16.18945	.9567092	15.23274	-35.17707
1994	16.51985	.8697357	15.65011	-19.52696
1995	15.2911	.7906688	14.50043	-5.026535
1996	10.67398	.7187898	9.95519	4.928658
1997	8.349624	.6534453	7.696179	12.62483
1998	11.89873	.5940411	11.30469	23.92952
1999	11.37653	.5400374	10.83649	34.76601
2000	10.68139	.4909431	10.19045	44.95645
2001	6.319436	.4463119	5.873124	50.82958
2002	5.885062	.4057381	5.479325	56.3089
2003	6.878644	.3688528	6.509792	62.8187
2004	6.253312	.3353207	5.917992	68.7367

Net Present Value = 68.7367 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	15.08371	1.27338	13.81033	-80.25492
1991	16.79077	1.157618	15.63315	-64.62176
1992	15.26434	1.05238	14.21196	-50.40981
1993	16.18945	.9567092	15.23274	-35.17707
1994	16.51985	.8697357	15.65011	-19.52696
1995	15.2911	.7906688	14.50043	-5.026535
1996	10.67398	.7187898	9.95519	4.928658
1997	8.349624	.6534453	7.696179	12.62483
1998	11.89873	.5940411	11.30469	23.92952
1999	11.37653	.5400374	10.83649	34.76601
2000	10.68139	.4909431	10.19045	44.95645
2001	6.319436	.4463119	5.873124	50.82958
2002	5.885062	.4057381	5.479325	56.3089
2003	6.878644	.3688528	6.509792	62.8187
2004	6.253312	.3353207	5.917992	68.7367
2005	5.684829	.304837	5.379993	74.11668
2006	5.168027	.2771245	4.890902	79.00758
2007	4.698206	.2519314	4.446275	83.45386
2008	4.271096	.2290285	4.042068	87.49592
2009	3.882815	.2082078	3.674607	91.17053

Net Present Value = 91.17053 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 94.06524
Reference Year for Discounting is 1985
Discount Rate = 10 %
Capacity Factor = .8
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	10.33815	1.174337	9.163812	-80.91572
1991	11.30264	1.048515	10.25413	-70.66159
1992	10.09164	.9361742	9.155469	-61.50613
1993	10.51213	.83587	9.676259	-51.82987
1994	10.53512	.7463124	9.788803	-42.04106
1995	9.577378	.6663504	8.911028	-33.13004
1996	6.566123	.5949557	5.971168	-27.15887
1997	5.044571	.5312105	4.513361	-22.64551
1998	7.060452	.474295	6.586157	-16.05935
1999	6.630043	.4234777	6.206565	-9.852783

Net Present Value = -9.852783 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .6
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	10.33815	1.174337	9.163812	-80.91572
1991	11.30264	1.048515	10.25413	-70.66159
1992	10.09164	.9361742	9.155469	-61.50613
1993	10.51213	.83587	9.676259	-51.82987
1994	10.53512	.7463124	9.788803	-42.04106
1995	9.577378	.6663504	8.911028	-33.13004
1996	6.566123	.5949557	5.971168	-27.15887
1997	5.044571	.5312105	4.513361	-22.64551
1998	7.060452	.474295	6.586157	-16.05935
1999	6.630043	.4234777	6.206565	-9.852783
2000	6.113769	.3781051	5.735664	-4.117119
2001	3.552502	.3375938	3.214908	-.9022141
2002	3.249239	.3014231	2.947816	2.045601
2003	3.729994	.2691277	3.460867	5.50647
2004	3.330352	.2402926	3.090059	8.596527

Net Present Value = 8.596527 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .6
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	10.33815	1.174337	9.163812	-80.91572
1991	11.30264	1.048515	10.25413	-70.66159
1992	10.09164	.9361742	9.155469	-61.50613
1993	10.51213	.83587	9.676259	-51.82987
1994	10.53512	.7463124	9.788803	-42.04106
1995	9.577378	.6663504	8.911028	-33.13004
1996	6.566123	.5949557	5.971168	-27.15887
1997	5.044571	.5312105	4.513361	-22.64551
1998	7.060452	.474295	6.586157	-16.05935
1999	6.630043	.4234777	6.206565	-9.852783
2000	6.113769	.3781051	5.735664	-4.117119
2001	3.552502	.3375938	3.214908	-.9022141
2002	3.249239	.3014231	2.947816	2.045601
2003	3.729994	.2691277	3.460867	5.50647
2004	3.330352	.2402926	3.090059	8.596527
2005	2.973529	.214547	2.758982	11.35551
2006	2.654936	.1915598	2.463376	13.81889
2007	2.370479	.1710355	2.199443	16.01833
2008	2.116499	.1527103	1.963789	17.98212
2009	1.889731	.1363485	1.753383	19.7355

Net Present Value = 19.7355 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .6
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	11.71657	1.170072	10.5465	-79.53304
1991	12.80966	1.044707	11.76495	-67.76808
1992	11.4372	.9327742	10.50442	-57.26366
1993	11.91375	.8328341	11.08091	-46.18275
1994	11.9398	.743602	11.1962	-34.98655
1995	10.85436	.6639303	10.19043	-24.79612
1996	7.441606	.5927949	6.848811	-17.94731
1997	5.717181	.5292811	5.187899	-12.75942
1998	8.001845	.4725725	7.529272	-5.230141
1999	7.514049	.4219397	7.092109	1.861969

Net Present Value = 1.861969 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .68
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS				
(millions of 1984 dollars)				
YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	11.71657	1.170072	10.5465	-79.53304
1991	12.80966	1.044707	11.76495	-67.76808
1992	11.4372	.9327742	10.50442	-57.26366
1993	11.91375	.8328341	11.08091	-46.18275
1994	11.9398	.743602	11.1962	-34.98655
1995	10.85436	.6639303	10.19043	-24.79612
1996	7.441606	.5927949	6.848811	-17.94731
1997	5.717181	.5292811	5.187899	-12.75942
1998	8.001845	.4725725	7.529272	-5.230141
1999	7.514049	.4219397	7.092109	1.861969
2000	6.928938	.3767319	6.552206	8.414177
2001	4.026169	.3363677	3.689801	12.10398
2002	3.682471	.3003283	3.382143	15.48612
2003	4.227327	.2681503	3.959176	19.4453
2004	3.774399	.2394199	3.534979	22.98028

Net Present Value = 22.98028 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .68
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	11.71657	1.170072	10.5465	-79.53304
1991	12.80966	1.044707	11.76495	-67.76808
1992	11.4372	.9327742	10.50442	-57.26366
1993	11.91375	.8328341	11.08091	-46.18275
1994	11.9398	.743602	11.1962	-34.98655
1995	10.85436	.6639303	10.19043	-24.79612
1996	7.441606	.5927949	6.848811	-17.94731
1997	5.717181	.5292811	5.187899	-12.75942
1998	8.001845	.4725725	7.529272	-5.230141
1999	7.514049	.4219397	7.092109	1.861969
2000	6.928938	.3767319	6.552206	8.414177
2001	4.026169	.3363677	3.689801	12.10398
2002	3.682471	.3003283	3.382143	15.48612
2003	4.227327	.2681503	3.959176	19.4453
2004	3.774399	.2394199	3.534979	22.98028
2005	3.369999	.2137678	3.156231	26.13651
2006	3.008928	.1908641	2.818064	28.95458
2007	2.686542	.1704144	2.516128	31.4707
2008	2.398699	.1521557	2.246543	33.71725
2009	2.141695	.1358533	2.005842	35.72309

Net Present Value = 35.72309 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .68
Number of Years in Operation = 20

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	13.7842	1.163674	12.62053	-77.45901
1991	15.07019	1.038995	14.03119	-63.42781
1992	13.45553	.9276739	12.52785	-50.89996
1993	14.01617	.8282803	13.18789	-37.71207
1994	14.04682	.739536	13.30728	-24.40479
1995	12.76984	.6603	12.10954	-12.29525
1996	8.754831	.5895536	8.165278	-4.129974
1997	6.726094	.5263871	6.199707	2.069733
1998	9.413935	.4699885	8.943946	11.01368
1999	8.840056	.4196326	8.420424	19.43411

Net Present Value = 19.43411 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .8
Number of Years in Operation = 10

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	13.7842	1.163674	12.62053	-77.45901
1991	15.07019	1.038995	14.03119	-63.42781
1992	13.45553	.9276739	12.52785	-50.89996
1993	14.01617	.8282803	13.18789	-37.71207
1994	14.04682	.739536	13.30728	-24.40479
1995	12.76984	.6603	12.10954	-12.29525
1996	8.754831	.5895536	8.165278	-4.129974
1997	6.726094	.5263871	6.199707	2.069733
1998	9.413935	.4699885	8.943946	11.01368
1999	8.840056	.4196326	8.420424	19.43411
2000	8.151691	.3746719	7.77702	27.21112
2001	4.736669	.3345285	4.402141	31.61326
2002	4.332319	.2986862	4.033632	35.64689
2003	4.973326	.2666841	4.706641	40.35353
2004	4.440469	.2381108	4.202358	44.5559

Net Present Value = 44.5559 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .8
Number of Years in Operation = 15

TABLE A.2. (contd)

NET PRESENT VALUE ANALYSIS

(millions of 1984 dollars)

YEAR	PRESENT VALUE OF BENEFITS	PRESENT VALUE OF O&M COSTS	NPV FOR GIVEN YEAR	CUMULATIVE NET PRESENT VALUE
1990	13.7842	1.163674	12.62053	-77.45901
1991	15.07019	1.038995	14.03119	-63.42781
1992	13.45553	.9276739	12.52785	-50.89996
1993	14.01617	.8282803	13.18789	-37.71207
1994	14.04682	.739536	13.30728	-24.40479
1995	12.76984	.6603	12.10954	-12.29525
1996	8.754831	.5895536	8.165278	-4.129974
1997	6.726094	.5263871	6.199707	2.069733
1998	9.413935	.4699885	8.943946	11.01368
1999	8.840056	.4196326	8.420424	19.43411
2000	8.151691	.3746719	7.77702	27.21112
2001	4.736669	.3345285	4.402141	31.61326
2002	4.332319	.2986862	4.033632	35.64689
2003	4.973326	.2666841	4.706641	40.35353
2004	4.440469	.2381108	4.202358	44.5559
2005	3.964705	.2125989	3.752106	48.308
2006	3.539915	.1898205	3.350094	51.6581
2007	3.160638	.1694826	2.991156	54.64925
2008	2.821998	.1513237	2.670675	57.31992
2009	2.519642	.1351105	2.384531	59.70446

Net Present Value = 59.70446 millions of 1984 dollars

Assumptions:

Present Value of Capital Costs = 90.07953
Reference Year for Discounting is 1985
Discount Rate = 12 %
Capacity Factor = .8
Number of Years in Operation = 20

APPENDIX A

YEAR BY YEAR RESULTS OF THE NET PRESENT VALUE ANALYSIS

APPENDIX B

COMPUTER PROGRAMS USED TO CALCULATE NET PRESENT VALUES

APPENDIX B

COMPUTER PROGRAMS USED TO CALCULATE NET PRESENT VALUES

The computer programs in Appendix B use similar procedures to calculate the net present value of the FFTF power addition by year. The user inputs values for discount rate, capacity factor and project life for both programs. The programs differ because the first uses the nominal schedule of capital costs, while the second uses the compressed schedule, to calculate project costs. In addition, the avoided cost of power shows up as a benefit one year earlier, in 1990 rather than in 1991, for the compressed construction schedule. Appendix A shows samples of the program outputs.

Computer Program Used to Calculate Net Present Values: Nominal Construction Schedule

```

10  REM Program to calculate present value of the FFTF Power Addition
20  CC1=26.59:CC2=21.665:CC3=19.965:CC4=24.385:CC5=23.995:CC6=2.945
30  REM CC1-CC6=capital cost in millions of 1984 dollars
40  PRINT "input discount rate":INPUT R
50  PRINT "input capacity factor":INPUT CF
60  PRINT "input number of years in operation":INPUT N
70  REM Print table heading
80  LPRINT TAB(8) " _____"
90  LPRINT ""
100 LPRINT ""
110 LPRINT TAB(30) "NET PRESENT VALUE ANALYSIS"
120 LPRINT ""
130 LPRINT TAB(30) "(millions of 1984 dollars)"
140 LPRINT ""
150 LPRINT TAB(20) " PRESENT" TAB(32) "PRESENT" TAB(44) "NPV FOR " TAB(57) "CUMULATIVE"
160 LPRINT TAB(20) "VALUE OF" TAB(32) "VALUE OF" TAB(44) " GIVEN" TAB(57) "NET PRESENT"
170 LPRINT TAB(8) " YEAR" TAB(20) "BENEFITS" TAB(32) "O&M COSTS" TAB(44) " YEAR" TAB(57) " VALUE "
180 LPRINT ""
190 LPRINT TAB(8) " _____"
200 LPRINT ""
210 REM calculate net present value of capital cost PVCC(t) for t=1,...,6, where
220 REM t(0), the reference year for discounting, is 1985
230 PVCC1=CC1*((1+R)^(-1)):REM present value of capital cost in 1986
240 PVCC2=CC2*((1+R)^(-2)):REM . . . . . 1987
250 PVCC3=CC3*((1+R)^(-3)):REM . . . . . 1988
260 PVCC4=CC4*((1+R)^(-4)):REM . . . . . 1989
270 PVCC5=CC5*((1+R)^(-5)):REM . . . . . 1990
280 PVCC6=CC6*((1+R)^(-6)):REM . . . . . 1991
290 REM calculate total net present value of capital cost for all 6 years (PVCC
300 PVCC=PVCC1+PVCC2+PVCC3+PVCC4+PVCC5+PVCC6

```

```

310 DIM P(N+6):REM dimension avoided cost p(t)
320 REM data are avoided costs in $1984.
330 DATA .042,.042,.049,.055,.056,.043,.037,.058,.061,.063,.041,.042
340 DATA .054,.054,.054,.054,.054,.054,.054,.054
350 FOR T=6 TO 5+N
360     READ P(T)
370     REM calculate periodic benefit in each period, where p=the avoided cost of new power in $/K in $1984;
380     REM cf=capacity factor; and 885.294 is a constant (101.061 KW plant load X 24 hrs. X 365 days / 1000)
390     B=(P(T))*CF*885.294
400     REM calculate present value of benefits in each period (pvbt)
410     PVBT=((B)*(1+R)^(-T))
420     REM calculate periodic variable costs in each period, where .0325*(1-cf)*2.891 is for power cost,
430     REM (2.891=330 KW X 24 hrs. X 365 days/1,000,000) and 2.032 is the combined
440     REM cost for labor, consumables and maintenance in millions of $1984.
450     C=((0.0325)*(1-CF)*2.891)+2.032
460     REM calculate present value of variable costs in each period (pvct)
470     PVCT=((C)*(1+R)^(-T))
480     NPVT=PVBT-PVCT: REM compute net present value for period t (npvt)
490     V=V+NPVT: REM cumulate npv in v
500     CUMPVC=CUMPVC+PVCT: REM cumulate present value of costs
510     CUMPVB=CUMPVB+PVBT:REM cumulate present value of benefits
520     YR=1985+T
530     REM Output project values for year 1985 + T
540     LPRINT TAB(8) YR TAB(18) PVBT TAB(30) PVCT TAB(43) NPVT TAB(57) V-PVCC
550 NEXT T
560 NPV=V-PVCC:REM compute net present value at end of project
570 REM Print Net Present Value at end of project
580 LPRINT ""
590 LPRINT TAB(8) "Net Present Value =";NPV "millions of 1984 dollars"
600 REM Print assumptions
610 LPRINT TAB(8) " "
620 LPRINT TAB(8) "Assumptions:"
630 LPRINT TAB(26) "Present Value of Capital Costs = ";PVCC
640 LPRINT TAB(26) "Reference Year for Discounting is 1985"
650 LPRINT TAB(26) "Discount Rate = ";R*100;"%"
660 LPRINT TAB(26) "Capacity Factor = ";CF
670 LPRINT TAB(26) "Number of Years in Operation = ";N
680 LPRINT TAB(8) " "
690 END

```

Computer Program Used to Calculate Net Present Values: Compressed Construction Schedule

```

10  REM  Program to calculate present value of the FFTF Power Addition
20  REM      with more rapid project construction
30  CC1=26.89:CC2=31.18:CC3=34.98:CC4=22.87:CC5=3.14
40  REM CC1-CC5=capital cost in millions of 1984 dollars
50  PRINT "input discount rate":INPUT R
60  PRINT "input capacity factor":INPUT CF
70  PRINT "input number of years in operation":INPUT N
80  REM Print table heading
90  LPRINT TAB(8) "-----"
100 LPRINT ""
110 LPRINT ""
120 LPRINT TAB(30) "NET PRESENT VALUE ANALYSIS"
130 LPRINT ""
140 LPRINT TAB(30) "(millions of 1984 dollars)"
150 LPRINT ""
160 LPRINT TAB(20) " PRESENT" TAB(32) "PRESENT" TAB(44) "NPV FOR " TAB(57) "CUMULATIVE"
170 LPRINT TAB(20) "VALUE OF" TAB(32) "VALUE OF" TAB(44) " GIVEN" TAB(57) "NET PRESENT"
180 LPRINT TAB(8) " YEAR" TAB(20) "BENEFITS" TAB(32) "O&M COSTS";
190 LPRINT TAB(44) " YEAR" TAB(57) " VALUE"
200 LPRINT ""
210 LPRINT TAB(8) "-----"
220 LPRINT ""
230 REM calculate net present value of capital cost PVCC(t) for t=1,...,5, where
240 REM t(0), the reference year for discounting, is 1985
250 PVCC1=CC1*((1+R)^(-1)):REM present value of capital cost in 1986
260 PVCC2=CC2*((1+R)^(-2)):REM      .      .      .      .      .      . 1987
270 PVCC3=CC3*((1+R)^(-3)):REM      .      .      .      .      .      . 1988
280 PVCC4=CC4*((1+R)^(-4)):REM      .      .      .      .      .      . 1989
290 PVCC5=CC5*((1+R)^(-5)):REM      .      .      .      .      .      . 1990
300 REM calculate total net present value of capital cost for all 5 years (PVCC
310 PVCC=PVCC1+PVCC2+PVCC3+PVCC4+PVCC5
320 DIM P(N+5):REM dimension avoided cost p(t)
330 REM data are avoided costs in $1984.
340 REM First data point now represents 1990 avoided cost
350 DATA .0343,.042,.042,.049,.055,.056,.043,.037,.058,.061,.063,.041,.042
360 DATA .054,.054,.054,.054,.054,.054,.054,.054

```



```

370 FOR T=5 TO 4+N
380   READ P(T)
390   REM calculate periodic benefit in each period
400   REM where p=the avoided cost of new power in $/K in $1984;
410   REM cf=capacity factor; and 885.294 is a constant:
420   REM 885.294 = 101.061 KW plant load X 24 hrs X 365 days /1000)
430   B=(P(T))*CF*885.294
440   REM calculate present value of benefits in each period (pvbt)
450   PVBT=((B)*(1+R)^(-T))
460   REM calculate periodic variable costs in each period,
470   REM where .0325*(1-cf) * 2.891 is for power cost,
480   REM (2.891=330 KW X 24 hrs. X 365 days/1,000,000) and 2.032 is the combined
490   REM cost for labor, consumables and maintenance in millions of $1984.
500   C=((.0325)*(1-CF)*2.891)+2.032
510   REM calculate present value of variable costs in each period (pvct)
520   PVCT=((C)*(1+R)^(-T))
530   NPVT=PVBT-PVCT: REM compute net present value for period t (npvt)
540   V=V+NPVT: REM cumulate npv in v
550   CUMPVC=CUMPVC+PVCT: REM cumulate present value of costs
560   CUMPBV=CUMPBV+PVBT: REM cumulate present value of benefits
570   YR=1985+T
580   REM Output project values for year 1985 + T
590   LPRINT TAB(8) YR TAB(18) PVBT TAB(30) PVCT TAB(43) NPVT TAB(57) V-PVCC
600 NEXT T
610 NPV=V-PVCC: REM compute net present value at end of project
620 REM Print Net Present Value at end of project
630 LPRINT ""
640 LPRINT TAB(8) "Net Present Value =";NPV "millions of 1984 dollars"
650 REM Print assumptions
660 LPRINT TAB(8) "-----"
670 LPRINT TAB(8) "Assumptions:"
680 LPRINT TAB(26) "Present Value of Capital Costs = ";PVCC
690 LPRINT TAB(26) "Reference Year for Discounting is 1985"
700 LPRINT TAB(26) "Discount Rate = ";R*100;"%"
710 LPRINT TAB(26) "Capacity Factor = ";CF
720 LPRINT TAB(26) "Number of Years in Operation = ";N
730 LPRINT TAB(8) "-----"
740 END

```

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