NUREG-0584
Rev. 2

Assuring the Availability of Funds for Decommissioning Nuclear Facilities

Draft Report

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

R. S. Wood

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Foreword to Revision 2

The earliest version of this draft report, NUREG-0584, was published in July 1979. This was revised, Revision 1, in December 1979. It has now been revised again in the light of information (referenced in the report itself) becoming available since that time.

This report will be utilized as background information in the formulation of recommendations by the NRC staff on policy in the use of financial assurance.

Persons wishing to comment on this revision of the draft report should mail their comments to:

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0.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) has undertaken a comprehensive reevaluation of its policy regarding the decommissioning of nuclear facilities. The NRC's primary objective in this reevaluation is to ensure that decommissioning is carried out so as to protect public health and safety. An important aspect of accomplishing this objective has been to reexamine the extent to which* the Commission's regulations and policies assure that adequate funds will be available to decommission a nuclear facility after its operating life has ended. The availability of adequate funds helps ensure that decommissioning can be accomplished in a safe and timely manner and that lack of funds does not result in delays in decommissioning that may cause potential public health and safety problems.

Currently, the NRC's policy on assuring funding for decommissioning reactors is codified in Sections 50.33(f) and 50.82 of 10 CFR Part 50. These regulations require applicants for reactor operating licenses to furnish the Commission with sufficient information to demonstrate that they can obtain the funds needed to meet both the costs of operating the plant as well as the estimated costs of permanently shutting down the facility and maintaining it in a safe condition. Until regulations on uranium mills and independent spent fuel storage facilities were recently proposed, Commission regulations had been generally silent on decommissioning non-reactor facilities and licensees, although decommissioning of these facilities is generally addressed in their licenses. Because the major part of the Commission's efforts are related to reactor licensing and because the public interest appears to be

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* Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities, NUREG-0436, Rev. 1, December 1978 and Supplement 1, August 1980.

concerned with large, expensive power reactors and the radiological impacts of decommissioning them, the major part of this paper will attempt to analyze funding for decommissioning of reactors. The second section will apply this analysis to non-reactor facilities and licensees.

1.0 FUNDING ASSURANCE FOR REACTOR DECOMMISSIONING

1.1 Problem Statement

Historically, the Commission has assumed in evaluating the financial qualifications of reactor licensees that if an applicant for a reactor operating license is financially qualified to construct or operate a nuclear facility, it is also qualified to shut it down. This was based on the assumption that compared to the cost to construct a nuclear power reactor -- currently in the range of $1 billion -- a cost* of decommissioning a nuclear facility of some $50 million would not be unmanageable. In fact, such a cost for decommissioning a plant has been compared to the fuel costs associated with reloading the reactor core every 18 months or even the preliminary planning and feasibility study costs in which a utility invests before it finally decides to complete the project. Further, it could be argued that regulated electric utilities are especially immune to negative economic conditions or unforeseen events because they provide an essential commodity and because, generally,

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* See further discussion of cost below.

they are allowed to recover the costs of providing this commodity from their customers.* Another analogy used in support of this policy is the deduction and amortization of casualties such as storm damage allowed by some state public utility commissions (PUCs).

The problem with the above comparisons is that decommissioning for most nuclear reactors will not take place for 30 to 40 years after start-up; if the delayed decommissioning alternative option is chosen, it may be over 100 years before a reactor is decommissioned. No matter what the current financial health of a utility is, financial solvency of any particular enterprise or even the structure of the electric utility industry cannot be projected with confidence so far in the future. If, for whatever reasons, an investor-owned electric utility ceases operation, it is probable, but not certain,

* For an elaboration of this point see the 1923 Supreme Court decision in "Bluefield Waterworks and Improvement Co. v. Public Service Commission" (262 U.S. 679), as quoted in, Clair Wilcox, Public Policies Toward Business, Fourth Edition; Richard D. Irwin Inc., 1971; p. 313:

> A public utility is entitled to such rates as will permit it to earn a return ... equal to that generally being made at the same time and in the same general part of the country on investments in other business undertakings which are attended by corresponding risks and uncertainties; but it has no constitutional rights to profits such as are realized or anticipated in highly profitable enterprises or speculative ventures. The return should be reasonably sufficient to assure confidence in the financial soundness of the utility and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise the money necessary for the proper discharge of its public duties. A rate of return may be reasonable at one time, and become too high or too low by changes affecting opportunties for investment, the money market, and business conditions generally.

that state PUCs or the Federal Energy Regulatory Commission (FERC) would require such a utility's successor to assume its commitments to decommission its plants. Presumably, public utilities that are federal, state, local or cooperative entities would have more power to set their own rates, but they,as well as PUCs, would not be immune to political pressure that could impede decommissioning. Unlike the costs of fuel reloading or planning, which produces a stream of current or future revenues for a utility, decommissioning is only an expense and does not produce any offsetting revenues or return on investment under most circumstances.

Although regulated, investor-owned utilities have historically maintained financial solvency, such solvency may be jeopardized in the case where a utility is forced because of accident or for other reasons to permanently shut down, decontaminate, and decommission its reactor prematurely. If one or more reactors owned by a utility is forced to be shut down and decommissioned, and such reactors contribute substantially to the utility's rate base, even a previously financially sound utility could encounter severe financial stress and, although unlikely, could be forced into bankruptcy and default on its decommissioning obligations. Certainly the accident at Three Mile Island (TMI) indicates that a utility can rapidly find itself in a precarious financial position with the resulting uncertainties that such a position raises. Prior to the TMI accident, General Public Utilities and its operating companies (the licensees) were generally thought to be financially sound. These uncertainties by themselves warrant the NRC's utmost concern for adequate funding assurance.

Decommissioning costs, although small in comparison to reactor construction cost, are not insignificant. Various estimates of cost for decommissioning large commercial nuclear reactors have been made. In 1975 the Atomic Industrial Forum (AIF) estimated this cost to be approximately $27 million in 1975 dollars. In 1978, Pacific Northwest Laboratory (PNL) performed a study for the NRC that estimated decommissioning cost at approximately $42 million in 1978 dollars. When the 25% contingency factor used by PNL is taken into account and when the present value costs of both studies are adjusted for the same year, the costs derived in both the PNL and AIF studies are almost equal. Other studies have indicated decommissioning costs of up to $100 million.* Further, most studies have estimated "technological" costs rather than the impact of interest rates, inflation, and Federal income taxes on decommissioning. Finally, if decontamination costs associated with accidents are considered, expenses could reach $600 million or more in current dollars.**

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* For a survey of decommissioning costs see, "Costs and Financing of Reactor Decommissioning: Some Considerations" by Vincent Schwent, California Energy Commission, September 1978.

** When discussing decommissioning cost, this paper does not include decontamination costs resulting from an accident or other unforeseen conditions. Decommissioning costs are defined to include only those costs that would be expended under normal operating conditions once decontamination under accident conditions had been completed. Nevertheless, such decontamination expenses could significantgly affect a utility's ability to finance decommissioning. For a discussion of the effects of post-accident cleanup on a specific utility's finances, see NUREG-0689, "Potential Impact of Licensee Default on the NRC and on Cleanup of TMI-2."

Although NRC expects most electric utilities to meet their decommissioning obligations, such decommissioning is not necessarily assured by the current financial health of reactor license applicants. In case of bankruptcy or default, the resulting financial uncertainty, even if ultimately resolved by FERC, a state PUC or some other regulatory body, could have a negative impact on the decommissioning process itself. For example, a contractor chosen to perform decommissioning work might be concerned about whether he would be paid fully or on time, particularly if he were one of several creditors of a utility going into receivership. This situation could delay or reduce the quality of such decommissioning work and thus negatively affect public health and safety. Because NRC is responsible for protecting public health and safety,it is in the process of examining various alternatives for assuring that funds for decommissioning reactor facilities will be available.

1.2 Criteria for Evaluating Alternative Financial Assurance Mechanisms

The NRC staff has developed five criteria by which it is evaluating the relative effectiveness of the alternative financial assurance mechanisms being considered. First and most important from the NRC staff's perspective is the actual degree of assurance provided by the alternative. (i.e., How high is the probability that the alternative will actually provide funds to pay for decommissioning?) Further, to what extent does the alternative provide assurance that funds collected and earmarked for decommissioning will actually be available for decommissioning? In other words, would a licensee or, in case of bankruptcy or default, a licensee's creditors have access to decommissioning funds prior to their expenditure for decommissioning. Such assurance cannot always be measured absolutely, but the alternatives can be ranked by the relative degree of assurance that they provide. This can then be compared to the alternatives' ranking by the other criteria to determine the overall cost-effectiveness of an alternative. Policy decisions can then be made based on the desired level of assurance and equity as compared to costs.

Second is the cost of providing the assurance. This cost includes not only the direct dollar costs of the alternative, but also its indirect administrative costs (including public cost through governmental expenditures). To facilitate comparisons among alternatives, current and projected future costs have been calculated in 1978 dollars.*

Third is the equity of the alternative. In other words, are the costs of decommissioning being paid by those customers who benefit from the facility? Are current or future customers, or society, paying a disproportionate share of decommissioning costs?

The fourth criterion is the degree to which the alternative is responsive to changes in inflation and interest rates, to changes in estimated or actual reactor life, to technological changes that decrease or increase ultimate decommissioning costs, and to other changes.

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* As used in this paper, costs of a good or service are given in 1978 dollars. To derive this value, an inflation rate is assumed, and future nominal dollar costs are discounted by the compounded value of that inflation rate.

Fifth is the ability of the alternative to handle effectively differing ownership and jurisdictional arrangements existing in the electric utility industry. Such arrangements can be a problem when, for example, a nuclear power plant is owned by several investor-owned utilities reporting to the PUCs of different states. Another aspect of this problem would be the situation of public utilities, which may not be regulated or which may report to regulatory bodies other than the state PUCs. Since the various state PUCs set the rates that investor-owned utilities may charge their customers by determining what may be allowed in the rate base, they are the bodies that have primary jurisdiction for such utilities over how decommissioning costs may be specifically collected. Finally, this criterion includes the specific problem of single-asset licensees, such as the Yankee companies in New England.

If one assumes that the economic viability of electric utilities cannot be projected many years in the future, then, as indicated above, the most important criterion is, of course, how effective is the alternative in providing assurance that funds for decommissioning will be available when needed. The cost and equity criteria are next in degree of importance. Criteria four and five are important in a negative sense. If an alternative does not meet these last criteria at some minimum or threshold level, then that alternative should be dismissed. However, once an alternative meets that threshold, then its relative ranking by the first three criteria should be controlling.

Finally, in addition to these criteria, financing alternatives will be analyzed in relation to the decommissioning alternative that can be used. Thus, the staff is examining whether any financing alternatives are particularly suited for, or ineffective in dealing with, immediate dismantlement (DECON) versus delayed dismantlement (SAFSTOR) versus entombment(ENTOMB).*

1.3. Alternatives for Assuring Funds Availability

The NRC staff has determined that there are six basic alternatives for assuring the availablity of funds for decommissioning nuclear power plants. Those alternatives may be classified into two basic groups. The first group covers those that involve plant-specific funding arrangements. The second group covers a pooled approach through surety, insurance, or joint financing. Each of these alternatives may be used exclusively -- except surety bonds -- and some may be used in combination with the others. Myriad variations of these alternatives abound. They are briefly described below before being more thoroughly discussed later in the paper. The alternative of doing nothing is not considered in this paper.

1.3.1. Plant-Specific Funding Alternatives

1.3.1.1. Prepayment of Decommissioning Costs. Cash or other liquid assets that will retain their value for the projected operating life of the

* For definitions of these decommissioning alternatives, see Appendix A.

plant may be set aside or deposited, prior to reactor start-up, in an account controlled by the licensee or some public body. Such funds could cover the total estimated cost of decommissioning at start-up or they could be invested such that the principal plus accumulated interest over the life of the plant together were sufficient to pay decommissioning costs. Allowances would have to be made for inflation over the projected life of the plant. As with some of the other alternatives discussed below, if subsequent decommissioning cost estimates vary from earlier projections, adjustments to the fund may have to be made.

1.3.1.2 External Sinking Fund. The funded reserve accumulated over the estimated life of the plant, or sinking fund, requires a prescribed amount of funds to be set aside annually in some manner such that the fund, plus any accumulated interest, would be sufficient to pay for costs at the estimated time of decommissioning. The fund could be invested in high-grade corporate securities, in state or municipal tax-free securities, in federal debt obligations, or other assets. The fund would be administered separately from the utility's assets. Finally, the fund could be built up by equal annual payments or by accelerated, inflation adjusted,or some other method of variable payments.

1.3.1.3. Internal Reserve Internal funding or reserve mechanisms take two basic forms. The unfunded (unsegregated) reserve is an accounting procedure generally using negative net salvage value depreciation, which allows estimated decommissioning costs to be accumulated over the life of the facility. When a company depreciates a capital asset, it normally estimates the cost (or replacement value) of the asset less any salvage value to arrive at net cost. In the case of a reactor or other nuclear facility, this salvage value is actually negative so that the net depreciation value of a nuclear facility equals its original capital cost plus its decommissioning cost. This net depreciable value is normally divided by the estimated operating life of the facility to arrive at the annual depreciation to be taken for the facility on the utility's books. The method of depreciation can be straight-line, where depreciation charges taken for a facility are the same each year. Accelerated depreciation can be used for income tax purposes as allowed by IRS regulations, where annual depreciation deductions are greater in the earlier years and less in the later years of a facility's life. Also decelerated depreciation (in nomimal dollars) can be geared to the rate of inflation so that constant dollar costs are the same from year to year.

Because the depreciation reserve accumulates on the company's books before it is needed for decommissioning, funds collected from customers through the rate base could be invested in the utility's assets. As the depreciation reserve accumulates, it is deducted from the rate base so that customers are not double charged.* If decommissioning begins as scheduled, the utility could have plant assets in the amount of the depreciation reserve that are not encumbered by securities. Bonds could then be issued against such plant assets and the funds raised used to pay for decommissioning.

The rate of return on such invested funds would be equal to the utility's combined rate of return on debt and equity. Presumably, but not necessarily, the after-tax rate of return would be higher than that which could be obtained from either taxable or tax-exempt higher-grade debt instruments issued by public or private entities. As with any investment, the rate of return would reflect both the utility's relative economic efficiency <u>and</u> investors' perceived risk of the investment they were making.

It should be kept in mind that the negative salvage approach is an accounting procedure. Any reserve accumulated through depreciation may not be segregated from the rest of a utility's operating funds. In this sense, it is unfunded. If it is segregated, the negative salvage approach is similar to the external sinking fund, although the fund would be held inside the company and invested in its own assets.

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* Alternatively, a separate internal decommissioning funded reserve could be established which would not be deducted from the rate base. Nevertheless, the rate of return would equal the utility's actual rate of return. For an excellent discussion of this variation, see two articles by John S. Ferguson: "A Case for Funding Nuclear Plant Decommissioning Cost" in <u>Power Engineering</u>, December, 1978, pp. 53-56; and "Capital Recovery Aspects of Power Reactor Decommissioning"; EEI Rate Research Committee, September 26, 1979.

1.3.2 Pooled Funding Alternatives

1.3.2.1. Surety Bonds* Bonds could be bought by licensees from surety companies. Basically, a surety bond guarantees that funds equal to the face value set for the bond will be paid in the event that the bond purchaser defaults. A surety bonding company, of course, will try to minimize its risk by carefully evaluating the financial health of the bond purchaser and only issuing a bond in cases where default is highly unlikely. The bond holders still must provide funding for decommissioning through some other method.

1.3.2.2 Decommissioning "Insurance." The nuclear or general insurance industry or some other public or private body could institute some form of pooled approach to decommissioning, where it could both administer a general fund for all decommissioning expenses and provide decommissioning insurance in case of premature reactor shut-down. Alternatively, only premature shut-down insurance could be provided. Either premiums or some type of users tax would be charged to cover decommissioning costs.

1.3.2.3. Funding from General Revenues. Funds for decommissioning can be paid out of general tax revenues, either at the state or federal level.

* Although this paper refers to surety bonding as an alternative for consideration, other surety mechanisms exist and should be assumed to be included in this analysis. For example, bank letters and lines of credit would operate similarly and would have similar costs as bonds.

1.4. Analysis of Alternatives

1.4.1. Comparative Analysis of the Plant-Specific Funding Alternatives

1.4.1.1. Assurance

As indicated earlier, assurance must be evaluated both in terms of whether sufficient funds will be available at the expected end of facility life and in terms of whether sufficient funds will be available in the event of premature shutdown of the facility.

As indicated in Section 1.3.1.1, prepayment of decommissioning costs would require the utility to deposit funds at the time of facility start-up such that these funds plus any accumulated interest would be sufficient to cover the costs of decommissioning. Such a deposit plus interest should also be sufficient to cover inflation and any other contingencies which may cause decommissioning costs to change.

Of all the plant-specific alternatives considered, a deposit at time of start-up provides the greatest assurance that funds will actually be available. This assumes, of course, that original estimates of decommissioning costs, including inflation and interest rates, were accurate. One variation of the deposit method is to set aside less than the full amount required for decommissioning in expectation that the interest earned will exceed inflation such that the correct amount will be available at the expected end of facility life. If the interest rate is over-estimated or the inflation rate under-estimated, a shortfall of funds could occur, particularly if the reactor were shut down prematurely. To prevent such a shortfall, funds covering total estimated decommissioning costs, taking into account inflation, could be deposited at reactor start-up. Any interest earned, which would presumably cause the amount on deposit to exceed, at any time, necessary decommissioning funds, could be returned to the utility as earnings or retained by the state. (However, as will be indicated in the section on taxes, returning earnings to the utility may endanger the tax-exempt status of the deposit fund. Additionally, such an approach tends to be a less efficient, and thus more expensive, use of a utility's or rate-payer's funds.)

Providing the next higher level of assurance is the external sinking fund option. Because such a fund is held outside the utility, it would not be vulnerable under most likely trust arrangements if the utility went bankrupt. On the other hand, in the event of premature shutdown, there would be a greater likelihood than with the prepayment method that insufficient funds had been accumulated. Such a situation would be mitigated if the fund was either structured so that higher payments were made earlier in a facility's life or coupled with a deposit or insurance. Another risk is that fund managers could make bad investments that would reduce the value of the fund. Diversification of investments, however, should ease this problem.

Providing the least amount of assurance is the internal unfunded reserve. Under normal circumstances, the unfunded reserve would be very similar to the external sinking fund in the pattern of funds set aside and should provide adequate funds if a facility is decommissioned at the end of its expected life. However, because it depends on financing internal to the licensee, the unfunded reserve is vulnerable to any event or situation th undermines the financial solvency of a utility. A bankrupt or seriously troubled utility would have difficulty in raising capital against its decommissioning reserve. Although a utility might have assets unencumbered by securities, such assets would probably not be liquid if a utility were forced to reorganize. Finally, in the event of financial distress of a utility, a segregated internal fund may not be available for decommissioning costs. Instead, funds earmarked for decommissioning may have to be paid instead to satisfy the claims of superior creditors.

1.4.1.2 Cost

Determining the cost of the various plant-specific funding alternatives is perhaps the most controversial aspect of this analysis. This is because there are so many variables influencing cost and so many variations in accounting for cost that effective comparisons are often difficult to make. Cost is sensitive to even relatively small variations in assumed inflation rates, interest and discount rates, expected facility life, federal tax policies, depreciation and amortization schedules, and other accounting procedures.

Several studies have been performed during the recent past which have contributed to understanding the complexities of the cost of funding alternatives.

The cost section of this paper relies primarily on five studies* but the interested reader is directed to additional studies listed in the attached bibliography. It should be emphasized that conclusions drawn from these studies on areas other than cost are those of this author and are not necessarily endorsed by the authors of these studies.

1.4.1.2.1. Federal Income Tax Considerations

As part of a cost analysis, the effects of the federal corporate income tax,** which are germane to the three plant-specific alternatives, should be discussed. Most investor-owned utilities are subject to a tax of 46% of their adjusted gross income. This is an important consideration in evaluating the cost aspects of the alternatives because of the way the U.S. Internal Revenue Service has indicated, at least informally to the NRC staff, it will

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* 1. Financing Strategies for Nuclear Power Plant Decommissioning (NUREG/CR-1481) prepared by Temple, Barker & Sloane, Inc. under subcontract with the New England Conference of Public Utilities Commissioners.

2. Financing and Accounting Alternatives for Decommissioning Nuclear Plants; September 28, 1978, and an updated version issued in September, 1979, by Preston A. Collins, Senior Consulting Engineer, Gilbert Associates, Inc.

3. Computer runs from DECOST Computer Routine For Decomissioning Cost and Funding Analysis (NUREG-0514) by Barry C. Mingst, US NRC.

4. "Financial Aspects of Power Reactor Decommissioning," by John S. Ferguson, Senior Vice President, Middle West Services Company, Dallas, Texas; September 19, 1979.

5. Cost Comparisons of Power Reactor Decommissioning Financing Alternatives by the Utility Decommissioning Group.

** State corporate income taxes, because of their diversity and lesser impact, are not treated in this paper, although state property taxes are discussed below.

treat decommissioning expenses. For most depreciation-type expenses, IRS allows a company to deduct from its gross income each year an amount reflecting the depreciation of a capital asset for that year. Two basic methods of depreciation are allowed by IRS. The first, or straight line remaining life method, assumes that an asset's value will decrease the same amount every year for each year of the asset's expected life. In the second method, the IRS allows, within certain limits, a company to accelerate depreciation deductions for an asset, such that annual depreciation deductions taken early in an asset's expected life are greater than those deductions taken towards the end of an asset's expected life.*

Under current IRS policy, deduction of decommissioning expense annually from a company's income is not allowed.** The IRS reasons that because decommissioning is a definite expense rather than a depreciable asset, it will only allow expenses for decommissioning to be deducted in the years in which such expenses are actually incurred. Although a utility will eventually be able to deduct decommissioning expenses from its income tax, it could lose the earlier use of cash assets that annual deductions for depreciation would afford.

It has been argued that, by not being able to deduct decommissioning expenses annually from its federal tax liability, a utility will have to collect

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* See a discussion of accounting for decommissioning expenses in "Accounting for Cost of Removal (Asset Depreciation Range System)" by Stuart G. McDaniel, <u>Public Utilities Fortnightly</u>, February 15, 1979, pp. 25-28.

** Note that publicly-owned utilities are exempt from federal income tax.

almost \$2 in revenues to provide for every \$1 in future decommissioning expense (assuming a 46% tax bracket). Such an argument is misleading because decommissioning expenses will eventually be deducted from adjusted gross income when they are actually expended to pay for decommissioning. If this eventual deduction is normalized (i.e., the tax benefit is spread out over the life of the facility) the effect is similar to being able to deduct decommissioning costs annually over the life of the facility. Nevertheless, depending on the type of accounting used, decommissioning financing costs could be increased somewhat and equity could be adversely affected if a utility did not have earlier use of, and earnings from, money collected from annual deductions.

In certain limited situations, the IRS has indicated that it would agree not to recognize the decommissioning expense as income in the year collected. Investor-owned utilities may be eligible for such non-recognition of income if they meet the following criteria. First, all funds collected from customers (or any other source) for decommissioning expense must be immediately segregated from the utility's assets. A utility may collect from its customers by its normal monthly billing procedures and deposit such funds in a blind trust immediately upon collection. In other words, the utility cannot have even short term use of these funds.* In fact, IRS suggested that, perhaps, a separate decommissioning account be established on a customer's bill.

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* If a utility merely collects decommissioning funds for another organization, no income is reflected on its books and there is consequently no tax liability. Non-recognition of income has the same practical effect as annual deductions for decommissioning expense, although IRS perceives a legal distinction between the two terms.

Second, the blind trust itself cannot be reinvested in a utility's assets. If it is desired that earnings from the trust fund themselves are tax-exempt, the fund should be invested in state or municipal tax-exempt securities. If the trust fund is state-controlled, the return on any investments made would be tax-exempt. Third, the fund must be administered by parties not normally involved with the operations of the utility. A fourth restriction indicated by IRS pertains to when a utility over-estimates decommissioning costs. If a state establishes a trust fund that meets the conditions described above, but provides that any excess funds after decommissioning expenses have been paid will be returned to the utility, such a provision would probably jeopardize the tax-exempt status of the fund.

Because utility rate-making is basically a state and FERC responsibility, NRC staff has not taken a specific position with respect to federal tax treatment of decommissioning expenses. NRC staff has met with IRS officials to describe to them the utilities' concerns on this matter and and the impact of IRS decisions on alternatives the NRC might consider. NRC is passing along to interested parties whatever information it has received from IRS. Utilities, in conjunction with guidance from state public utility commissions or other state bodies, that are interested in setting up a tax-exempt blind trust fund for decommissioning expenses prior to definitive NRC decommissioning rule making, may wish to request a "revenue ruling"* on a

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* A "revenue ruling" may be obtained by writing the specifics of a hypothetical or intended approach to: John Withers, Assistant Commissioner, Technical, Internal Revenue Service, 1111 Constitution Avenue, NW, Washington, DC 20224.

specific method of treatment of decommissioning expense. The IRS will indicate whether a proposed method meets its criteria for annual tax deductibility or non-recognition of income and, if such criteria are not met, will indicate why not. IRS will rule only on a case-by-case basis, and not generically. Recent contacts with IRS have indicated no change in their policies.

Because the remaining alternatives all have tax ramifications and because IRS tax policies can have significant cost and equity impacts as a result, the arguments and generalizations presented above should be kept in mind during the following analysis. Also, beyond the direct cost effects of taxes on funding for decommissioning are the indirect effects of how a utility chooses or is allowed to use various accounting procedures. For example, a utility may use straight-line depreciation in establishing its rate base before a PUC but may take advantage of accelerated depreciation allowed by the IRS. The difference in these accounting systems produces a difference in calculated tax owed by the company based on straight line depreciation and the actual tax owed based on accelerated depreciation. Some states allow this difference to be "flowed through" (i.e., passed on to the customer immediately) while in other jurisdictions the taxes can be "normalized" through a deferred taxes account which tends to smooth out the tax bill over the life of the facility. Each of these accounting procedures has significant impacts on the cost of the various funding alternatives to be discussed below.

1.4.1.2.2. General Cost Considerations

One would expect the prepayment method to be the most expensive of the three funding options being discussed in this section, because, if a utility is required to deposit funds in advance, these funds are removed earlier from its use than with other funding options. Over the long run, a utility can normally earn more from its own capital structure (e.g.,sometimes as high as a 12-15% return) than by investing in higher grade commercial securities outside the company (currently 9-13%). However, a deposit should not be invested in a utility's own assets for one of the very reason that the deposit account was established in the first place - i.e., to minimize the risk that decommissioning funds would not be available. Investment in stocks of outside corporations, unless widely diversified, should also not be allowed for the deposit method due to their increased risk or instability. Therefore, this paper considers only high-grade debt instruments such as high grade corporate or government bonds.

Similarly, an external sinking fund would tend to be more expensive than negative salvage value depreciation because it, like the deposit method, would probably not be earning as high a rate of return as would an internal fund. Likewise, it should tend to be cheaper than the deposit method because, unlike the deposit method, a licensee could generate funds from annual operating expenses rather than have to generate capital requiring payment of a return.

Those decommissioning funding alternatives that allow greater use by the utility of its own capital structure should tend to be cheaper than those using external funding. For example, New York State's approach*, which basically follows the negative salvage value depreciation method and allows depreciation reserves to be invested in the utility's own assets, should allow a greater return and should thus cost less overall. This, in fact, is the basis upon which New York justified its approach. Additionally a utility can take advantage, through its deferred taxes account if it normalizes tax expense, of the additional cash flow generated by the negative salvage approach.

Although the above general ranking of the cost of the three funding alternatives holds empirically under many assumptions, both absolute and relative cost can vary significantly. As indicated above, the primary reason that costs vary among the three funding options is the variation in the after-tax return obtained by each. Other important variables affecting the absolute or relative cost ranking of the three alternatives are: (1) tax deductibility -- not only of the return on a fund, but also of the amortization used to establish the fund; (2) the schedule of the amortization -- that is, whether it is accelerated, decelerated, or straight line; (3) whether taxes for the fund and its return are normalized or flowed through; (4) whether the ultimate tax deduction received for decommissioning expense is passed on to the consumer or credited to the decommissioning reserve; and (5) whether

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* Letter from Charles A. Zielinski, Chairman, New York State Public Service Commission to Robert G. Ryan, Director, Office of State Programs. U. S. NRC; dated January 9, 1978.

the utility, and thus its customers, or the fund, pays the taxes.* The theoretical combinations of these variables are represented in Figure I, although it should be recognized that some of these combinations are not currently allowed (e.g., decelerated amortizations and non-taxable negative salvage value amortizations). Variables that affect the absolute but not normally the relative cost of the three funding options include the rate of inflation, the federal corporate income tax rate, plant life, and technological cost.

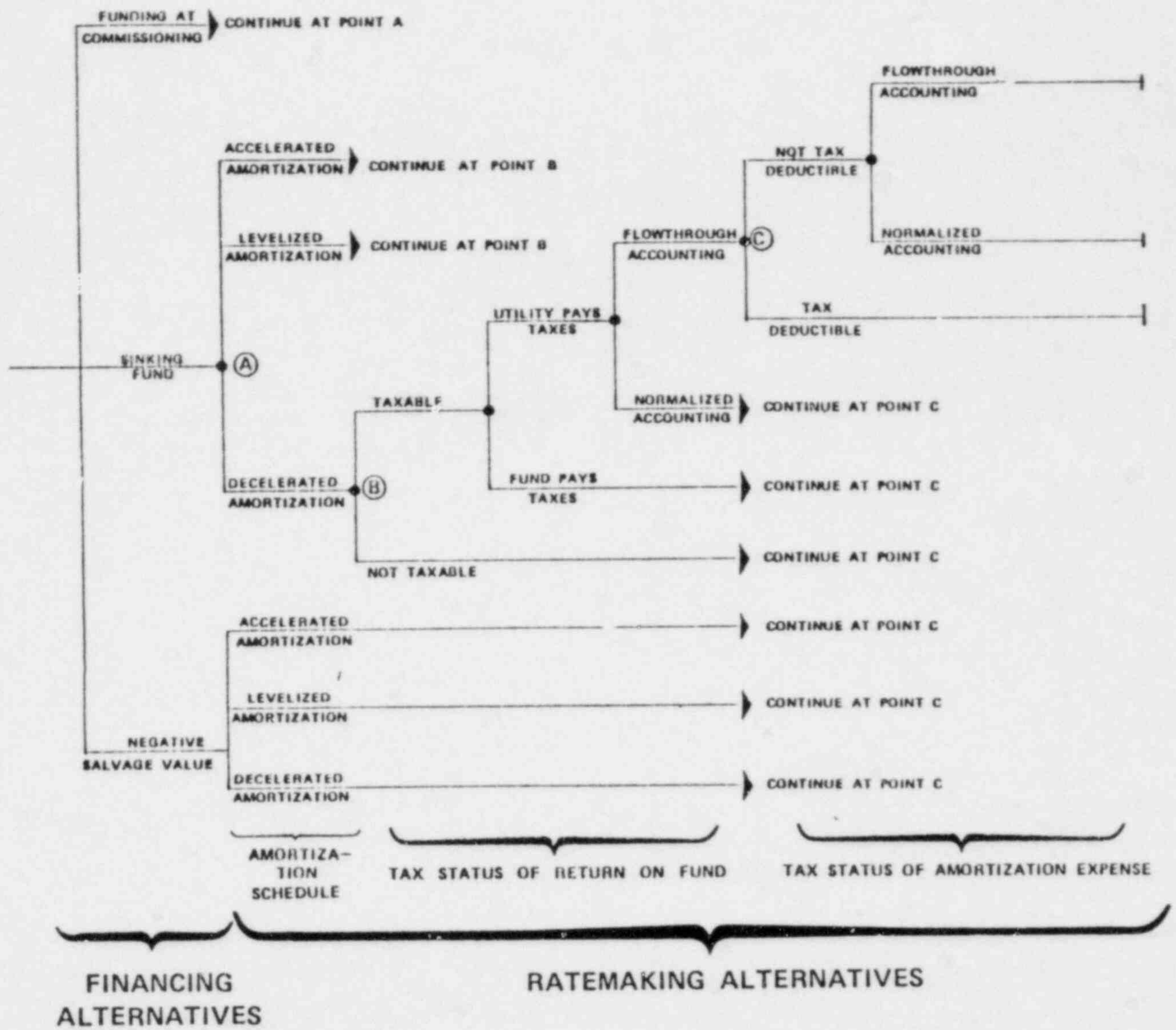
With so many variables affecting cost it is not surprising that studies making different assumptions have reached different conclusions regarding the cost of the three plant specific funding alternatives. The Temple, Barker & Sloane (TBS) study analyzes in detail the relationships of the variables relevant to decommissioning financing. The study also applies such analyses to impact of decommissioning financing options on the rates of two New England utilities, Northeast Utilities and the Maine Yankee Atomic Power Company.

In its study, TBS assumed the following: $50 million reactor decommissioning cost (in 1979 dollars), regardless of decommissioning alternative; 7.4 percent inflation for decommissioning cost; 5 percent after-tax return on

* This last variable makes a somewhat artificial distinction. Under most circumstances the customers would be paying taxes in either case. Under the fund-itself-paying-taxes option, the fund is capitalized at a higher level so that it can generate sufficient earnings to pay taxes by itself and still have enough remaining to pay for decommissioning. Under the customer-pays-the-taxes option, the fund is capitalized at a lower level with annual revenues collected directly from the customer to pay for taxes. However, the customer would also be paying a significantly lower capital amortization under this latter option.

Figure 1

DECOMMISSIONING FINANCING ALTERNATIVES



(From NUREG/CR-1481, <u>Financing Strategies for Nuclear Power Plant Decommissioning</u>, p. II-5) the decommissioning fund; reactor life of 30 years; straight-line normalization of the decommissioning expense tax deduction; and 9.4 percent discount rate.*

With these assumptions, the TBS study found that the net present value of revenue requirements (i.e., discounted at 9.4 percent) for the three options to be as follows:

Funding at commissioning	- $283 million
External sinking fund	- $186 million
Internal (unfunded) reserve	- $ 91 million

Despite these differences in cost, the increases in customers' bills due to nuclear decommissioning would not be large under any of the options, ranging between 0.2 and 0.7 percent depending on the option chosen.

* With respect to the longer-term relationship between the interest rate and inflation rate, studies have found that the real interest rate, i.e., the annual yield on investments over and above inflation, has averaged from approximately 1.5% to 2.0%. As indicated in NUREG/CR-0570, "For the period 1961 to 1976, the average real return relative to the gross national product deflator on 3- to 5-year U.S. Government securities was 1.43%. For the period 1963 to 1976, the average real return on AAA corporate bonds was 1.95%. The average expected real return on 9-to 12-month Treasury issues, relative to expected inflation rates for the period 1953 to 1975, was about 2.2%. Two percent thus appears to be a reasonable assumption for real rate of return." (See NUREG/CR-0570, Technology, Safety and Costs of Decommissioning a Reference Low-Level Waste Burial Ground, Vol. 2, E.S. Murphy and G.M. Holter, Pacific Northwest Laboratory, March 1979.) An internal NRC study justifies a 3% real rate of return (See NUREG-0607, "Treatment of Inflation in the Development of Discount Rates and Levelized Cost in NEPA Analyses for the Electric Utility Industry"; J.O. Roberts, et al., January 1980). Of course, the real rate of return discussed here is before income taxes.

Using the base case discussed above, TBS then performed sensitivity analyses by holding all variables constant except the one being analyzed. Analyses were performed on: discount rates; rates of return on the fund; inflation rates; and cost of capital. Figures 2 through 4 and Table 1 present the results of these analyses. To summarize these results:

1. As the discount rate increases, the range of costs of the three plant-specific options narrows;

2. As the rate of return that a utility can earn on external investments increases, the costs of the three options converge;

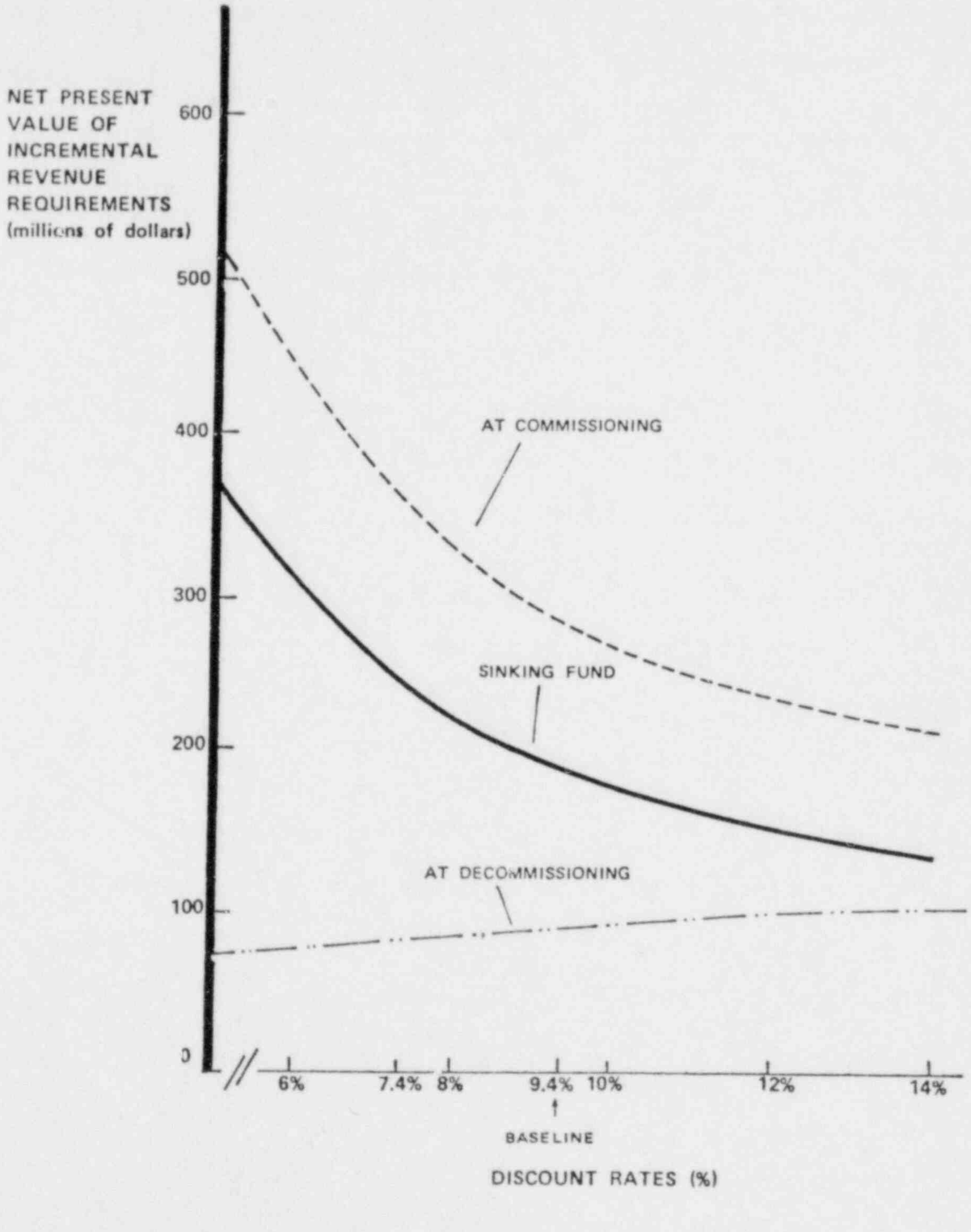
3. The costs, although not the ranking, of the three options increase as the inflation rate increases. This effect is mitigated if interest and discount rates increase proportionately;

4. As the utility's cost of capital increases, the cost for funding at commissioning increases, and for the unfunded reserve decreases. If the discount rate is proportionately adjusted, such differences are small.

Another study, by Barry Mingst of the NRC, indicated that the negative-salvage-value method is more expensive than the deposit method, which in turn is more expensive than the sinking fund method. This relationship holds true under a variety of parametric assumptions with respect to interest rates, inflation rates, method of decommissioning chosen, etc. However, although

Figure 2

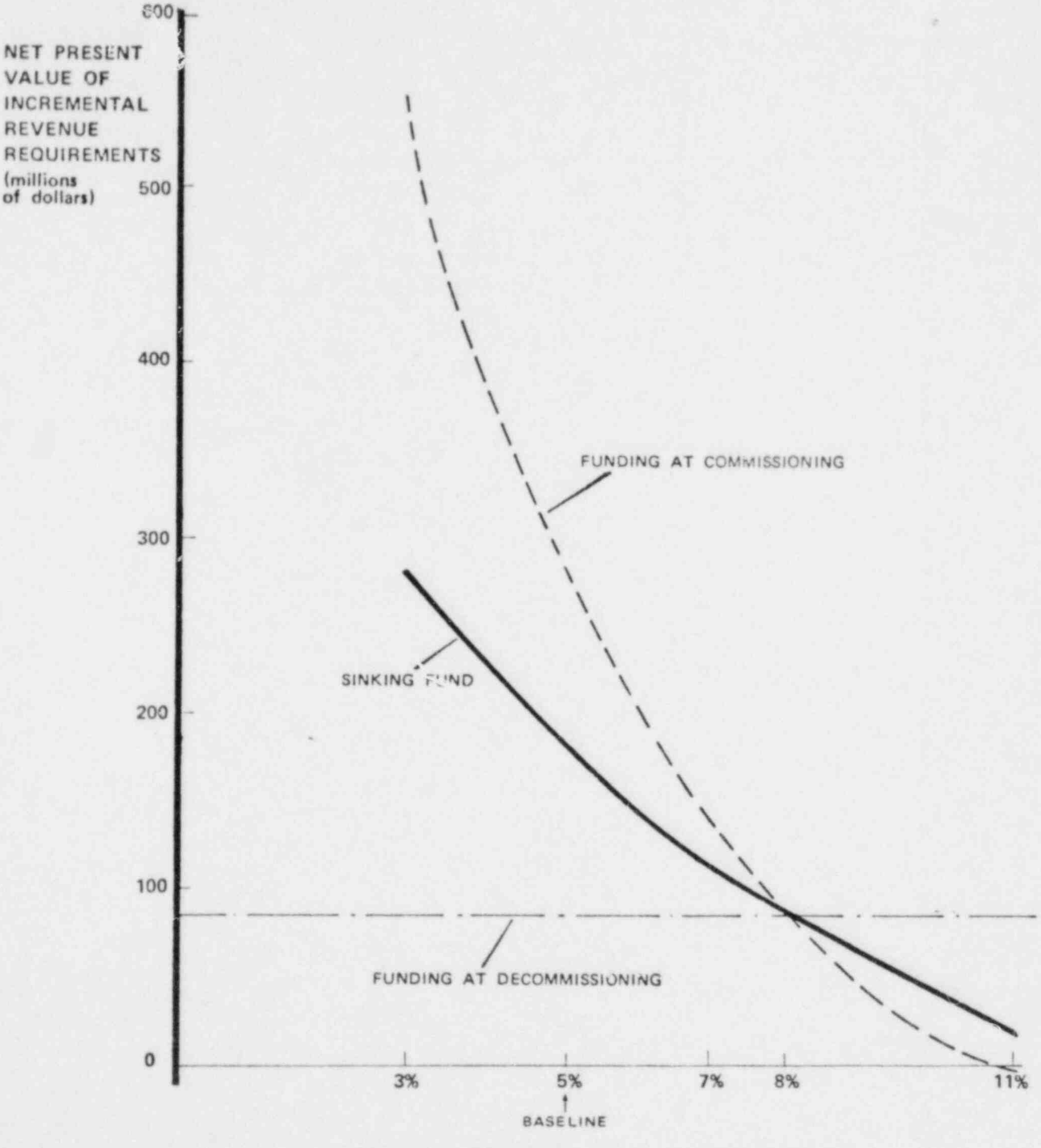
SENSITIVITY ANALYSIS ON DISCOUNT RATES



(from TBS, p. IV-3)

Figure 3

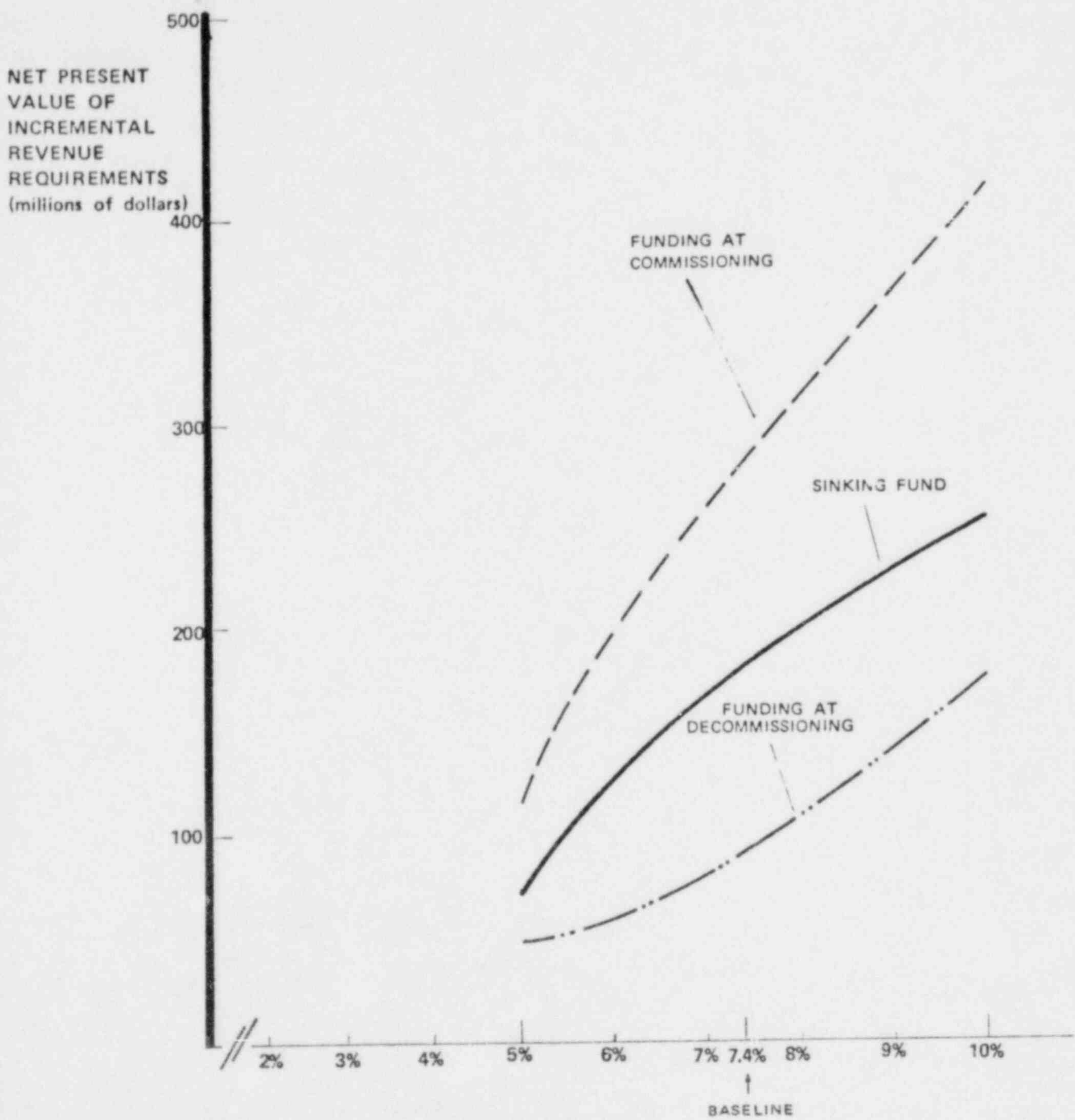
SENSITIVITY ANALYSIS ON RATES OF RETURN ON THE DECOMMISSIONING FUND



(from TBS, p. IV-5)

Figure 4

SENSITIVITY ANALYSIS ON INFLATION RATES



(from TBS, p. IV-6)

Table 1

SENSITIVITY ANALYSIS ON THE COST OF

CAPITAL TO THE UTILITY

	Net Present Value of Incremental Revenue Streams (millions of dollars)			
	Baseline	High Interest* (discounted at 9.4%)	High Interest* (discounted at 12%)	High Interest** and Inflation
Funding at Commissioning	283	388	294	295
Sinking Fund	186	240	165	202
Funding at Decommissioning	91	68	76	154

* This scenario assumes a 2 percent rise in the cost of all forms of capital.

** This scenario assumes a 7 percent return on the decommissioning fund, 10 percent inflation, and a 2 percent increase in the cost of common, preferred, and debt financing. A discount rate of 12 percent was used. (From TBS, pp. IV-7 and-8).

the Mingst study provides a broad-based method for analyzing the sensitivity of most important variables affecting the costs of the various decommissioning funding alternatives, it has made simplifying assumptions regarding accounting for federal income taxes and has not allowed for a return to the negative salvage value depreciation accounts. The assumption of no return on negative salvage depreciation accounts is not generally valid. For these reasons, the costs associated with Mingst's projections are artificially high and the relative ranking distorted.

A study by Preston Collins examines in some detail how various assumptions about federal taxes and accounting for them can affect the ultimate cost of decommissioning funding alternatives. His study has assumed the following: the plant will be immediately decommissioned in 35 years; the annual rate of return on capital is 10%; the average annual interest and inflation rates are each 8%; and the federal corporate income tax rate is 46%.*

In the first version of his study, Collins analyzed the three plant-specific funding options using three variables. The first is whether the federal income tax on the earnings of the fund is either paid by the fund itself

* These assumptions vary somewhat from Collins' earlier study cited in the draft version of NUREG-0584. Rather than assume a cost to decommission of $24 million, Collins calculates financial costs as a percentage of technical cost in the final version of his report. Thus, whichever technical decomissioning cost estimates are used can be multiplied by Collins figures to estimate combined technical and financial decommissioning costs. Collins has also increased estimated life to 35 years from 32 and has reflected recent federal corporate income tax changes by reducing the tax rate to 46% from 48%.

directly or by the consumers through the rate structure. If paid indirectly by the consumers through the fund itself, the fund would have to be capitalized at a higher level than if paid directly by consumers. Another variable is whether the federal income tax on the annual amortization of the fund is "normalized" or "flowed through." Finally, the study examines whether the fund should be established to include total dollar costs prior to or after the expense for decommissioning is deducted from income tax. In the second version of his study, Collins no longer considers how the fund would be structured to pay for income taxes and has assumed in all cases where taxes are included that the eventual tax deduction should be accounted for at inception when establishing and capitalizing the fund or reserve.

The range of constant dollar costs derived in Collins studies is enumerated below in Table 2* on a per-unit-of-cost basis. The columns on the right give the results of Collin's earlier draft, although it should be remembered that the assumed tax rate and expected facility life vary from the final version. Also in his revised study, Collins has added the option of increasing the depreciation deduction of the negative salvage approach by 8% per year to keep pace with the assumed rate of inflation.

* From Collins 2, p. 5.

TABLE 2
COLLINS' STUDY
COST RESULTS

Case	Financing Method	Taxes: Rate	Taxes: Accounting	Total Revenue	Present Worth	Collins' Earlier Study: Case	Collins' Earlier Study: Present Worth
1	Funding at Commissioning	0		2.800	1.167	#1	1.16
2.	Funding the Reserve	0		5.317	1.000	#7	1.0
3.	Funding at Decommissioning	0		6.220	.776	#13	.67
4.	Funding at Decomm., 8% Comp.	0		2.950	.685	--	--
5.	Funding at Commissioning	46%	Flow-through	9.141	2.359	#6	1.28
6.	Funding at Commissioning	46%	Normalized	17.479	3.927	#5	1.37
7.	Funding the Reserve	46%	Flow-through	9.673	1.579	#12	1.16
8.	Funding the Reserve	46%	Normalized	15.399	2.341	#11	1.22
9.	Funding at Decommissioning	46%	Flow-through	6.220	.776	#16	.93
10.	Funding at Decommissioning	46%	Normalized	6.220	.776	#15	1.71
11.	Funding at Decomm., 8% Comp.	46%	Flow-through	2.950	.685	--	--
12.	Funding at Decomm., 8% Comp.	46%	Normalized	2.950	.685	--	--

A comparison of both versions of Collins' study indicates wide variations in the results for certain cases. There are many reasons for this. First, Collins changed certain assumptions about several variables from one study to the next. Second, some arithmetic errors occurring in the first version were corrected in the second. Additionally, he varies the amortization schedule from alternative to alternative so that it is difficult to compare alternatives. For both the deposit and sinking fund methods, the amortizations tend to be greater in earlier years whereas for negative salvage value depreciation, the amortizations tend to be greater in the later years. In an inflationary economy, such an amortization pattern would tend to make negative salvage depreciation cheaper relative to the funded methods than it would be if the amortization schedules were consistent.

Finally, the Utility Decommissioning Group under the auspices of the law firm, Debevoise & Liberman, sponsored five case studies by utility members of that group. The utilities preparing the studies were: Arkansas Power & Light Company; Carolina Power & Light Company; Duke Power Company; Northeast Utilities; and Southern California Edison Company. Although each case study made somewhat different assumptions and obtained somewhat different results, the general range of costs for the three plant-specific funding options was similar. In general, funding at commissioning was found to be three times as expensive, and the external sinking fund twice as expensive, as the internal unfunded reserve. However,no significant sensitivity analyses were performed as part of these studies.

A final point to be made on cost with respect to the deposit method is that, if a deposit was required of all utilities at the same time, a significant impact on the capital market could occur. Approximately \$3.5 billion would be required for reactors currently operating (i.e., \$50 million/reactor X 70 reactors). This amount could vary significantly depending on whether utilities had to pay more or less for capital than a deposit fund could earn. It would also vary according to the degree to which fund earnings exceeded or fell short of the inflation rate. Coupled with the fact that capital raised for decommissioning would not contribute to increasing revenue, a deposit fund might increase the cost of capital to utilities. However, if placed in the perspective of a percentage of the total capital requirements of electric utilities, funding at commissioning should not prove unmanageable. (Currently, the electric utility industry's capital expenditures are approximately \$35 to \$40 billion per year.)

Several important conclusions can be drawn about the costs of the plant-specific funding alternatives. The most important variable affecting the absolute and relative cost of the three funding options is the real, after-tax rate of return that the fund or reserve is able to earn. Other variables (e.g., inflation rate, facility life, etc.) affect cost less significantly but nevertheless are important. Federal income tax policies and the methods of accounting chosen to conform with those policies also contribute to the overall ambiguity of the cost of the plant-specific funding options. Each of the options has a fairly wide cost range depending on the tax accounting and amortization schedule assumptions used. Although the deposit method is generally the most expensive, the sinking fund less expensive and negative salvage depreciation the least expensive, this generalization may not be true under all assumptions. When a deposit fund is administered by a state government body, both the initial deposit and the annual return would be tax deductible. Thus the gap between the negative salvage method and the deposit method should narrow or even disappear. This relationship is also true for public utilities, which are not subject to federal income tax. This latter conclusion plus the existence of varying accounting procedures used by and allowed of utilities in different states implies that the most expensive option in one state may be relatively cheaper than another option in another state. Consequently, it will be the responsibility of the utilities together with their state public utility commissions to determine the optimal accounting for and structure of a particular option since no one option is clearly less costly in all reasonable circumstances. Finally, despite the difference in cost among the three plant-specific funding alternatives found by most of the studies under many assumed conditions, the overall impact on increased revenue requirements -- i.e., the ratepayer's bill -- of the most expensive option is estimated to be less than 1%.

1.4.1.3 Equity

As discussed earlier, the ideal situation from the point of view of equity is for consumers of a particular service to pay for all costs associated with that service. In the case of decommissioning, absolute equity would require customers to pay the same amount annually in constant dollars over the life of the facility. In practice, an absolutely equitable payment stream is difficult to achieve. As the Collins and New England studies indicate, the capitalization of the fund and the financial and accounting methods used to recover that capital significantly affect the equity of the alternative. Equally important is the vulnerability to change of the decommissioning cost estimates themselves. As costs change, the annual payments embodied in any funding alternative will have to be changed commensurately. If we assume that cost changes will inevitably be in the direction of higher costs than estimated, later customers would required to pick up a proportionately greater share of the costs, other things being equal. Also, the achievement of equity by a sinking fund or reserve tends to reduce its ability to provide assurance of the availability of funds in case of premature shut-down. This is because the greater is the amount of funds collected early in a facility's life to provide such assurance, the more inequitable the fund tends to be.

Interestingly, the TBS study found the funding at commissioning option to be the most equitable when using a straight-line amortization schedule. A sinking fund is somewhat less equitable, placing a proportionately greater burden on later ratepayers. The unfunded reserve is the least equitable because its negative revenue requirements in later years constitute a subsidy of later ratepayers by near-term customers. (See TBS, p. IV-13 ff.) Negative revenue requirements arise because, as the reserve accumulates and is deducted from rate base, such deductions are sufficiently large to make that component of the rate base negative. However, each of the plant-specific
priate am

1.4.1.4 Administrative Impacts

Any of the three plant-specific funding options should require moderate administrative effort depending on how they are structured. All methods of funding will require some regulatory oversight to assure that funds are not inappropriately invested or otherwise mismanaged or that reserves are being accumulated as required. The degree to which additional administrative effort is required is also dependent upon how often changes are required in either deposits or investments made by the fund. Both the deposit and negative salvage value depreciation methods should require less administrative effort than the sinking fund method. For the deposit method, once the deposit is made, the fund can accumulate interest with perhaps only occasional shifts in investments. For the negative salvage depreciation method, no actual cash is involved and the utility would be subject to no more than the outside audit of its accounts that it normally receives. In contrast, the sinking fund would probably require somewhat closer oversight of its operations because of the constant influx of new funds.

As is true with all options however, if estimates of eventual decommissioning costs or inflation caused the amount on deposit to be less than required, additional administrative effort will be necessary. Also requiring additional administrative effort would be that form of the deposit and external sinking fund methods formally under control of the states to take advantage of tax exemptions. On balance, there will not likely much difference in administrative impact between the deposit method and the external sinking fund method. The negative salvage depreciation approach should require less administrative effort but this does not appear to be significant.

1.4.1.5. Responsiveness to Change

As indicated in the previous section, each of the three funding options discussed in this chapter can be structured to accomodate changes in estimated decommissioning cost resulting from changes in inflation rates, technology, interest rates, etc. A sinking fund and depreciation reserve are the most amenable to change since annual payments could always be increased or decreased. The deposit method is relatively more resistant to change once a deposit is made if unexpected changes in decommissioning cost estimates occur. This problem can be alleviated either by structuring the deposit so that funds can be increased or decreased as necessary, or by combining the deposit with a variable-rate sinking fund. The negative salvage depreciation alternative is, of course, the easiest to change since it is an internal mechanism, although changes in depreciation rates would have to be approved by the state PUCs or FERC.

Care will have to be taken, however, that any structural shift will not affect the potential tax-exempt status of a fund. Thus, the sinking fund, because of its ability to be "fine-tuned" periodically over its life, can limit the amount of money that might be returned to the utility because of an overestimate of decommissioning cost.

1.4.1.6. Adaptability to Multiple Ownership and Jurisdictions

Many power plants are jointly owned by several utilities. Particularly in New England and the Pacific Northwest, a facility is often owned by utilities in different states which report to different PUC's; or it is owned by both investor-owned and public utilities, the latter usually not reporting to state PUC's. When this situation occurs, a certain option or options may not be fully effective. Additionally, once wholesale power is sold interstate, FERC regulations will apply, thus introducing another dimension to the regulatory questions associated with decommissioning. For example, a state PUC may not wish to approve payments in advance or annually into a sinking fund when such funds may go out-of-state into either a blind trust or a utility-administered fund. Similarly, a municipal system may be proscribed by its charter from contributing to a fund over which it has little control.

To evaluate these problems, the NRC initiated a study with the New England Conference of Public Utilities Commissioners, Inc. The results of this study, prepared by their subcontractor, Temple, Barker and Sloane, Inc., are presented below. Their basic conclusion is that neither multiple ownership nor multiple jurisdictional arrangements should present significant problems for financing decommissioning. There are, however, potential legal problems associated with single-asset utilities such as the Yankee companies. These findings are presented verbatim from the TBS study, as follows:

Joint ownership by members of a holding company or by unrelated companies should not pose barriers to the use of any financing mechanisms discussed thus far, because numerous accounting and financial arrangements could be made. For example, the subsidiaries of NU are responsible for their capital contributions toward joint construction projects. However, they turn to another NU subsidiary, Northeast Nuclear Energy Company, for the management of nuclear plant construction and operation and nuclear fuel purchasing. Similarly, unrelated joint owners could maintain their own decommissioning accounts or make contributions to a joint venture.

Maine Yankee, however, poses some unusual, primarily legal, problems. The length of its NRC license and the agreements signed by the sponsor companies may be shorter than the actual reactor life, so that legal responsibilities become vague toward the end of the reactor life. These issues are broader than decommissioning, however.

Questions have been raised regarding the feasibility of the funding at decommissioning approach for one of the Yankee companies. In a recent case before the Federal Energy Regulatory Commission, the FERC staff argued that a sinking fund should be established for the Connecticut Yankee Company because funding at decommissioning amortizes a negative salvage value and leads to a negative ratebase.

TBS believes that funding at decommissioning using negative salvage value is a viable alternative financially, although it may not be desirable because of its risk. From the financial point of view, however, amortization of a negative salvage value is consistent with the existing problem of excess cash flow.

To understand this, first consider a single asset firm with no decommissioning requirement. Such a firm, which depreciates that asset but which does not have a construction or acquisition program, will generate a higher flow of funds than it has uses for funds. The company has two financial alternatives. One option is to gradually reacquire its own capital stock. The company needs to keep only nominal shares outstanding to retain its corporate identity. The second option is to accumulate and invest the excess funds which in turn can be liquidated and dispersed to investors at the plant's retirement. In either case, the company will raise sufficient financial assets during the plant's life to satisfy all liabilities including the refunding of the owner's equity.

Funding at decommissioning increases the excess cash flow because of the increased amortization of the negative salvage value. The company can continue to pursue whichever financial policy it was planning without decommissioning. If the company reacquires its stock and bonds, it will merely do so at a faster rate. In fact, it will reacquire virtually all of its capital several years before the plant's retirement. If all goes as planned, the remaining amortization will provide for the cost of decommissioning. If the company accumulates and invests the excess funds, it will have sufficient funds at the end of the plant's life to satisfy all of the company's liabilities including decommissioning.

While the above discussion demonstrates that the negative salvage value approach presents no financial problems if all goes as planned, it should also be clear that there is a higher level of financial risk. Although the balance sheet appears strong enough to pay for decommissioning, there is no physical asset of value to support the liability. Thus if the plant were forced to close prematurely, there is no underlying financial strength against which to borrow.

Another potential problem with the Yankee organization is the possibility under current tax law that the tax deduction for decommissioning would not be able to be used. This problem is indepedent of financing strategy. TBS's projections show that, for Maine Yankee, taxable income in the last year of the plant's operation will be approximately $8 million and the deduction, if the plant is decommissioned that year, would be $258 million. It is highly unlikely that decommissioning could be completed in one year, however, and there will be no significant revenues after plant retirement.

In addition to the case studies of privately owned utilities discussed in this report, other plant ownership arrangements are possible including federal power authorities, municipalities, and rural electric cooperatives. In the case of federal ownership, the U.S. goverment is the guarantor of the organization's obligations. Funding at decommissioning is therefore more attractive n this case, because here is little risk that funds will be unavailable, although it is the U.S. taxpayer who absorbs the risk.

Municipal ownership is the unique case where the utility's cost of capital and the rate of return which can be earned on external investments are approximately equal because municipalities pay no income taxes. In that case, the cost differences among the three financing strategies should be less because a municipal entity does not have to pay for the difference between its borrowing and lending costs.

Rural electric cooperatives also present a unique financing situation. They are generally exempt from federal income taxes becasue they are cooperatives and distribute their margins. Thus their decommissioning fund would be able to accumulate at a tax-free rate. As with municipal utilities, the cost difference among the three strategies should be less than for privately owned utilities because of the increased return on the fund.

Mutliple Jurisdictions

Most utilities are subject to more than one jurisdiction on rate and financial matters. Northeast Utilities is regulated by state commissions in Connecticut and Massachusetts as well as by FERC. Maine Yankee is primaily regulated by FERC, although its sponsors are regulted by five New England state commissions.

Multiple jurisdictions should not preclude the use of any strategy for decommissioning financing, although the use of different strategies in different jurisdictions will cause cross-jurisdictional subsidies. . . . In [a] hypothetical example, NU/Connecticut adopts funding at commissioning, and NU/Massachusetts uses funding at decommissioning. If the holding company maintains the decommissioning accounts, or if a separate subsidiary is used, then Connecticut ratepayers will subsidize Massachusetts ratepayers. The subsidy occurs because Massachusetts ratepayers have chosen the low-cost, high-risk option, and yet the resulting finanial assurance of the joint account is higher than anticipated because the Connecticut ratepayers have chosen to pay for the low-risk option.

In practice, cross-jurisdictional subsidies occur constantly and with much larger magnitude than those potentially created by conflicting decommissioning strategies. For example, the different timing of Massachusetts and Connecticut rate cases is sufficient to keep the actualized rate of return different in the two states. Thus it is frequently the case that one state earns a lower rate of return, and the state with the lower return is being temporarily subsidized by the other because the utility's common stock, which is sold only by the holding company, is evaluated by investors as the weighted average of all subsidiary returns. In general, utilities frequently are subject to different accounting rules in different jurisdictions. (see TBS, pp. IV-25-29)

1.4.2. Analysis of the Pooled Funding Alternatives

1.4.2.1 Surety Bonding

In response to a petition for rule making tendered before the NRC by the Public Interest Research Group and others, the NRC staff asked the ten largest surety bonding companies* whether surety bonds in the amount of $50 million for a term of 40 years would be available, and if so, what would be their cost? All companies responded that bonds would not be available in that large amount for that long a term. Surety bonding companies apparently do not issue bonds for more than a few million dollars and for longer than a few years.

Also, although a surety bond theoretically provides a high degree of assurance that funds for decommissioning will be available, in reality surety companies have indicated that their practice is to renew surety bonds annually. If a

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* Size as measured by surety capacity ranked by the U.S. Department of the Treasury.

company began to experience financial problems, the surety company could, and most likely would, decline to renew the bond. Thus, long-term assurance evaporates.

The cost of a surety would be high. Even if surety bonds were available in the amounts and time span necessary for reactor decommissioning, the cost could be 1.5% to 2% per year of the face value of the bond.* Over the estimated 35-40 year life of a reactor, this cost could be 80% of actual decommissioning cost and would be in addition to the cost of any provisions the utility would have to make for decommissioning funds themselves (since, as described earlier, the surety company would pay only in the event of default by the utility).

For the foregoing reasons, the Commission staff dismisses surety bonding <u>for reactors</u> as unavailable and not adequately meeting the evaluation criteria. However, for other facilities as discussed in Part II of this paper, surety bonds are deemed to be acceptable. Furthermore, surety bonds for reactors could be acceptable if they were ultimately to become available and if the renewal problem were adequately resolved.

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* In the use of a letter or line of credit, cost would more likely be 0.5% per year.

1.4.2.2. The "Insurance" Option

Another alternative is to have either the nuclear, insurance or utility industries provide insurance for either expected or premature decommissioning. Because decommissioning at end of expected facility life is an event that must take place rather than one having only some probability of taking place, it is not, strictly speaking, an insurable event. However, the insurance or other industries could provide the support necessary to administer a decommissioning fund pool among participating utilities.

Decommissioning insurance could also be offered in the more limited situation of providing funds only in those cases where utilities were forced to decommission facilities prematurely. This approach is more in keeping with the traditional role of insurance and is similar to the "captive" insurance company recently established by the electric utility industry to provide payment for replacement power in the event of an accident at a nuclear facility. Premature decommissioning insurance could be coupled with negative salvage value depreciation or an external sinking fund to provide an increased level of assurance of funds availability.

The NRC has asked the two nuclear liability insurance pools* and Nuclear Mutual Limited (NML)* to evaluate the role of the nuclear insurance industry

* American Nuclear Insurers (ANI) is an association of stock property and casualty insurance companies and Mutual Atomic Energy Liability Underwriters (MAELU) is an association of mutual companies, both of whom offer liability and property insurance coverage for nuclear facilities and activities. NML is a mutual program organized by a few large utilities to provide reactor property insurance.

in providing assurances for funding for decommissioning. NML's respnse was that it felt that decommissioning insurance was probably unnecessary and, in any case, violated the insurance principal of spreading risk among similarly exposed insureds.*

ANI, and through it MAELU, indicated in informal discussions that there might be some role for the nuclear insurance industry to play, particularly with regard to premature shut-down insurance. They envisioned four possible approaches that they intended to study further for feasibility, cost, and their possible role. In the first approach, two separate annual payments would be made. The larger would be to a trust fund administered by the insurance pools to pay for actual decommissioning expense when incurred at the end of the facility's expected life. The utility would have full vesting rights to its contributions. The smaller payment would be into a fund for decommissioning after premature shut-down.**

Second would be a single fund from which all decommissioning expenses would be paid. There would be no attempt to segregate funds between expected and premature decommissioning costs. There is some possibility that contributions to such a fund would be considered insurance payments and thus be tax-deductible.

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* Letter from Hubert H. Nexon, Senior Vice President, Commonwealth Edison Company, dated February 7, 1979.

** Although estimates are preliminary, based on the Atomic Industrial Forum's decommissioning estimates of roughly $24,000,000, "premiums" would be $750,000 and $250,000 annually in constant dollars.

Third, the pools could collect only those funds required for premature shut-down insurance, while the utilities provide their own system of funding for decommissioning at the end of expected facility life. The premium for such coverage presumably would decline as the utility accumulated more funds.

Fourth, ANI could provide up to 10% of an insured's policy limit from its property insurance in a segregated fund for decommissioning in case of an accident. Given the current property insurance limit of $300 million, this would be up to $30 million. It is not clear that property insurance would cover decommissioning expenses that resulted in premature shut-down due to excessive contamination from operations rather than from accidents.

Analysis of the insurance option is constrained by the fact that it is not yet clear that the option will actually be available. Although the insurance pools have been evaluating it, they have not yet drawn any definite conclusions. Particularly in view of the Three Mile Island accident, it is not clear that the pools would be able or willing to offer the increased capacity required for decommissioning insurance. However, the pools and others continue to express interest in the concep and, as mentioned previously, even if the pools decline to participate in decommissioning insurance, a captive insurance company could be established by the electric utility industry.

The efficacy of such a captive is under continuing NRC study. For an insurance program of this magnitude to be developed, some indication by potential customers (the utilities) in purchasing such insurance if made available must be shown. The NRC staff has not learned of any such expression of interest by utilities.

Certain generalizations and conclusions can be made. In terms of the level of assurance provided, decommissioning insurance is excellent. Decommissioning insurance could be structured to include both expected and premature decommissioning costs and could provide whatever balance of funds was necessary to cover decommissioning costs. One problem, of course, would be the extent to which actual decommissioning costs exceed the estimated costs. But this is a problem with all options. It should be no more difficult for an insurance system to accomodate changing cost estimates than for any other option. If cleanup costs increased drastically because of an accident at a facility, insurance would be better suited than other funding options to provide required funds. Also, if a utility were to encounter finanical distress despite having decommissioning insurance,it is possible that insurance proceeds could be paid to the licensee's trustees or successor to complete decommissioning.

Because the insurance pools are composed of companies within the United States and throughout the world representing enormous assets, it is highly unlikely that the insurance companies themselves would be unable to pay for decommissioning expenses for which they were legally obligated. If a captive insurance company were providing premature decommissioning insurance, somewhat more care would have to be taken that it had adequate assets. Potential capacity problems, if there were several premature shutdowns, could jeopardize the insurance option.

With respect to equity, the insurance option is also good. Because insurance premiums involve continuing payments, they could be structured so that the users of the facility would be paying the costs associated with it. If used in combination with another alternative, such alternative could be chosen having optimal equity and cost characteristics.

As indicated above, the cost of the insurance option cannot yet be determined because of the tentativeness of the pool's estimates. However, using the gross figures provided by ANI, we can conclude that the decommissioning insurance option will be relatively expensive. The $750,000 annual payment discussed above is analogous to a sinking fund payment made annually over the estimated life of the facility. In addition to this, another annual payment of $250,000 is made for premature decommissioning insurance. Assuming the ratio of these payments, if not the absolute amounts themselves, remains constant, the insurance option could be one third more expensive than the sinking fund before taxes. However, if premature decommissioning insurance alone were coupled with an unfunded reserve or an external sinking fund, the cost could be considerably less.

From the standpoint of the other criteria by which these alternatives are being evaluated, the insurance option is adequate. Its ability to adapt to changed assumptions regarding decommissioning costs is essentially identical to the sinking fund and there should be no problem with respect to the effects of joint ownership. Any internal administrative expense would already be built into the premium, and external administrative expense should be no greater than with the other alternatives.

1.4.2.3 Funding from General Revenues

Having the general public pay for decommissioning out of general tax revenues may also be considered. However, in recent years the trend in economic decision-making has been to tie the cost of a product as closely as possible to the ultimate users of the product lest economic dislocations result. Decommissioning costs, particularly those that are expected at the end of normal facility life, are real costs that will definitely have to be paid rather than a contingency that may never arise. As such, these costs should be treated as part of the overall cost of generating electricity via nuclear power and should be paid, to the greatest practical extent, by users of that power unless there are overriding societal or political reasons. Although it can be argued that decommissioning is a special expense and thus should be treated specially by society, more persuasive arguments suggest that if a utility decides to build a nuclear plant based on its best economic judgment, then prospective decommissioning expense should be factored into that judgment. Thus, unless funding by public agencies for decommissioning was tied specifically to usage taxes earmarked for decommissioning, this option should be dismissed.

A stronger case can be made for premature decommissioning costs being funded from public revenues. Premature decommissioning is not a definite expense but may be considered similar to "acts of God" for which governments often provide relief. Nevertheless, even premature decommissioning should probably be considered as part of the risk of generating electricity through nuclear power. As such, it is part of the cost to be borne by utilities and their customers unless private mechanisms fail or society decides to finance premature decommissioning publicly.

A variation of this method is for states to certify to the NRC that sufficient funds would be available to decommission a facility, either at expected end-of-life or prematurely. The certification would have to guarantee that if the utility did not have sufficient funds, either sufficient revenues would be generated or the state itself would provide the necessary funds. The state, of course, would have the option of making its own arrangements with the utilities under its jurisdiction for providing this service.

1.5. Effect of Different Decommissioning Alternatives on Funding Assurance

Thus far we have discussed various alternatives for assuring the availability of funds for decommissioning by assuming that the facility would undergo DECON, i.e., the facility would be decommissioned immediately after it ceases operation and released for unrestricted use (See Appendix A). In addition to DECON, two decommissioning alternatives exist. These are SAFSTOR and ENTOMB. In SAFSTOR, a facility may be placed in safe storage with subsequent deferred decontamination of the facility occurring at some point in the future. During the safe storage period the facility can be either actively safeguarded through custodial care or passively safeguarded, possibly through in-place physical barriers. The third decommissioning alternative, ENTOMB, assumes that the facility will be permanently entombed at its site.

In terms of financial assurance, delayed decommissioning using SAFSTOR or ENTOMB presents more potential problems than DECON because of the longer time period involved. Even if monies collected over the expected life of the facility are sufficient to decommission when the facility is shut-down, the value of such money may not be maintained until the safe storage period is over and decommissioning is complete. If funds were to be collected both during expected facility life and after the facility is shut down prior to final decommmissioning, providing adequate funding assurance would become even more difficult. Premature decommissioning would, or course, exacerbate these effects.

SAFSTOR or ENTOMB also present several equity problems. If funds are collected equitably over the life of a facility but are then invested for future decommissioning use, the danger exists that there could be a significant funds overage or shortfall that would be passed on to or made up by customers not directly benefitting from the facility. Likewise, if funds are collected over both the life of the facility and during the period of shutdown, this would penalize those later customers not directly benefitting from the facility.

The PNL study found that the constant dollar technological cost for decommissioning via passive SAFSTOR with deferred decontaminatin after 30 years was approximately 20% higher than DECON. Decommissioning via custodial SAFSTOR with dismantlement after 30 years was approximately 40% higher than DECON. However, although costs were higher, delaying final decontamination for 30 years would reduce overall potential man-rem exposure by almost 70%

As with DECON, the relationships of the variables affecting the financial cost of SAFSTOR or ENTOMB are complex but generally similar. The major determinant of cost is whether the real rate of return after inflation and taxes on any of the funding options is positive or negative. If positive, the longer decommissioning is delayed, the greater the fund will grow relative to what is actually needed. Thus, a smaller amount would be required to be set aside initially or to be amortized through a sinking fund or reserve. If negative, the longer decommissioning is delayed, greater is the amount of funds that will have to be added to replace value lost to inflation.

Delayed decommissioning may become a more expensive an option when local property taxes are considered. Although it is difficult to generalize about something as variable as local property taxes, the results of a study by Northeast Utilities on decommissioning costs for their three Millstone plants and Connecticut Yankee indicated significant property tax costs prior to the site being returned to its original state. Estimated total property tax cost for 50 years in constant 1978 dollars ranged from a low of $24.8 million for the partial dismantlement and delayed removal of Millstone 1 to a high of $264 million for the safe storage and delayed removal of Millstone 3.*

1.6 Adaptability of Alternatives to Operating Facilities

Thus far, decommissioning funding alternatives have been generally discussed in terms of facilities not yet operating. Nevertheless, all the alternatives appear to be adaptable to operating facilities as well. For example, if a

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* Preliminary Nuclear Power Plant Decommissioning Study for Northeast Utilities; January 1979. However, that the initial brief filed by the Federal Energy Regulatory Commission disputes the size of Northeast Utilities' property tax estimates and suggests they may be much smaller. (FERC Docket # ER 78-360; Initial Brief of the Commission Staff; Telemac N. Chryssikos, Staff Counsel, June 22, 1979).

deposit were required, it could be raised after start-up as well as before, provided the licensee was allowed a reasonable time to plan for it. Likewise, if a sinking fund or negative salvage value depreciation were allowed, the annual amortization or payment would be distributed over the remaining life of the facility. Insurance or surety mechanisms could also be applied. Obviously, some inequities would result as early customers might not be charged for decommissioning expense, but these should not be severe except for those plants nearing the end of their operating lives. In any case, such inequities are unavoidable.

Another factor to consider when applying decommissioning funding requirements to plants already existing is the somewhat reduced level of uncertainty embodied in a shorter planning horizon. For those plants with few operating years remaining, it may not be necessary to require a deposit or external sinking fund, particularly if the licensee is solid financially. On the other hand, the absolute difference in cost among the funding options would be reduced because of the lessened impact of inflation, taxes, and financial risk.

1.7 Conclusions and Recommendations

Funding for decommissioning is a complex problem with few definitive answers. Conclusions on the various funding alternatives depend heavily on assumptions about events that may or may not occur thirty or more years hence. The costs of the alternatives are sensitive to the inflation rate, the interest rate, technological changes and other variables. Investor-owned utility accounting practices are by no means standardized for application to many specific problems, including decommissioning, and the various state bodies regulating utilities are subject to different rate-making philosophies. For public utilities, different accounting practices exist and such utilities are not subject to state or federal rate regulations under most circumstances.

Nevertheless, certain patterns emerge which may lead to some generalizations. First, to satisfy NRC's objective of protecting public health and safety during decommissioning, funds for decommissioning should be assured by some funding or reserve method. This is because of the magnitude and uncertainty of the availabilty of funds required and because of the negative effects on equity of postponing providing for funds until they are actually needed. The level of assurance provided should be sufficient to provide adequate funds many years in the future. Although it is beyond the scope of this paper to estimate the probability of premature decommissioning or financial failure, in view of the TMI accident it is the staff's belief that funding options that provide some mechanism to cope with either premature decommissioning or the inaccessibility of funds are not unreasonable.

Second, the very complexity of the variables influencing the funding alternatives analyzed, together with the often ambiguous effect of many of those variables, indicates that the NRC should allow a wide latitude of approaches to implement some standard adequate level of assurance. NRC should avoid imposing requirements so specific that they conflict with state or federal rate-making authority or with utility accounting practices, particularly when the effects of those requirements are not clear. In view of the NRC's mandate to protect public health and safety and the environment, the NRC's function should be to require adequate assurance of the availability of decommissioning funds within reasonable bounds of cost-effectiveness.

Third, in conjunction with any of the plant-specific funding options, premature decommissioning insurance appears to offer the greatest assurance of the availability of funds with good equity characteristics, although at a potentially higher cost. This is true because, although it is reasonable to assume that most funding mechanisms will prove to be adequate under normal operating conditions, such may not be the case if decommissioning is forced to occur prematurely. Insurance can provide coverage for such contingencies. However, it is by no means clear that premature shutdown insurance will be available without the creation of a market for such insurance by utilities.

Without insurance, on the basis of assurance the next best option appears to be that variation of the deposit-at-start-up option that is capitalized to take into account the eventual tax benefit and that accumulates interest over its life. Although funds may not be completely provided in advance because the tax benefit and interest earnings have been factored in, this alternative under most circumstances provides a high level of assurance of funds availability thoughout the facility's life. If capitalized properly, it is also relatively equitable.

As indicated previously, the cost of the deposit method is relatively high -- as much as three times as high as the negative salvage approach under certain assumptions. However, for investor-owned utilities,establishing a fund under a state's administration would, if appropriately constructed, cause the fund to be tax exempt for both the deposit itself and any accrued earnings and thus would eliminate much of the additional cost associated with the deposit method. For public utilities, the same effect would be attained because such utilities are public organizations not subject to federal tax. In addition, the overall impact on ratepayers from this option has been shown to be relatively small.

An external sinking fund is also relatively costly; but as with the deposit method, such cost can be mitigated by establishing a sinking fund under a state's administration. From the point of view of assurance, the sinking fund is not as good as the deposit method but better than the negative salvage method. From the point of view of equity, the sinking fund under most assumptions is excellent. Overall, a sinking fund would be acceptable but less preferable than either insurance or the deposit method.

The internal reserve method, including negative salvage value depreciation, although having several positive attributes, also has shortcomings with respect to assurance. Under most assumptions, the unfunded reserve is the cheapest of the funding alternatives. It can either be equitable or inequitable, depending on how it is structured. Nevertheless, despite its apparent popularity, it is so fraught with uncertainty as to be of marginal adequacy unless coupled with premature shutdown insurance, other surety arrangements, state certification, or some other mechanism to increase the assurance provided by this option. Under the NRC's responsibility to assure that a utility is financially qualified to shut down and decommission a licensed reactor, the internal reserve by itself is probably insufficient because of both the long time period being considered for decommissioning and the potential inaccessibility of the funds generated by such a method.

Finally, it would be appropriate for NRC to revise its decommissioning regulations as one part of a broader reevaluation of its overall financial regulations. Under most circumstances, utilities will have sufficient resources to construct, operate, and decommission a nuclear power plant. However, in the event of an accident and the possibility of premature decommissioning, a utility could be faced not only with greatly increased decontaminating and decommissioning costs but also with replacement power costs (unless covered by a NEIL-type insurance scheme) and loss of the affected unit and possibly other units from the rate base. Any of these conditions will adversely affect a utility's ability to finance decommissioning and will ultimately have to be addressed in the Commisison's regulations.

2.0 FUNDING ASSURANCE FOR DECOMMISSIONING FUEL CYCLE FACILITIES, EXPERIMENTAL AND RESEARCH REACTORS, AND MATERIALS LICENSEES

2.1 Introduction and Problem Statement

Many of the problems associated with funding for power reactor decommissioning are also apparent in funding for decommissioning non-power reactor facilities and licensees. Consequently, much of the following relies on the analyses presented in Section 1 of this paper. Rather than repeat earlier analyses, Section 2 will indicate special considerations and exceptions.

Decommissioning nuclear facilities and licensees other than power reactors represents a wide diversity of technique, risk, and cost. Although it is difficult to generalize about such diversity, it is apparent that many such licensees are not as financially secure as the regulated utilities operating large commercial power reactors. Notable exceptions to this situation exist with firms like Exxon, Gulf, and other large corporations involved in various phases of the fuel cycle. However, even in the case of these firms, their corporate structure is such that operating subsidiaries have occasionally been established to run a particular facility or facilities. In case of defaults of the subsidiary, the assets of the parent company could probably be shielded from creditors. In many other cases, licensees may be small companies, universities, hospitals, and, in the case of many materials licensees, individuals.

Events of the past few years have indicated that assurance of funding decommissioning non-reactor facilities and licensees should be strengthened. The most recent example is the situation with respect to Nuclear Engineering Company at its Sheffield, Illinois waste burial ground. Another example is the American Nuclear Company default which caused the state of Tennessee to pay approximately $1,000,000 for the decontamination of that facility. Similarly, there are the major financial difficulties posed to New York

State by the West Valley plant. Recent legislation on hazardous wastes and uranium mill tailings also indicate the thrust of public concern.

The cost to decommission various facilities varies, of course, according to the function and size of the facility being considered. The cost for DECON for a large fuel reprocessing plant was estimated by Battelle Pacific Northwest Laboratory to cost $67 million in 1978 dollars. For a small mixed oxide fuel fabrication facility, Battelle estimated decommissioning costs to be, in 1978 dollars: $7.5 million for DECON; $2.6 million for ENTOMB; and $15.8 million for 30 year SAFSTOR. For a low-level waste burial ground, decommissioning costs range from approximately $20 million for modest stabilization plus long-term care at a western site to approximately $31 million for more complex stabilization and long-term care at an eastern site. The cost to decommission uranium mining and milling installations is estimated to be about $5 million. Small research and experimental reactors will mostly like cost about $5-10 million. Materials licensees show the widest variation in cost of decommissioning. Cost of removal and disposal of radioactive material from byproduct licensees could range from a few hundred dollars to over one million dollars.*

* For discussion of various fuel cycle decommissioning costs, see Task Force Report on Bonding and Perpetual Care of Licensed Nuclear Activities; Conference of Radiation Control Program Directors; April 5, 1976.

As with reactors, assurance of the availability of decommissioning funds is also necessary to protect against financial uncertainty due to premature shut-down. Although most fuel cycle facilities (with the exception of reprocessing plants) should not usually be vulnerable to premature shut-down due to accident or excessive contamination, they are more vulnerable than power reactors to adverse business conditions that could cause the facility to shut down.

Another factor that increases the need for assuring the availability of decommissioning funds is the decommissioning alternative being considered. For several types of non-reactor facilities, decommissioning options are being considered that require very long-term surveillance -- i.e., over 200 years. For this period of time, the continued existence of even the most financially stable firm cannot be automatically assumed.

Still another problem should be considered -- that is, the availability of funds does not necessarily guarantee that decommissioning will be performed properly at reasonable cost. Unless there is sufficient incentive for an owner to decommission, he may default even if decommissioning funds have been set aside. For example, the cost to decommission a facility may be $1,000,000, which amount has been set aside for decommissioning. The licensee may not be willing to use its labor or capital assets to decommission its facility if it is not earning a rate of return equivalent to using those assets on some other project. Thus the licensee could go into technical default even though it was still financially viable. The licensing authority would then have the responsibility to contract out the decommissioning job, perhaps at a higher cost than the $1,000,000. To prevent this from happening, a contingency factor of perhaps up to 25% of basic cost has usually been added to most estimates.

Finally, the sheer number and diversity of licensees requires assurance sufficiently broad so that decommissioning in all cases will be completed safely.

2.2 Criteria for Evaluating Alternative Financial Assurance Mechanisms

All evaluati eria discussed in Section 1 of study are relevant to decommissioning with the exception of criterion five. Few, if any, non-reactor facilities are owned jointly, and even if they were, such firms are usually not regulated in the same way as are electric utilities. However, a variation of criterion five -- the extent to which a funding option is compatible with state laws and policies -- is relevant. Many non-reactor facilities and licensees are licensed by the state through NRC's Agreement States program.

2.3 Alternatives for Assuring Funds Availability

All funding methods considered in Section 1 remain relevant to non-reactor facilities. The sinking fund option can be broadened to include an annual tax based on production or use. The revenue from this tax would be the basis of annual payments to the fund. Similarly, in the case of materials licensees, another alternative would be to impose, through legislation, a set license fee that could include costs for disposal of the licensed material. We exclude funding from public revenues at the state or federal level for the reasons that were used in the case of power reactors.

A major difference in alternatives between power reactors and non-reactor facilities and licensees is in the area of surety bonding. For some of the smaller facilities where relatively small decommissioning costs are involved and where the operating life of the facility or the license is somewhat shorter, surety bonds may be available as an option.* In fact, several states currently require licensees under their jurisdiction to post surety bonds as a method of assuring the availability of decommissioning funds. Also, the NRC has proposed regulations allowing

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* Although this paper refers to surety bonding as an alternative for consideration, other surety mechanisms are equally valid and should be assumed to be included in this analysis. For example, bank letters and lines of credit would operate similarly and would have similar costs as bonds.

surety bonding as an option for assuring the funding of decommissioning for uranium mills and mill tailings disposal facilities. However, care will have to be taken that, when surety bonding is allowed, it provides adequate assurance of funds over an extended period of time. As discussed in Section 1, many surety bonding companies require, as a condition of their bond, that the bond be subject to periodic renewal. If the licensee were to experience financial difficulty, the surety company could decline to renew the bond and the assurance would be severely reduced.

2.4. Analysis of Alternatives

2.4.1 Comparative Analysis of the Plant-Specific Funding Alternatives

2.4.1.1 Assurance

Most of the analysis in the comparable section of Section 1 is also valid here. The deposit-at-start-up method provides the greatest assurance that funds will be available; the internal reserve method provides the least assurance. As indicated above, special care will have to be taken for those facilities that may be in custodial safe storage for 200 years or longer. Because of the uncertainty raised by such a long planning horizon, particularly stringent financial assurance standards may have to be imposed and co-responsibility by the states may be required.

2.4.1.2 Cost

As with commercial power reactors, under IRS regulations, decommissioning expenses for other nuclear facilities and licensees would not be deductible from income until actually incurred. For small materials licensees or non-profit licensees such as universities and hospitals whose revenues would be either non-taxable or taxable at less than the 46% tax rate, this provision may not be as significant. Similarly, blind trusts could be established with the principal from such trusts invested in tax-free securities such that both contributions to principal and interest would not be subject to federal tax. Alternatively, state administered funds could be established such that both the amortization and interest were tax-exempt.

It should be kept in mind that non-reactor licensees have the same range of accounting options as do utilities. Funded and unfunded reserves can be structured to take advantage of accelerated depreciation through normalization or flow-through accounting methods, by net-after-tax funding, or by any of the other funding methods discussed for utilities. In fact, the range available to such licensees may be broader than for utilities, whose accounting practices are usually regulated by the state PUCs and FERC.

One special consideration is the effect of various funding methods on small licensees. The NRC's primary mission is to protect public health and safety and the environment. Assuring the availability of funds for decommissioning is part of this mission. Nevertheless, some weight should be given to the effect that the deposit-at-start-up method may have on small or marginal producers. The argument can be made that licensees who are so vulnerable that they could be forced out of business by having to pay a deposit should not be in business in the first place. However, the effect of such a policy could run counter to U.S. antitrust laws or may be viewed as discriminating against small businesses which the NRC is also charged to uphold in its operations. From this point of view, annual sinking fund payments would tend to be less disruptive than a deposit at start-up.

Thus, essentially the same conclusions drawn in Section 1 on cost can be drawn for non-power-reactor facilities and licensees. For smaller licensees, the methodology presented would be valid but may be too detailed for the level of decommissioning cost involved.

2.4.1.3 Equity

With respect to equity also, many of the same conclusions apply except customers here may be quite different from electric utility ratepayers.

There may be only a small number of customers but many non-customer neighbors may be impacted by a facility that needs cleanup. One difference may be with those decommissioning alternatives that provide for long periods of custodial care. If funding options are chosen for such decommissioning modes that require a licensee to make payments as custodial expenses are incurred, the equity principle could be substantially violated unless the payment were generated from deposits accumulated during the productive life of the facility.

2.4.1.4 Other Considerations

One final consideration involves the administrative burden that could be incurred with 20,000 materials licensees. Although few generalizations can be made, any but the most simple system of funding for decommissioning tied directly to the issuance of most of these licenses could prove to be overly burdensome and not cost-effective.

2.4.2 Analysis of the Pooled Funding Alternatives

As indicated above, surety bonding for many non-reactor facilities and licensees is both available and acceptable provided that sureties can be made available for the whole term of the license. Likewise, pooled funding might be feasible if based on a users tax.

When the NRC staff solicited the views of the nuclear insurance pools on reactors, it also solicited their views on providing some form of decommissioning insurance for fuel cycle facilities. Again, there is no indication that the larger fuel cycle facilities would be treated any differently than reactors, although it is not yet clear that smaller licensees could be included at a reasonable cost. As with reactors, any decommissioning insurance plan is extremely tentative at this point and would be subject to the same limitations discussed earlier. There is also the problem of whether, by providing decommissioning insurance to reactors, there would be sufficient insurance capacity remaining for non-reactor facilities.

2.5 Conclusions and Recommendations

As can be seen from the above discussion, most of the conclusions reached concerning reactor decommissioning funding can generally be applied to non-power-reactor facilities. As with reactors, it appears that the alternative of assuring funding for decommissioning through an unfunded reserve is fraught with uncertainty and thus would provide questionable assurance unless coupled with premature decommissioning insurance or other surety arrangements. As with reactors, analysis indicates that the NRC should allow a wide latitude of approaches to achieve assurance of the availability of funds.

Of all the options, the best over-all appears to be premature decommissioning insurance coupled with one of the plant-specific funding methods for the same reasons as discussed in Section 1. In the absence of insurance, the deposit-at-start-up method appears to be the next best option. The sinking fund should also be acceptable in those cases with little likelihood of premature shutdown. For smaller facilities at least, surety bonding may be an available option and may be acceptable if the bond is not able to be terminated by the surety company prior to other arrangements being made.

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Appendix A

Definition of Decomissioning and of the Decommissioning Alternatives

DEFINITION OF DECOMMISSIONING

Decommissioning means to safely remove the property from radioactive service and to dispose of radioactive materials. The level of any residual radioactive remaining on the property after decommissioning must be low enough to allow unrestricted use of the property.

DEFINITION OF THE DECOMMISSIONING ALTERNATIVES

DECON means to immediately remove all radioactive materials down to levels which are considered acceptable to permit the property to be released for unrestricted use.

SAFSTOR is defined as those activities required to place (preparation for safe storage) and maintain (safe storage) a radioactive facility in such condition that the risk to safety is within acceptable bounds and that the facility can be safely stored for as long a time as desired. SAFSTOR is completed by subsequently decontaminating the facility to levels which permit release of the facility for unrestricted use (deferred decontamination).

ENTOMB means to encase and maintain property in a strong and structurally long-lived material (e.g., concrete) to assure retention until radioactivity decays to a level acceptable for releasing the faciilty for unrestricted use.