NUREG-0584

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ASSURING THE AVAILABILITY OF FUNDS FOR DECOMMISSIONING NUCLEAR FACILITIES

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U. S. NUCLEAR REGULATORY COMMISSION
July 1979

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(Note: Any opinions or conclusions contained in this paper are those of the author and do not represent official NRC policy.)

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I. Funding Assurance for Reactor Decommissioning

A. Introduction and Statement of the Problem

The NRC has undertaken a comprehensive reevaluation of its policy regarding the decommissioning of nuclear facilities. One aspect of that reevaluation has been to reexamine the extent to which the Commission's regulations and policies assure that adequate funds will be available to shut down a nuclear facility after its operating life has ended. Currently, the NRC's policy on assuring funding for decommissioning is codified in Sections 50.33(f) and 50.32 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. Current Commission regulations are generally moot 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 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 in terms of reactors. The second part will apply this analysis to non-reactor facilties and licensees.

Historically, the Commission has implicitly assumed in evaluating the financial qualifications of reactor licenses that if an applicant for a reactor operating license is financially qualified to construct or operate a nuclear facility, it

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is also qualified to shut it down. When compared to the current 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 should not be unmanageable. In fact, such a cost for decommissioning a plant is comparable to the fuel costs associated with reloading the reactor core every 18 months. Further, it can be argued that regulated electric utilities are especially immune to negative economic conditions because they provide an essential commodity and because, generally, they are allowed to recover the costs of providing this commodity from their customers.**

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* See further discussion of cost below.

** 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 Edision, 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.

The problem with the above analysis is that decommissioning for most nuclear reactors will not take place for 30 to 40 years after start-up, if the delayed dismantling option is chosen, it may be 60 to 100 years before a reactor is dismantled. No matter what the current financial health of a utility is, financial solvency of any particular enterprise cannot be projected with confidence so far in the future. If, for whatever reasons, an electric utility ceases operation, there is no guarantee as to the degree that its successor would assume its commitments to decommission its plants. Unlike the costs of fuel reloading, which produces a stream of revenues for a utility decommissioning is only an expense and does not produce any offsetting revenues or return on investments. In other words, there is no direct economic incentive for a utility to decommission.

A compounding problem arises in the case where a utility is forced because of accident or for other reasons to permanently shut down its reactor prematurely. If one of 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 be forced into bankruptcy and default on its decommissioning obligations. Certainly the accident at Three Mile Island indicates that a utility can rapidly find itself in a precarious financial position with the resulting uncertainties that such a position raises.

It must be kept in mind that 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 constant 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 interest, inflation, and Federal income tax costs to decommission.

Although most electric utilities would most likely meet their decommissioning obligations, such decommissioning is not absolutely assured by the current financial health of reactor license applicants. Thus, NRC is in the process of examining various alternatives for assuring that funds for decommissioning reactor facilities will be available.

B. Criteria for Evaluating Alternative Financial Assurance Mechanisms

The NRC has developed five criteria by which it is evaluating the relative effectiveness of the alternative financial assurance mechanisms being considered.

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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.

First and most important is the actual degree of assurance provided by the alternative. In other words how high is the probability that the alternative will actually provide funds when needed 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? 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.

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) of the alternative. To facilitate comparisons among alternatives, current and projected future costs have been calculated on a present value basis in 1978 dollars.*

Third is the equity of the alternative. In other words, are the costs of decommissioning being paid by those who benefit from the facility?

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

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* As used in this paper, present value means the value of a good or service 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.

reactor life, to technological changes that decrease or increase ultimate decommissioning costs, and to other changes.

Fifth is the ability of the alternative to handle effectively differing ownership and jurisdictional arrangments existing in the electric utililty industry. Such arrangments can become problematic when, for example, a nuclear power plant is owned by several investor-owned utilities reporting to the Public Utility Commission (PUC's) of different states. Further compounding such a problem would be the situation of public utilities, which may not be regulated or which may report to regulatory bodies other than the state PUC's. Since the various state PUC's 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.

If one assumes that the economic viability of electric utilities cannot be "guaranteed" 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 equity and cost criteria are next in degree of importance. Finally, 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, the alternatives will be analyzed in relation to the type of decomissioning mode that can be used. Thus, the staff is examining whether any of the alternatives are particularly suited for, or ineffective in dealing with, immediate dismantlement versus delayed dismantlement versus entombment.

C. Alternatives for Assuring that Funds will be Available

The NRC staff has determined that there are six basic alternatives for assuring the availablity of funds for decommissioning nuclear power plants. Each of these alternatives may be used exclusively -- except surety bonds -- and some may be used in combination with the others. They are briefly described below before being more thoroughly discussed later in the paper.

1. Prepayment of decommissioning costs. Cash or other liquid assets that will retain their value for the projected operating life of the plant may be set aside or deposited in an account prior to reactor start-up. 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. At the time funds were set aside, 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 be made.

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2. A funded reserve accumulated over the estimated life of the plant. The funded reserve, or sinking fund, requires a prescribed amount of funds to be set aside annually in some manner such that the fund, plus accumulated interest, would be sufficient to pay for costs at the estimated time of decommissioning. The fund could be invested in high-grade securities, in state tax-free securities, in federal debt obligations, or other assets. The fund could be administered as part of or separate 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 payment.

3. An unfunded reserve or funding at decommissioning. The unfunded reserve is an accounting procedure generally using negative net salvage value depreciation which allows estimated decommissioning costs to be depreciated 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 a cost (i.e., decommissioning expense) 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. Alternatively, accelerated depreciation can be used 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.

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. Securities 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 rate of return would be higher than that which could be obtained from higher-grade debt instruments issued by public or private entities. As with any equity 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 aproach 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.

4. 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.

5. Decommssioning "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 expense and provide decommissioning "insurance" in case of premature reactor shut-down. Alternatively, only premature shut-down insurance could be provided.

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

D. Analysis of Alternatives

1. Exclusion of two alternatives

To simplify the analysis of the various alternatives it may be helpful first to narrow the range of acceptable alternatives by applying the criteria discussed in section B of this paper. As applied to decommissioning funds for reactors, two alternatives -- surety bonding and funding out of general tax revenues -- should be immediately dismissed because they fail to meet acceptable minimums of at least one of the criteria.

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

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

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).

Second, we dismiss having the general public pay for decommissioning out of general tax revenues. 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 that product lest economic dislocations result. Decommissioning costs 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 as such they should be paid, to the greatest practical extent, by the 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 perhaps 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 the prospective decommissioning expense should be factored into that judgment.

2. Federal income tax considerations

Before analyzing the remaining four alternatives individually, we should first mention the problem of the federal corporate income tax* which is germane to the remaining four alternatives. Most private utilities must pay a tax of 48% of their adjusted gross income. This is an important consideration in evaluating the cost aspects of the remaining alternatives because of the way the U.S. Internal Revenue Service has indicated, at least informally to the NRC staff, it will treat decommissioning expenses. For most depreciation-type expenses, IRS allows a company to deduct from its gross income each year an amount reflecting the depletion 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. Second, 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.**

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

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

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 will 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 almost $2.00 in revenues to provide for every $1.00 in future decommissioning expense (assuming a 48% tax bracket). This is somewhat misleading because decommissioning expenses will eventually be deducted from federal corporate income taxes when they are actually expended to pay for decommissioning. Nevertheless, decommissioning financing costs could be increased somewhat, if a utility did not have earlier use of, and earnings from, money entailed in annual deductions.

In certain limited situations, the IRS has indicated that it will allow annual deductions for decommissioning expense. Investor-owned utilities may be eligible for annual deductions if they meet the following criteria.*

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

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. 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. 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, the IRS has indicated that this 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-deductible blind trust fund for decommissioning expenses prior to definitive NRC policy, may wish to request a "revenue ruling"* on a specific method of treatment of decommissioning expense. The IRS will indicate whether a proposed method meets its tax exempt criteria and, if such criteria are not met, will indicate why not. IRS will rule only on a case-by-case basis, and not generically.

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.

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* A "revenue ruling" may be obtained [illegible] the specifics of a hypothetical or intended approa[illegible]ohn Withers, Assistant Commissioner, Technical, Internal Re[illegible]ce, 1111 Constitution Avenue, NW, Washington, DC 202[illegible].

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3. Comparative analysis of the "funding-at-commissioning," "sinking fund," and "funding at decommissioning" alternatives

a. Levels of assurance

As indicated in Section C, funding at commissioning 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 must also be sufficient to cover estimated inflation.

Of all the 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. Because funds deposited at start-up can grow in real terms over the life of a reactor, there could be a shortfall if a reactor is shut-down prematurely. To prevent such a shortfall, there could be required a deposit covering total decommissioning costs at reactor start-up, regardless of interest to be earned. 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 was indicated in the section on taxes, returning earnings to the utility may have negative implications for 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 ratepayer's funds.)

Providing the next higher level of assurance is the sinking fund option. Particularly if the fund is structured so that higher payments are made earlier in a facility's life, a relatively high degree of assurance of funds availability occurs. Providing the least amount of assurance is the funding-at-decommissioning alternative. All three alternatives, but particularly the latter two, do not allow sufficient accumulation of funds if a facility is forced to be shut down prematurely or if a utility encounters financial difficulties.

b. Cost considerations

Intuitively, one would expect the deposit-at-start-up option to be the most expensive, because if a utility is required to deposit funds in advance, these funds are removed earlier than with other funding options from its use. Normally, a utility can, over the long run, earn more from its own equity capital structure (e.g., usually a 12-15% return) than by investing in higher grade commercial securities outside the company (currently 9-11%). A deposit should not be invested in a utility's own assets for 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 should also not be allowed due to their increased risk or instability. Therefore, this paper considers only high-grade debt instruments such an non-electric-utility bonds, other high grade corporate bonds, or various government bonds.

Those decommissioning funding alternatives that allow greater use by the utility of its own capital structure should tend to be cheaper. The New York State 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.*

Other studies have indicated that the deposit at start-up method is perhaps not that much more expensive than other options. One study by Barry Mingst of the NRC** has 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. For example, Mingst assumes the following in one scenario: Decommssioning a PWR is estimated to cost $50 million in 1978 dollars; the interest rate is 8% on invested funds, the utility's discount rate is 10%, the inflation rate is 8%, and the tax rate is 48%, where each of these

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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 remainder of the analyses of costs of funding alternatives will rely primarily on two studies. One is Decost Computer Routine For Decommissioning Cost and Funding Analysis (NUREG-0514) by Barry C. Mingst, Office of Nuclear Material Safety and Safeguards, U.S. NRC. The second is Financing and Accounting Alternatives for Decommissioning Nuclear Plants by Preston A. Collins, Senior Consulting Engineer, Gilbert Associates, Inc., September 28, 1978.

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rates is the average annual rate over the expected life of the facility; and the actual facility life is 32 years, at which time the facility will be immediately dismantled. Given these assumptions, the Mingst study found that costs in constant dollars for the various funding options are: (1) Constant-fee sinking fund - $104 million; (2) Escalating-fee sinking fund - $83 million; (3) Deposit at facility start-up with earnings accumulated in the fund - $118 million; (4) Deposit at facility start-up with earnings returned to the utility - $79 million; (5) Straight-line negative salvage value depreciation - $210 million; and (6) Adjusted straight-line negative salvage depreciation - $130 million.

Mingst's study found that the same relationship among the various alternatives generally held if other values were assigned to the variables. For example, with other variables remaining the same as above but with an inflation rate of 6% rather than 8%, the following decommissioning costs are derived: (1) Constant-fee sinking fund - $70 million; (2) Escalating-fee sinking fund - $65 million; (3) Deposit at facility start-up with net earnings accumulated in the fund - $80 million; (4) Deposit at facility start-up with earnings returned to the utility - $78 million; (5) Straight-line negative salvage value depreciation - $142 million; and (6) Adjusted straight-line negative salvage value depreciation - $107 million.

The Collins study has indicated that the costs of the various alternatives may not be as high as the Mingst study indicates. Although the Mingst study provides a broad-based method for analyzing the sensitivity of most important variables affecting the costs of the various decommissioning fund alternatives, it has made simplifying assumptions regarding accounting for federal income taxes and the capitalization involved in the negative salvage value depreciation method. These appear to be the primary reasons for the overall higher costs associated with Mingst's projections.

Preston Collins, on the other hand, assumes the constancy of most variables, but examines how various assumptions about federal taxes and accounting for them can affect the ultimate present value cost of decommissioning funding alternatives. His study has assumed the following: Decommissioning currently costs $24 million; the plant will be immediately dismantled in 32 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 48%.

Collins then proceeds to analyze the three options being discussed in this section, using as his variables whether the federal income tax on the earnings of the fund is either paid by the fund itself directly or by the consumers through the rate structure* If paid indirectly by the consumers through the

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* This is 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 decomissioning. 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 cost of capital amortization under the lower capitalized option.

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. (See Appendix A for a more detailed description of these alternatives.)

The range of present-value costs (in 1978 dollars) derived in the study following the above assumptions is described below. In general, it proved cheaper to capitalize the fund at a lower level initially to include the tax deduction accruing when decommissioning occurs. Thus, options assuming full funding, which does not account for the eventual tax dedution, have not been included below with one exception.

1. Deposit at start-up. It was considerably less costly to have the customers rather than the fund itself pay taxes. When taxes were paid by the customers, the fund cost $30,825,000 when the fund amortization was flowed through and $32,801,000 when the amortization was normalized. When taxes were paid by the fund itself, the fund cost $52,955,000 when flowed through and $52,627,000 when normalized. (If decommissioning is assumed to cost $50 million, rather than $24 million as Collins assumed for his study, the above costs should be adjusted by a factor of 2.08 and are, respectively, as follows: $64,218,000; $68,334,000; $110,321,000; $109,638,000.)

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2. Funded reserve, or sinking fund. The range of costs varying according to the accounting systems used was narrower than the deposit method. Again, structuring the fund so that customers will pay income taxes due on the earnings of the fund is somewhat less costly than income taxes on earnings paid by the fund itself. When taxes on earnings were paid by the customers, the present value cost of this alternative was $28,000,000 when the amortization was flowed through and $29,305,000 when the amortization was normalized. When taxes on earnings were paid by the fund, the present value cost of this alternative was $38,408,000 when the amortization was flowed through and $45,153,000 when the amortization was normalized. (If decommissioning is assumed to cost $50 million, the above costs would be, respectively: $58,332,000, $61,051,000, $80,015,000, and $94,064,000.)

3. Unfunded reserve, or funding at decommissioning. Because an unfunded reserve earns no interest, income taxes on interest are not relevant considerations for this option, although a return on equity is earned on the reserve. The present value cost of the unfunded reserve option would be $37,346,000 if the federal income tax on the amortization were flowed through and $41,214,000 if the tax on the amortization were normalized. However, if the ultimate tax deduction is taken into account when the reserve is initially established, the present value cost when taxes on the amortization are flowed through is $22,290,000. (If decommissioning is assumed to cost $50 million, the above costs would be, respectively: $77,803,000, $85,861,000, and $46,347,000.)

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Several important conclusions can be drawn with regard to the costs of the funding alternatives from the results of the Mingst and Collins studies. First, it is cheaper to have the customers pay for taxes on a fund directly (rather than indirectly by capitalizing a fund at a higher level initially to cover annual tax payments). Not only is direct payment by the fund more costly, but it also may have negative effects on a utility's ability to attract capital, particularly because such capital would be used for a non-revenue-producing expense. Second and more broadly, the present value cost of the fund is more affected by federal income tax policies and the method of accounting chosen to deal with those policies than it is by variations in interest rates,* inflation rates, expected facility life, etc. Of course, this assumes that the country does not encounter the disasterous type of inflation suffered by Germany during their Weimar republic. Third, and most broadly, the relative present-value cost of the various funding alternatives is ambiguous. Each of the options has a fairly wide cost range depending on the tax accounting

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* 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.) Of course, the real rate of return discussed here does not consider income taxes.

assumptions used and each of these ranges overlaps with the other, so that varying accounting procedures used by and allowed of utilities in different states may imply 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 structure for a particular option since no one option is clearly preferable in all circumstances.

c. Analysis of the equity implications of the three funding options

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, equity requires customers to pay the same amount annually in real or present value cost over the life of the facility. This implies that the optimal funding alternative from the point of view of equity is some form of the sinking fund method or negative salvage value depreciation. The sinking fund would be structured such that annual payments would escalate to be equivalent to the rate of inflation. Although payments would increase year-by-year (assuming inflation continues) in nominal dollars, in constant dollars they would remain the same.

A deposit at start-up would theoretically impose relatively greater costs on users early in a facility's life or even prior to plant start-up, depending on how and whether the fund is capitalized. Customers receiving benefits from the plant well into its operating life will be paying considerably less for its decommissioning under the deposit method. Funding at decommissioning, or an unfunded reserve, could impose costs either on those customers later in its life or even those customers of the utility after the facility closed down.

In practice, an absolutely equitable payment stream is difficult to achieve. As Collins' study indicates, 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 alernative will have to be changed commensurately. If we assume that cost changes will inevitably be in the direction of higher costs than estimated, the theoretical inequity of the deposit at start-up option might be further mitigated as later customers are required to pick up increased costs. Further, this equity argument can get over-refined and over-stated. As a group, the customers at the end will be the same as at the beginning. Customers who move into another service area will place themselves at some unknown spot on a second utility's equity scale.

We can use, as a benchmark measurement of equity of the various alternatives, the ratio of the present value of the first payment to the last in the 32-year payment stream posited by Collins. The closer the ratio is to one (1), the more equitable the option is. For the deposit-at-start-up alternative, the best ratio achieved was 4.3. For the sinking fund alternative, the best ratio achieved was 2.6. For the unfunded reserve alternative, the best ratio achieved was 1.6. Thus, for Collins' evaluation of the alternatives, the unfunded reserve is the most equitable, primarily because customers are paying relatively equal annual payments for the reserve which is used by the utility as an internal source of capital. (A similar analysis of Barry Mingst's results indicates the following results: constant fee sinking fund - 11.7; escalating fee sinking fund -1.0; deposit-at-start-up -11.7; straight line depreciation - 11.7; and adjusted straight line depreciation - 1.0.)

Unfortunately, the achievement of equity by a fund tends to reduce its ability to provide assurance of the availability of funds in case of premature shut-down. This is so because the greater amounts of funds collected early in a facility's life to provide such assurance, the more inequitable the fund tends to be.

d. Administrative impacts

Any of the three direct 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. 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. In theory, both the deposit-at-start-up and funding-at-decommissioning methods require less administrative effort than the sinking fund method. This is because, for the deposit method, once the deposit is made, the fund can accumulate interest with perhaps only occasional shifts in investments required, and because, for the funding at decomissioning 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. As is true with all options, if estimates of eventual decommissioning costs or inflation cause the amount on deposit to be less than required, additional administrative effort will be necessary. In sum, there will not likely be sufficient administrative difference between the deposit method and the sinking fund method. The unfunded reserve approach will require less administrative effort but this does not appear to be significant.

e. 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 estimates of final decommissioning cost resulting from changes in inflation rates, technology, interest rates, etc. A sinking fund is 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 it can be added to or subtracted from as necessary, or by combining the deposit with a variable-rate sinking fund. The funding-at-decommissioning alternative is, of course, the least affected by change since funds are not actually involved until decommissioning takes place except that changes in depreciation rates must be passed on to the customer.

Care will have to be taken, however, such that any structural shift will not effect the potential tax-exempt status of certain methods. Thus, the annual 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 utililty because of an over-estimate of decommissioning cost.

f. Adaptability to multiple 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.

No generalizations can be made at this point concerning the overall superiority of one funding option over another with regard to jurisdictional problems raised by joint ownership. Although NRC has funded a project to study these problems with the New England Regulatory Assistance Program, the project has not yet been completed. If any funding alternative were shown to be clearly superior to any other, then most states should tend to select that one. So far, this has not proven to be the case as is evidenced by the wide diversity of

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funding options approved by different states. The extent to which utilites can own plants jointly now indicates that jurisdictional problems should be relatively minor. If utilities from different states can fund plants for over $1 billion, they should be able to jointly fund decommissioning costs for $50 million.

4. Decommissioning Insurance and The Pooled Approach to Funding for Decommissioning

a. Description of the insurance option

Another alternative is to have either the nuclear insurance industry or some other part of the insurance industry provide decommissioning insurance. Because decommissioning 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 pools 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.

With the above distinctions in mind, the NRC has asked American Nuclear Insurers (ANI)* and Nuclear Mutual Limited (NML)* to evaluate the role of the

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* ANI is the larger of the two nuclear insurance pools, offering 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.

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nuclear insurance industry in providing assurances for funding for decommissioning. NML's response was in 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, on the other hand, 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. First, 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-exempt.

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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, the payments 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, and let 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 $30,000,000. 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.

b. Analysis of Insurance Option

Analyzing 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 begun to evaluate 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.

Nevertheless, certain generalizations and conclusions can be made. In terms of the level of assurance provided, decommissioning insurance is excellent.

Assuming that decommissioning insurance would cover whatever balance of funds was necessary to cover decomissioning costs, such payments would be assured. 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. 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 decomissioning expenses for which they were legally obligated. Nevertheless, the insurance method might be more vulnerable to a rash of premature shutdowns than would be the case of each utility handling its own decommissioning independently. Potential capacity problems, if there were very many premature shutdowns ,could jeopardize the insurance option.

From an equity standpoint, the insurance option is also good. Because insurance premiums involve annual 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 the 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 an expensive one. 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 shut-down insurance. Assuming the ratio of these payments, if not the absolute amounts themselves, remains constant, the insurance option will be one third more expensive than the sinking fund before taxes, and approximately one sixth more expensive after taxes, since the premature shutdown premium would most likely be deductible from income taxes.

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.

5. Effect of Funding Alternatives on Other Decommissioning Modes

Thus far we have discussed various alternatives for assuring the availability of funds for decommissioning by implicitly assuming that the facility would be immediately dismantled. In addition to immediate dismantlement -- i.e., a facility will be decommissioned immediately after it ceases operation -- three other basic decommissioning modes exist. A facility may be mothballed with complete dismantlement and removal of the facility occurring at some indefinite point in the future. During the mothballing phase, one

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mode assumes that the facility will be actively safeguarded through custodial care; the other mode assumes that the facility will be passively safeguarded, possibly through in-place physical barriers. The third additional option assumes that the facility will be permanently entombed at its site.

The PNL study found that the constant dollar cost for decommissioning via mothballing with passive safe storage for 30 years was approximately 20% higher than immediate dismantlement, and for decommissioning via mothballing with custodial safe storage for 30 years was approximately 40% higher than immediate dismantlement. However, although costs were higher, delaying dismantling for 30 years could cause a reduction in overall potential man-rem exposure of almost 70%.

Delayed dismantling becomes even 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 mothballing and delayed removal of Millstone 3.* These costs are in addition to the already higher technological costs of the delayed dismantling options.

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* Preliminary Nuclear Power Plant Decommissioning Study for Northeast Utilities, January 1979.

When inflation and potential interest on a fund are taken into account, current dollar cost is reduced as long as the interest rate exceeds the inflation rate. For example, assuming an inflation rate of 5% and interest rate of 7%, the range of present worth costs for local property taxes is projected to be from $9.1 million to $85.6 million depending on the reactor. This factor alone tends to indicate that, under most circumstances, immediate dismantling is significantly cheaper than any of the delayed options.* Local property tax costs associated with delayed dismantlement override the somewhat lower finanical costs Mingst found in some delayed dismantlement funding options.

Conclusions and Recommendations

It has become apparent from the above discussion that funding for decommissioning is a complex problem with few definitive answers. So much of the various funding alternatives depends on assumptions about events that may or may not occur thirty or more years hence. The costs and effectiveness of the alternatives are somewhat sensitive to the inflation rate, the interest rate, technological changes and other variables. 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 pressures and philosophies of rate-making.

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* We recognize again however that there might be other reasons (e.g., the desire to reduce worker radiation exposure) that would argue in favor of delayed dismantling.

Nevertheless, certain patterns emerge which may lead to some generalizations. First, assuring that funds for decommissioning will be available by some funding method is desirable both 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. (Collins' study indicates that under certain accounting assumptions, the unfunded reserve may be very equitable, but such equity varies according to how the reserve is amortized, or if it is amortized at all.) The alternative of relying solely on an unfunded reserve for decommissioning, even if acceptable to a particular state, is so fraught with uncertainty as to be questionable under the NRC's responsibility to assure that a utility is financially qualified to safely shut down a licensed reactor.

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 level of assurance. NRC should avoid imposing requirements so specific that they impinge on state or federal rate-making authority or on utility accounting practices, particularly when the effects of those requirements are not all that clear. The NRC's function should be to require assurance of the availability of decommissioning funds within reasonable bounds of cost-effectiveness.

Third, it is by no means clear that premature shutdown insurance will be available. In conjunction with one of the other funding options, and assuming a stable and reliable insurance market, this would appear to offer the greatest assurance of the availability of funds with good equity characteristics, albeit as a relatively high cost.

Without the insurance option, on the basis of assurance and cost, 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. (See Collins' case numbers 5 and 6.) Although this option penalizes customers earlier in a facility's life to the benefit of later customers, it is not unreasonably inequitable. Further, although funds are not completely provided in advance because the tax benefit has been factored in, this alternative under most circumstances provides a high level of assurance of funds availability thoughout the facility's life at a cost that is usually not substantially higher in real dollars than that of the sinking fund. By taking account of the eventual tax benefit, the initial deposit is substantially reduced. This should not have a negative effect on the level of assurance provided, because even utilities in serious financial difficulty will be able to use this tax benefit at time of decommissioning. One possible problem with the deposit approach is that a utility may have problems raising capital for decommissioning because it is a cost not contributing to generating revenue. However, if considered as part of the normal capital cost of the facility, this problem should not be serious. Finally, the point should be made that for publicly-owned utilities not subject to federal taxes, the present value cost of this method will be less, although the initial deposit will be greater. (See Collins' case number 1.)

II. Funding for Decommissioning of Fuel Cycle Facilities, Experimental and Research Reactors, and Byproduct Licensees

A. Introduction and Statement of Problem

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 Part I of this paper.

Decommissioning nuclear facilities and licensees other than non-power reactors represents a wide diversity of technique, risk, and cost. Many of the decommissioning studies being done by Pacific Northwest Laboratories and others for the NRC on decommissioning various nuclear facilities have not yet been completed. Consequently, several conclusions in this section are necessarily tentative.

Although it is difficult to generalize about the wide diversity of licensees operating non-reactor facilities or possessing materials licenses, it is safe to say that many are not as financially secure as the regulated utilities operating large commercial power reactors. Notable exceptions to this situation abound 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 been established to run a particular facility or facilities. In case of defaults of the subsidiary,

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the assets of the parent company could probably not be touched. In many other cases, licensees may be small companies, universities, hospitals, and, in the case of many byproduct materials licensees, individuals.

Events of the past few years have also 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. Finally, there are the major financial difficulties posed to New York state by the West Valley plant.

The cost of decommissioning various facilities varies, of course, according to the function and size of the facility being considered. The cost to immediately dismantle 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 immediate dismantlement; $2.6 million for entombment; and $15.8 million for dismantlement delayed for 30 years. 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 $1.4 billion for complete exhumation and reburial of the wastes in a deep geological repository. The cost to decommission uranium mining and milling installations are estimated to be about $5 million. Small research and experimental reactors will mostly like cost about $5-10 million. Materials licensees should show the widest variation in cost of decommissioning. Cost of removal of disposal of radioactive material from byproduct licensees could range from a few hundred dollars to over one million dollars.*

As with reactors, another major reason to require some assurance of decommissioning funds is 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 decommissioning funds is the decommissioning modes 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 assurred.

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

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 25% of basic cost should be added to estimates.

B. Evaluation Criteria

All evaluation criteria discussed in Part I of this 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. Although state criteria must be compatible with NRC regulations, this should not mean that the NRC is heedless of state needs.

C. Alternatives for Assuring that Funds Will be Available and D. Analysis of Alternatives

1. Variations in alternatives

All funding methods considered in Part I 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.) We are able to exclude funding from public revenues at the state or federal level for the reasons that were used in the case of power reactors. One possible exception to excluding public funding is in the case of materials licensees where one alternative would be to impose a set license fee that could include costs for disposal of the licensed material.

Another difference 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

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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 to bonds.

states currently require licensees under their jurisdiction to post surety bonds as a method of assuring the availability of decommissioning funds. The NRC staff has yet to be convinced, however, that surety bonding provides adequate assurance of funds over an extended period of time. As discussed in Part I, 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 disappear.

2. Federal income tax considerations

As with commercial power reactors, decommissioning expenses for other nuclear facilities and licensees would not be deductible from income tax under IRS regulations until actually incurred. For small materials licensees or non-profit licensees such as universities and hospitals whose revenues would not subject them to the full 48% tax rate, this 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 principal and interest would not be subject to federal tax. Finally, 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 methods Collins discusses 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 public utility commissions and the Federal Energy Regulatory Commission.

3. Comparative analysis of the "funding-at-commissioning," "sinking fund," and "funding at decommissioning" alternatives

Most of the analysis in the comparable section of Part I is also valid here. The deposit-at-start-up method provides the greatest assurance that funds will be available; the funding-at-decommissioning method provides the least assurance. As indicated above, special care will have to be taken for those facilities who may be in custodial safe storage for 200 years or longer. Certainly, to expect companies to be around to pay, such expenses annually as they are incurred for so long a period of time would invite cases of default.

Another consideration is the effect of various funding methods on small licensees. Of course, the NRC's primary duty is to assure the funding of decommissioning as part of its mission to protect public health and safety and the environment. 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. Although this argument has some merit, its effect could run counter to U. S. antitrust policies, 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.

With respect to cost, the analyses performed by Collins and Mingst can be applied just as easily to the larger fuel cycle facilities and, thus, we can draw essentially the same conclusions as we drew in Part I. For smaller licensees, the analysis would apply but would probably be too detailed for the level of cost involved.

With respect to equity also, many of the same conclusions apply. 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.

One final consideration involves the administrative burden that could be incurred with 20,000 materials licensees. Although few generalizations can be made at this point, 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 burdenson and not cost-effective.

4. Decommissioning insurance for non-power reactor facilities

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.

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 NRC should reject the alternative of assuring funding for decommissioning through an unfunded reserve as being too fraught with uncertainty. Also as with reactors, our analysis indicates that the NRC should allow a wide latitude of approaches to achieve assurance of the availabilty of funds.

Of all the options, the best appears to be the deposit-at-start-up method for the same reasons as discussed in Part I. The sinking fund should also be acceptable in those cases with little likelihood of premature shutdown. Unlike reactors, it appears that, 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. Finally, if available, decommmissioning insurance should prove to be acceptable under most circumstances.

Appendix A

Preston Collins' study addresses three fundamental approaches to funding for decommissioning -- funding at commissioning, the funded reserve, or sinking fund, and the unfunded reserve or funding at decommissioning. For each of these alternatives, when applicable, he examines three basic income tax effects via two approaches to each of these effects. They are:

1. Should the fund anticipate the use of the eventual tax deduction for decommissioning expense?

1a. A fund or reserve is established at the full cost of decomissioning, without allowing for a tax deduction received when decommissioning is actually performed and paid for. When the deduction was received, it would be returned to the customers at that time.

1b. A fund or reserve is established at the net cost of decommissioning, which allows for a tax deduction received when decommissioning is actually performed and paid for.

2. Should taxes on fund earnings be paid directly by the fund?

2a. A fund is established at a sufficiently high level such that its earnings are sufficient both to build the fund at the appropriate rate, plus pay income tax on those earnings. Of course, the customer pays such taxes indirectly through taxes on the higher amortization required by this approach.

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2b. A fund is established such that the customers pay taxes on its earnings directly through revenues. Thus it is capitalized at a significantly smaller amount than in approach 2a.

3. <u>How should tax effects from different accounting methods be treated?</u>

3a. Income tax on the amortization of the fund or reserve is "normalized." Basically, this requires a utility to reflect the discrepancy between accelerated and straight-line depreciation in a deferred tax account. As Collins states, "The company is financing the tax on the decommissioning amortization on which customers are paying a rate of return instead of the tax." (p.-5)

3b. Income tax on the amortization of the fund is "flowed through." This method allows for any tax savings (or costs) through accelerated depreciation to be passed on directly and immediately to the consumer.

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