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Report to Congressional Requesters

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NUCLEAR REGULATION

Better Oversight Needed to Ensure Accumulation of Funds to Decommission Nuclear Power Plants

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Resources, Community, and
Economic Development Division

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The Honorable John D. Dingell
The Honorable Ralph M. Hall
The Honorable Edward J. Markey
House of Representatives

This report responds to your request that we review the adequacy of electric utilities' efforts to accumulate funds to eventually decommission their nuclear power plants after the plants have been permanently shut down.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 20 days after the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Honorable Shirley Ann Jackson, Chairman, Nuclear Regulatory Commission; and the Honorable Jacob J. Lew, Director, Office of Management and Budget. We will make copies available to others upon request. Please contact me at (202) 512-8021 if you or your staff have any questions. Major contributors to this report are listed in appendix III.

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Associate Director, Energy, Resources,
and Science Issues

Executive Summary

The estimated cost to dismantle all of the commercial nuclear power plants in this country, dispose of the resulting radioactive waste, and clean up the plant sites is about $30 billion dollars (in 1997 present-value costs), of which, about $14 billion is currently unfunded. This process, called decommissioning, is necessary because, following the retirement of a nuclear power plant and the removal of the plant's spent (used) fuel, a significant radiation hazard remains. Utilities licensed by the Nuclear Regulatory Commission (NRC) to own and operate nuclear power plants collect money from their electricity customers to be used for decommissioning. In recent years, the Federal Energy Regulatory Commission and at least 18 states have enacted legislation or issued regulations promoting competition within their electricity industries. Competition, according to NRC, could result in economic pressures to cut costs or electricity rates, thus affecting the availability of funds for decommissioning.

Concerned about the potential cost to decommission nuclear power plants and the implications of competition within the electricity industry, the congressional requesters of this report asked GAO to determine if (1) there is adequate assurance that NRC's licensees are accumulating sufficient funds for decommissioning and (2) NRC is adequately addressing the effects of electricity deregulation on the funds that will eventually be needed for decommissioning.

To address the first issue, GAO compared, for 76 licensees owning 118 nuclear plants, the amount of decommissioning funds that each licensee actually accumulated through 1997 with the expected amount. Making these comparisons required GAO to assume future economic and plant operating conditions. GAO made baseline, or most likely, assumptions and then, using more pessimistic and more optimistic assumptions, tested the effects of changes in these assumptions on the results.

Background

From 1959 through March 1999, a total of 125 nuclear power plants were licensed to operate. Currently, there are 104 plants with operating licenses. While NRC has the authority to require its licensees to assure that they will have sufficient funds for the eventual decommissioning of their nuclear power plants, it does not have the authority to directly regulate the economic affairs of its licensees. Most of these licensees are investor-owned utilities who generate electricity from a variety of sources, including coal, gas, and hydropower and whose economic activities have traditionally been regulated by state utility commissions and the Federal

Energy Regulatory Commission. Thus, licensees' financial plans for decommissioning are subject to the review of and approval by state utility commissions as a part of the economic regulation of licensees' electricity generating and delivery systems. Traditionally, through the regulation of electricity rates, the utility commissions allowed the licensees to include charges for eventual decommissioning. Portions of the charges that licensees' customers pay for their electricity are earmarked for deposit into funds that may be used only to pay decommissioning costs. Until decommissioning occurs, the money in these funds is invested to earn income.

By July 1988, when NRC began requiring licensees to provide specific assurances that funds would be available to decommission their plants, 114 plants were already licensed to operate. At that time, NRC required licensees to provide "reasonable assurance" that sufficient funds would be available to decommission their nuclear power plants. Licensees must use a formula contained in NRC's regulation to calculate the minimum amounts of funds to be accumulated over the operating life of each of their plants. To provide this assurance, practically all licensees agreed to establish externally-managed sinking funds to accumulate funds for decommissioning.[1] Money collected from customers for decommissioning would be deposited in these funds, invested to earn income, and then made available when needed to pay decommissioning costs.

Results in Brief

Although the estimated cost to decommission a nuclear power plant is on the order of $300 million to $400 million in today's dollars, NRC does not know if licensees are accumulating sufficient funds for this future expense. GAO's analysis showed that, under likely assumptions, 36 of 76 licensees had not accumulated sufficient decommissioning funds through 1997. However, all but 15 of these 36 licensees appeared to be making up their funding shortfalls with recent increases in the rates that they are accumulating decommissioning funds. Using more pessimistic and optimistic assumptions would increase or decrease the number of underfunded licensees, respectively. For example, some experts anticipate that the deregulation of the electricity industry will result in the retirement of some nuclear power plants before sufficient funds to decommission the plants have been accumulated. Although utility commissions have permitted licensees to continue charging their customers for the costs of

[1]The Tennessee Valley Authority elected to provide, as permitted by NRC's regulations, a statement of intent to fulfill its financial obligations to decommission its six nuclear power plants. However, in December 1998, the Authority notified NRC that it had begun to use external sinking funds.

decommissioning prematurely retired plants, this financial safeguard could be affected by states' efforts to deregulate the electricity industry.

To address the movement toward deregulating the electricity industry, in November 1998 NRC began requiring its licensees to provide additional financial assurances if the Federal Energy Regulatory Commission and/or state utility commissions will no longer guarantee, through the regulation of electricity rates, the collection of sufficient funds for decommissioning. However, one additional form of financial assurance—the early payment of decommissioning costs—may not be practicable or affordable. Also, NRC considered requiring licensees to accelerate decommissioning funding as a hedge against the premature retirement of plants but rejected the concept because of possible adverse effects on licensees' finances. On the other hand, NRC's alternative methods to the collection of decommissioning funds earlier essentially rely on the continued financial health of the licensee or its parent company. Thus, the effectiveness of NRC's 1998 regulatory changes will likely depend on how vigorously NRC monitors the financial health of its licensees. In this regard, licensees must now provide financial reports every 2 years to NRC so it can monitor financial assurances for decommissioning. However, NRC did not establish thresholds for clearly identifying acceptable levels of financial assurances or establish criteria for identifying and responding to unacceptable levels of assurances.

Principal Findings

Regulatory System Did Not Ensure Adequate Funding

Under its 1988 regulations, NRC did not require licensees to periodically report balances in their decommissioning funds and the rates at which they were accumulating additional funds. GAO's comparison between actual and expected fund balances at the end of 1997 showed that, under baseline assumptions, 36 of 76 licensees had not yet accumulated the expected level of funds. These assumptions addressed such factors as the initial decommissioning costs, cost-escalation rates, net earnings on the investments of licensees' decommissioning funds, and the operating life of plants. Under pessimistic and optimistic assumptions, 72 and 8 licensees, respectively, have not accumulated the expected levels of funds.

Although a licensee might have collected less than the expected funds for decommissioning through 1997, increasing the annual amounts collected

in 1998 and subsequent years may enable the licensee to accumulate sufficient funds by the time the licensee retires its plants. GAO compared the amounts that licensees collected in 1997 with the annual average of the present value of the amounts that they would have to accumulate each year over the remaining life of their nuclear plants to have sufficient funds to decommission their plants. GAO's results suggest that, under the baseline assumptions, most licensees have recently increased funding to make up earlier funding shortfalls. For example, only 17 licensees, including 15 that had not collected sufficient funds through 1997, are not yet collecting the amounts that they will need to collect each year to meet their decommissioning obligations. Under pessimistic and optimistic assumptions, 66 and 4 licensees, respectively, are not collecting funds at sufficient rates. Currently, 21 nuclear power plants have been retired prematurely, and the deregulation of the electricity industry is expected to increase this number. Moreover, 19 of 26 plants that one investment house considers as candidates for early retirement are owned by licensees that have not accumulated decommissioning funds at the expected levels. To date, utility commissions have permitted licensees to continue collecting decommissioning funds from their customers even if their plants have been retired early. Also, bankruptcy courts have allowed licensees to continue accumulating decommissioning funds after they filed for bankruptcy.

Adequacy of Assurance Depends on Financial Reviews

In anticipation of the electricity industry's deregulation, in November 1998, NRC began requiring that, when the collection of decommissioning funds is no longer guaranteed by the regulation of electricity rates, licensees must provide added assurance through a variety of means that they will meet their decommissioning obligations. The prepayment of expected decommissioning costs, the purchase of surety instruments, and/or the purchase of insurance are methods acceptable to NRC for providing added financial assurance. Licensees owning nuclear power plants have not used these methods; however, and both NRC and industry representatives said that these types of up-front payments might not be available or might be prohibitively expensive.[2] Other methods are self guarantees and guarantees by parent companies. Guarantees must be backed by specified financial tests, such as a parent company's having net working capital, tangible net worth, and assets located in the United States worth at least six times the amount of decommissioning funds that would be needed.

[2]According to NRC, the terms of three recent sales of nuclear power plants have included the prepayment of all estimated decommissioning costs and, in its view, will likely be the preferred means of assuring that decommissioning funds are available for future sales transactions.

NRC elected not to address the likelihood of premature plant retirements because, in its view, a few premature closures do not justify requiring all licensees to accelerate the collection of their decommissioning funds. NRC intends to continue its practice of addressing early plant retirements on a case-by-case basis. Also, at NRC's request, the administration included a provision in its 1999 proposed bill on the deregulation of the electricity industry that would give priority to funding decommissioning in bankruptcy proceedings.

NRC also began requiring licensees to report financial information on decommissioning funds every 2 years beginning by the end of March 1999. Each licensee must report the amounts of decommissioning funds accumulated, expected to be needed at a plant's retirement, and remaining to be collected each year. The reports must state the licensee's assumptions for escalating decommissioning costs, estimating the fund's earnings, and discounting projections for the fund. After reviewing the initial reports from licensees, NRC intends to consider the need for further rulemaking in this area.

The new financial-reporting requirements should provide NRC with the information to address such issues as the rates at which licensees are accumulating decommissioning funds, the effect of the electricity industry's deregulation on financial assurances for decommissioning, and the possibility of the additional early retirements of uneconomical plants. However, NRC has not explained how it intends to act on the reported financial information. For example, NRC has not established criteria for requiring a licensee to change how it accumulates funds or to provide additional assurance that funds will be available. Instead, NRC stated that it will consider issuing additional guidance after licensees have submitted their initial reports.

Recommendations

To provide for the logical, coherent, and predictable oversight of licensees' financial assurances for decommissioning their nuclear power plants, GAO recommends that the Chairman, NRC, provide licensees and the public with information on the (1) objectives of, scope of, and methods used in NRC's reviews of licensees' financial reports; (2) thresholds for identifying, on the basis of these reviews, acceptable, questionable, and unacceptable indications of financial assurances; and (3) criteria for actions to be taken on the results of these reviews.

Agency Comments and GAO's Evaluation

GAO provided NRC with a draft of this report for review and comment. NRC said that GAO's recommendations merit serious consideration but disagreed on the timing of their implementation. NRC's position is that it should not act unless it determines, on the basis of licensees' initial status reports, that problems exist with licensees' financial assurances for decommissioning. However, GAO believes that a more proactive approach is needed to inform licensees and the public about NRC's expectations about financial assurance. As a result, GAO made no changes to the recommendations.

NRC also made several comments on the complex changes that are occurring in the electric utility industry and the interactions among NRC, utility commissions, and the nuclear power industry. Where appropriate, GAO incorporated these comments into the text of the report. NRC's comments and GAO's response are discussed at the end of chapter 3 and in appendix II.

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Abbreviations

DOE	Department of Energy
EIA	Energy Information Agency
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GAO	General Accounting Office
GDP	gross domestic product
NRC	Nuclear Regulatory Commission

Introduction

The electricity industry is the largest industry in the United States. According to the Department of Energy's (DOE) Energy Information Administration (EIA), the industry had total assets worth about $700 billion in 1993 and has revenues of about $200 billion annually.

Nuclear power plants have provided about 20 percent of the nation's electricity in recent years. Most nuclear power plants are owned and operated by investor-owned utilities. Investor-owned utilities comprise only about 8 percent of the nation's 3,200 electric utilities but generate and sell over 75 percent of the electricity. One such utility—the Commonwealth Edison Company—received the former Atomic Energy Commission's first license to operate a civilian nuclear power plant almost 40 years ago. Since then, the Atomic Energy Commission and its successor regulatory agency—the Nuclear Regulatory Commission (NRC)—have issued operating licenses for a total of 125 plants. Twenty-one of the plants licensed to operate have been permanently retired, leaving 104 with operating licenses.

The Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended, require NRC to, among other things, protect the radiological health and safety of the public. Under this mandate, NRC licenses nuclear power plants to operate for up to 40 years and continually regulates the utility-licensees' operation of these plants. In addition, NRC permits utilities to seek license extensions of up to 20 years.

Regulatory Challenges to Decommissioning Nuclear Power Plants

Decommissioning a nuclear power plant involves dismantling the structures and equipment at the plant, properly disposing of the resulting radioactive and other wastes, and then ensuring that the plant site complies with applicable environmental standards. Decommissioning involves a combination of technical, financial, and regulatory challenges. For example, the nuclear reactor vessel, other plant components, and concrete surfaces of various rooms in the plant are radioactive or contaminated with radioactive material. Therefore, the processes of maintaining the plant in a safe condition prior to dismantling it and disposing of the resulting radioactive wastes requires constant attention to protecting workers and the public from exposure to radiation.

The interval of time between the initial operation of a plant and its eventual dismantling also presents challenges to licensees and NRC. This interval can be as short as a few years if a plant is retired earlier than expected and dismantled shortly thereafter or as long as 40 to 60 years if a

plant operates for an extended license period.[1] In lieu of dismantling a plant immediately after its retirement, a utility may instead elect to decommission a plant by placing the plant in safe storage before dismantling it, as long as the entire decommissioning process is completed within 60 years. This feature of NRC's regulation allows utilities to defer dismantling a retired plant if they (1) are awaiting the retirement of a colocated plant, (2) need to give DOE time to remove all of the spent (used) fuel from the plant, and (3) need to allow the radioactivity in the plant to decay before dismantling the plant, among other things.

Finally, the financial aspects of decommissioning also present challenges to utility-licensees. For example, although actual decommissioning experience is limited, decommissioning a single plant is expected to cost hundreds of millions of dollars. NRC does not have the authority to regulate the manner in which licensees recover from their customers the costs of constructing, operating, and decommissioning nuclear power plants. Most licensees are investor-owned utilities that traditionally have been provided a monopoly within their service areas. In return, these utilities built generating plants, including nuclear, coal, gas, and hydro power plants, and transmission and distribution facilities to provide electricity for all of the existing and future customers within their service areas. Under this traditional "cost-of-service" regulation, state public utility commissions approved electricity rates that reflected the utilities' costs of building and operating their electricity systems and approved the financial returns on these investments. Similarly, the interstate aspects of the electric utility industry, including financial transactions, wholesale rates, and interconnection and transmission arrangements, are regulated by the Federal Energy Regulatory Commission (FERC). In this context, utilities' proposed arrangements to finance the decommissioning of their nuclear plants are a part of their financial operations that are subject to review and approval by their respective state public utility commissions and FERC.[2]

NRC's authority to require utilities to accumulate funds to decommission their nuclear power plants is derived from its responsibilities under the Atomic Energy Act of 1954, as amended, to regulate the safety of nuclear power. Until 1988, NRC required licensees to certify that sufficient financial resources would be available when needed to decommission their nuclear

[1]NRC's regulations permit a licensee to complete decommissioning beyond 60 years if other factors affect the licensee's capability to carry out decommissioning, such as the unavailability of capacity to dispose of radioactive waste.

[2]Other utilities, such as the Tennessee Valley Authority, are publicly owned, rather than investor-owned. These utilities are either economically self-regulating or subject to other constraints on their financial affairs.

power plants but did not require these licensees to make specific financial provisions for decommissioning. On July 26, 1988, NRC's original regulations on the technical and financial aspects of decommissioning became effective. By then, NRC had licensed 114 plants to operate.

NRC's 1988 regulations provided utilities with the following options for providing decomissioning financial assurance:

- The prepayment of cash or liquid assets into an account segregated from the licensee's assets and outside the licensee's administrative control. Prepayment may be made in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities.
- External sinking funds. These types of funds are established and maintained through the periodic setting aside of funds in an account segregated from the licensee's assets and outside the licensee's administrative control. An external sinking fund may be in the same forms permitted for prepayment.
- A surety method or insurance. A surety method may be in the form of a surety bond, letter of credit, or line of credit payable to a trust established for decommissioning costs.
- For "federal licensees," such as the Tennessee Valley Authority, a statement of intent that decommissioning funds will be obtained when necessary.

NRC recognized both the uncertainty over decommissioning costs and the authority of public utility commissions and FERC to regulate the economic affairs of utilities. Therefore, NRC approached the regulation of the financial aspects of decommissioning by requiring utilities to provide "reasonable assurance" that sufficient funds would be available to decommission their nuclear power plants when the plants are permanently shut down. Among other things, NRC required, by July 27, 1990, each holder of an operating license to (1) certify that the licensee would provide the required financial assurance for decommissioning; (2) calculate, using a formula contained in NRC's regulations, the minimum amount (expressed in current-year dollars) that utilities would accumulate for decommissioning their plants by the time they expect to retire them;[3] and (3) provide a copy of the financial instrument(s) executed to provide the required financial assurance. Essentially all utilities have elected the option of establishing external sinking funds to finance future

[3]The amount stated in the certification may also be based on a site-specific cost estimate for decommissioning the plant as long as the site-specific amount exceeds the amount calculated using NRC's formula.

decommissioning costs.[4] A portion of the charge that utilities' customers pay for their electricity is earmarked for deposit in these funds, and the funds are invested to earn income.

In its regulations, NRC deferred to utilities and their rate regulators the details of collecting the required decommissioning funds. NRC requires only that the amount actually accumulated by the end of a plant's operating life equals the projected cost to decommission the plant. About 5 years before the projected end of plant operations, NRC requires a utility to submit a preliminary decommissioning cost estimate that includes an up-to-date assessment of the major factors that could affect the cost to decommission its plant. Also, if necessary, the cost estimate shall include plans for adjusting needed funds for decommissioning to demonstrate that a reasonable level of assurance will be provided so that funds will be available when needed to cover the cost of decommissioning. Finally, not later than 2 years after a plant has been permanently shut down, the utility must submit to NRC a decommissioning report that includes, among other things, a site-specific decommissioning cost estimate.

Deregulation of the Electricity Industry

After about 10 years of experience with NRC's 1988 decommissioning regulations, the electricity industry has begun to change in ways that have prompted NRC to reassess the adequacy of its regulations governing nuclear power plants, including financial assurances for decommissioning retired plants. Over the next 10 years or so, many states are expected to replace their traditional systems of economic regulation of monopolistic electric utilities with more-competitive, less-regulated environments mainly for the generation of electricity but, to a lesser degree, for the transmission and distribution of electricity as well. Competition, according to NRC, could result in economic pressures that will affect the availability of adequate funds for decommissioning and how utilities address maintenance and safety in nuclear power plant operations.

Currently, the Congress is considering a number of bills to restructure the retail electricity industry to promote a more efficient and market-driven industry. Also, as of September 1997, 49 states had considered reforming their retail electricity markets. As of June 1, 1998, FERC and at least 18 states had either enacted legislation or issued comprehensive regulatory

[4]The principal exception is the Tennessee Valley Authority, which elected to use the statement of intent available to federal licensees for its six nuclear power plants that have been licensed to operate. In December 1998, the Authority told NRC that it had begun to use external sinking funds because it was no longer eligible to use a statement of intent.

orders implementing plans to restructure the industry.[5] In California, for example, a plan to produce competitive electricity markets and allow consumers to choose their electricity supplier went into effect in March 1998. Also, some of these initiatives would encourage or require the restructuring of the affected electricity industry. Specifically, utilities that have traditionally generated, transmitted, and distributed electricity would be encouraged or required to separate the operation of electricity generation systems from the operation of transmission and distribution systems.

Objectives, Scope, and Methodology

Concerned about the potential costs to decommission nuclear plants and the implications of a competitive electricity environment on the ability of plant owners to finance decommissioning projects, the congressional requesters of this report asked us to determine if (1) there is adequate assurance that NRC's licensees are accumulating enough funds to decommission their nuclear power plants when the plants are retired and (2) NRC is adequately addressing the effects of electricity deregulation on the funds that will eventually be needed for decommissioning.

To address both of our objectives we met with, and obtained documentation from, officials of the following organizations:

- NRC, Rockville, Maryland.
- Nuclear Energy Institute, Washington, D.C. (The Institute represents the nuclear industry, including utilities that operate nuclear power plants.)
- National Association of Regulatory Utility Commissioners. (The Association represents public utility commissions and other state-level rate-setting entities.)
- National Nuclear Safety Network (a public interest organization).
- public utility commissions of Oregon (Salem), Maryland (Baltimore), and New Hampshire (Concord).
- Portland General Electric (Portland, Oregon); Commonwealth Edison (Chicago, Ill.); Office of Consumer Advocate (Concord, NH.); and Moody's Investors Service (New York, N.Y.).

To address the adequacy of assurance that NRC's licensees are accumulating enough decommissioning funds, we also met with, and obtained documentation from, TLG Services, Inc., which prepares decommissioning cost estimates for owners/licensees of nuclear power

[5]The 18 states are Arizona, California, Connecticut, Illinois, Maine, Maryland, Massachusetts, Michigan, Montana, Nevada, New Hampshire, New Jersey, New York, Oklahoma, Pennsylvania, Rhode Island, Vermont, and Virginia.

plants and Dr. Bruce Biewald, a consultant to groups that participate in state public proceedings on setting electricity rates, including charges for decommissioning. We also analyzed whether licensees or their parent companies have (1) accumulated decommissioning funds at a rate consistent with the percentages of their reactors' operating life already used up (i.e., the fund for each reactor should equal this percentage times the present value of its future decommissioning cost) and are (2) currently (viz., 1997) adding enough money to their decommissioning funds (i.e., assuming that contributions in future years will increase at the funds' after-tax rate of return) to accumulate sufficient funds to decommission their plants when they are retired. The scope and methodology that we used in these two analyses are discussed in appendix I. To address whether NRC is adequately considering the effects of electricity deregulation on the funds that will eventually be needed for decommissioning, we also obtained and reviewed public comments on NRC's advance notice of proposed rulemaking for decommissioning financial assurances and on the subsequent proposed rule.

We conducted our review from October 1997 through March 1999 in accordance with generally accepted government auditing standards.

NRC's System Did Not Ensure That Licensees Were Accumulating Adequate Decommissioning Funds

We analyzed the status of decommissioning funding as of December 31, 1997, (the year of the most recent data available) for 76 licensees that own all or part of 118 operating and retired nuclear power plants. We performed this analysis because NRC had not, for its own regulatory purposes, systematically collected and analyzed information on its licensees' decommissioning funds. Our analysis showed that, under likely assumptions about future rates of cost escalation, net earnings on the investments of funds, and other factors, 36 of the licensees had not accumulated funds at a rate that is sufficient for eventual decommissioning.[1] Under these conditions, these licensees will have to increase the rates at which they accumulate funds to meet their future decommissioning financial obligations. Under more pessimistic (unfavorable) and more optimistic (favorable) assumptions, 72 and 8 licensees, respectively, had not accumulated funds at a sufficient rate.

We also analyzed whether licensees had recently increased the amount of funds that they had collected to make up for under-collections in earlier years. For this analysis, we compared the amounts collected in 1997 with the annual average of the present value of the amount of funds needed to meet licensees' funding obligations when their plants' licenses expire. We found that, under likely assumptions, 17 companies collected less funds in 1997 than they need to collect each year over their plants' remaining operating life. The 17 companies included 15 companies that had not collected sufficient funds through 1997. Under more pessimistic and optimistic assumptions, 66 and 4 licensees, respectively, need to increase the amount of funds that they collect in future years.

Our funding analysis generally assumes that nuclear power plants would operate for their current licensed operating period—usually 40 years—and that the licensees will remain financially solvent. No plant, however, has yet operated for the full period of its operating license, and electricity deregulation is expected to cause or contribute to more premature plant retirements. Furthermore, 19 of 26 plants that one Wall Street firm considers at risk for early retirement are owned, in whole or in part, by companies that have been slow to accumulate funds to decommission their plants. So far, however, neither early plant retirements nor licensee bankruptcies have adversely affected decommissioning. Economic

[1]Other factors that we considered in our analysis included initial decommissioning cost estimates, plants' operating periods, and the use of decommissioning funds for cleanup activities related and unrelated to radiation. (NRC requires licensees to accumulate funds to pay designated radiation-related costs only, but licensees may need to incur other costs, such as the costs to manage spent fuel, dismantle nonradioactive structures, and restore the site to "green field" condition, in the process of decommissioning their plants.)

regulators have allowed utilities to charge their customers rates that included amounts for decommissioning plants that were retired early, and courts have permitted the continued accumulation of decommissioning funds during bankruptcy proceedings.

From 1990 through 1997, most licensees' estimates of the costs to decommission their plants have increased rapidly. Likewise, the utilities' periodic calculations, using a formula contained in NRC's regulations, of the minimum amount that they must accumulate in their decommissioning funds generally have been escalating more rapidly (particularly in recent years) than the site-specific cost estimates. Also, there are uncertainties over what the actual decommissioning costs might be. For example, the eventual resolution of a protracted dispute between NRC and the Environmental Protection Agency (EPA) over appropriate radiation standards for decommissioned sites could affect final decommissioning costs.

Rates at Which Decommissioning Funds Are Being Accumulated

NRC requires licensees using external sinking funds for decommissioning financial assurance to deposit funds collected for decommissioning into their funds each year. For two reasons, however, NRC does not know if licensees are accumulating decommissioning funds at rates that will provide enough funds to decommission their plants when the plants have been retired. First, NRC leaves the amounts to be put aside up to licensees and their public utility commissions. Second, until recently, NRC has not required that licensees report on the status of their decommissioning funds.[2]

We analyzed the status of decommissioning funds, as of the end of 1997, for 118 operating and retired nuclear plants owned by 76 licensees (or the parent companies of subsidiaries that are the legal owners of the plants). In our first analysis, we compared the total amount of each licensee's decommissioning funds with the expected amount of funds that should have been accumulated by that date. To determine the expected amount, we assumed that licensees would accumulate increasing (but constant present-value) amounts annually. Once in the fund, each yearly contribution would continue to grow at the fund's after-tax rate of return. The sum of these annual amounts, plus the income earned on the investments of the funds, would equal the total estimated decommissioning costs when the licensees' plants' operating license

[2]In November, 1998, NRC began requiring each licensee to report financial information, including the status of its decommissioning funds, every 2 years. The first licensee reports were due by the end of March 1999.

expires. For example, at the end of 1997, a licensee's decommissioning fund for a plant that had operated half of a 40-year license period (begun in 1977) should equal one-half of the present value of the estimated cost to decommission the plant beginning after 2017. This expected level of funding is not the only funding stream that could accrue to equal future decommissioning costs but provides us with both a common standard for comparisons among licensees and, from an equity perspective among ratepayers in different years, a financially reasonable growing current-dollar funding stream over time. Appendix I describes our methodology, assumptions, and results for each of the 76 licensees.

Performing this analysis required that we make assumptions about future economic and plant-operating conditions. Key assumptions included initial decommissioning cost estimates, rates of cost escalation, net earnings on the investments of funds (discount rate), plant-operating periods,[3] and the use of decommissioning funds for both radiation- and non-radiation-related decommissioning activities.[4] Because of the inherent uncertainty associated with assuming future conditions over many years, we used assumptions of the most likely future conditions to develop a baseline scenario. And, to bound the results of the baseline scenario, we developed pessimistic and optimistic scenarios using unfavorable and favorable economic and plant-operating conditions, respectively.

For our baseline scenario, 36 of the 76 licensees (47 percent) had not accumulated funds at a rate that is sufficient for eventual decommissioning. Under these conditions, these licensees will have to increase the rates at which they accumulate funds to meet their future decommissioning financial obligations. Changing assumptions to reflect the pessimistic and optimistic scenarios, greatly affects the adequacy of the licensees' funding. Under pessimistic and optimistic assumptions, 72 (95 percent) and 8 (11 percent) licensees, respectively, had not accumulated funds at a sufficient rate for eventual decommissioning.

The fact that a licensee might have collected funds for decommissioning at a lesser rate than the expected rate does not, by itself, mean that the licensee will not meet its financial obligations by the time it retires its

[3]Specifically, for the baseline scenario, only six currently-operating nuclear power plants are assumed to be retired early (from 1998 to 2001). In the optimistic scenario, no currently operating plants close early. In the pessimistic scenario, however, these 6 plants plus 20 other plants are assumed to close early (in 2002).

[4]In the baseline scenario, we assumed that 86 percent of each licensee's decommissioning fund was available to pay decommissioning costs as defined by NRC. In the pessimistic scenario, 82 percent and, in the optimistic scenario, 100 percent of the fund was assumed to be available.

plants. By increasing their rates of collection, these licensees can still accumulate the funds that are necessary. Therefore, to obtain insights on whether licensees are now collecting funds at adequate rates, we undertook a second analysis. We compared the available amounts that each licensee collected in 1997 with the average yearly present value of the amounts that the licensees would have to accumulate each year over the remaining life of their plants to have enough decommissioning funds upon the retirement of the plants. This analysis assumes that the licensees will increase their yearly future funding at the after-tax rate of return on the investments of their funds. And, once in the fund, these yearly contributions will grow at this same rate. Our analysis shows these results for the baseline (most likely), pessimistic, and optimistic scenarios.

For the baseline, the results show that only 17 of 76 licensees (22 percent) were not yet collecting the amounts that they will need to meet their decommissioning obligations. Thus, while 47 percent of the licensees had less than expected levels of funds at the end of 1997, only 22 percent did not appear to be currently on track, as represented by the funds that they collected in 1997, to eventually meet their decommissioning financial obligations. In other words, while licensees might not have funded sufficiently in the early years of their plants' operating life, our results suggest that most licensees have recently increased funding to make up the funding shortfalls from earlier years. But if conditions deteriorate from those assumed in our baseline scenario, as represented by the pessimistic scenario, 66 licensees (87 percent) under-collected funds in 1997. Conversely, under the optimistic scenario, only 4 licensees (5 percent) are currently accumulating funds too slowly.

Plant Operating Life's Effect on Decommissioning Funding

If a nuclear power plant is retired prematurely, sufficient funds may not have been collected by the retirement date to pay all decommissioning costs. To date, 21 plants have been retired before their licenses expired. So far, however, public utility commissions have permitted licensees to continue collecting the funds for decommissioning from the licensees' electricity customers after these plants were retired.

Twenty-One Plants Were Retired Early

To date, no plant has operated for its full licensed operating life, and 21 plants have been retired before their operating license would have

expired.[5] (See table 2.1.) Two of the 20 plants operated for as long as 25 years. Fifty-two of the 104 plants that are currently licensed to operate have operated from 20 to 30 years.

Table 2.1: Retired Commercial Nuclear Power Plants

Plant's name	State	Retirement date	Years operated
GE VBWR	Calif.	Dec. 1963	6
Pathfinder	S.D.	Sept. 1967	4
Fermi 1	Mich.	Sept. 1972	9
Indian Point 1	N.Y.	Oct. 1974	13
Peach Bottom 1	Pa.	Oct. 1974	9
Humboldt Bay 3	Calif.	July 1976	14
Dresden 1	Ill.	Oct. 1978	19
TMI-2[a]	Pa.	Mar. 1979	1
La Crosse	Wis.	Apr. 1987	20
Fort St. Vrain	Colo.	Aug. 1989	16
Shoreham[b]	N.Y.	June 1989	0
Rancho Seco	Calif.	June 1989	15
Yankee Rowe	Mass.	Oct. 1991	28
San Onofre 1	Calif.	Nov. 1992	26
Trojan	Oreg.	Nov. 1992	17
Haddam Neck	Conn.	Dec. 1996	30
Big Rock Point	Mich.	Aug. 1997	34
Maine Yankee	Maine	Aug. 1997	25
Zion 1	Ill.	Jan. 1998	24
Zion 2	Ill.	Jan. 1998	24
Millstone 1	Conn .	July 1998	27

[a]TMI-2 (Three Mile Island Unit 2) operated just over 1 year before incurring an accident that resulted in the plant's retirement.

[b]Over a calendar period of approximately 2 months, the Shoreham plant was operated for the equivalent of 2 full-power days. The plant was only operated for low-power testing purposes and was then permanently shut down.

Nine commercial nuclear power plants were permanently shut down before NRC issued its original decommissioning regulations. Eight of these retired plants are in safe storage. The ninth plant (Pathfinder), which was a small demonstration plant, has been decommissioned. Twelve

[5]NRC generally licenses nuclear power plants to operate for a maximum of 40 years. It also permits utilities to seek license extensions of up to 20 years. In 1998, Baltimore Gas and Electric and Duke Power became the first licensees to file applications for license extensions. The extensions were filed for the former's Calvert Cliffs units 1 and 2 and the latter's Oconee units 1, 2, and 3.

commercial nuclear power plants have been retired since NRC issued its decommissioning financial assurance regulations. Four of these plants are in safe storage. Two plants—Fort St. Vrain and Shoreham—have been decommissioned. Five plants are currently being dismantled, and the owner of one plant has not yet decided whether to dismantle the plant soon or put it in safe storage.

The five plants that are now being dismantled—Big Rock Point, Haddam Neck, Maine Yankee, Trojan, and Yankee Rowe—were retired before their owners had accumulated sufficient funds to decommission them. For example, the Trojan plant was retired in 1992 after 17 years of operation. At that time, the plant's licensees estimated that decommissioning the plant would cost $198 million (in 1993 dollars). However, the licensees had accumulated only $43 million, or 22 percent, of that amount. The Maine Yankee plant was permanently shut down in 1997 after 24 years of operation. When the plant was retired, the licensee had accumulated $188 million for decommissioning. That amount was only 53 percent of the $357 million (in 1997 dollars) that the licensee estimated would be needed to decommission the plant. In both of these cases, as well as in other states where retired nuclear plants are located, public utility commissions are permitting the licensees to continue collecting decommissioning funds from their customers even if their plants were retired early.

Experts Expect More Early Plant Retirements

Industry experts, such as major financial institutions, and DOE's Energy Information Administration anticipate that the deregulation and restructuring of the electricity industry could result in the early retirement of from 9 to 40 percent of the nation's nuclear power plants because these plants may not be competitive with other sources of electricity. In April 1998, Standard & Poor's predicted that poor economics would cause the early retirements of six plants by 2001.[6] (See table 2.2.) The company also concluded that another 20 units are "at risk" through 2020 for early retirement on the basis of expected poor operating and economic performance over the remainder of the plants' license. According to the company, in a competitive market, plant owners will attempt to improve profitability; however, the vulnerability of these plants to unscheduled outages may squeeze operating margins and cause the plants to lose their long-term value.

[6]"World Energy Service: U.S. Outlook," DRI, Standard & Poor's/DRI (Apr. 1998). Standard & Poor's/DRI provides historical analysis and forecasts of energy balances for over 60 countries around the world.

Table 2.2: Nuclear Power Plants Identified by Standard & Poor's as Candidates for Early Retirement

Predicted	At-risk
Millstone 1,[a] Conn.	Beaver Valley 1, Pa.
Millstone 2, Conn.	Crystal River 3, Fla.
Dresden 2, Ill.	Duane Arnold, Iowa
Dresden 3, Ill.	Fermi 2, Mich.
Oyster Creek, N.J.	Fitzpatrick, N.Y.
River Bend, La.	Fort Calhoun, Nebr.
	Ginna, N.Y.
	Indian Point 3, N.Y.
	Nine Mile Point 1, N.Y.
	Palisades, Mich.
	Perry, Ohio
	Pilgrim, Mass.
	Point Beach 1, Wis.
	Point Beach 2, Wis.
	Quad Cities 1, Ill.
	Quad Cities 2, Ill.
	Robinson 2, S.C.
	Salem 1, N.J.
	Salem 2, N.J.
	Sequoyah 1, Tenn.

[a]The plant was retired in 1998.

In commenting on our report, NRC pointed out that one plant that Standard & Poor's listed as "at risk" for premature retirement—Pilgrim—is in the process of being sold. The prospective buyer, NRC added, intends to operate the plant for its full license term and will consider seeking a license extension for the plant. This example, NRC said, serves to illustrate both the speculative and controversial nature of projecting the premature retirements of nuclear power plants.

Other experts, however, have reached conclusions that are similar to Standard & Poor's. For example, in January 1999, Synapse Energy Consultants, Inc., a firm that often testifies in electricity rate proceedings conducted by state public utility commissions, concluded in a report that, depending upon the assumptions used, from 20 to 90 nuclear power plants may be retired early. The most likely case, according to the authors of the report, is that 34 plants will be retired early. Nineteen of the 26 plants that

Standard & Poor's predicts may be retired early are also included in Synapse's list of 34 plants that it believes may be retired early.

Compounding the risk that more nuclear power plants may be retired prematurely is the possibility that the licensees that own these plants may have, so far, under-accumulated funds to decommission these plants. For example, 19 of the 26 plants that may be retired early, according to Standard and Poor's predictions, are owned, in whole or in part, by 14 licensees that have not accumulated sufficient decommissioning funds, according to our analysis. Additional predictions of more early plant retirements have also been made. For example, in December 1997, EIA projected that 24 nuclear plants would retire as early as 10 years before their license expires.[7] In 1995, Moody's concluded that at least 10 nuclear plants may be closed for economic reasons if the generation of electric power is completely deregulated.[8] One year later, Moody's downgraded the bond ratings of 24 electric utilities that operate nuclear plants. Again, in 1997, Moody's said that the frequency that certain nuclear plants tend to require expensive capital additions to comply with their operating license increases the likelihood of even more early plant retirements.

The premature retirement of the Zion-1 and Zion-2 nuclear power plants in January 1998 illustrates the effect of deregulation on power plant economics. The Commonwealth Edison Company determined that the plants could not generate electricity at competitive prices in the deregulated environment. Therefore, the utility decided to retire both plants after about 24 years, or 60 percent, of their licensed operating life. When the plants were permanently shut down, the utility had put aside $362 million, or less than 43 percent of the $834 million estimated to be needed to decommission the two units. According to officials of Commonwealth Edison, however, under Illinois law the utility is authorized and directed to include in the rates that it charges its electricity customers amounts for the necessary and prudent decommissioning costs for these plants.

A Few Licensees Have Declared Bankruptcy

In addition to early plant retirements, licensees of nuclear power plants have declared bankruptcy in a few cases. So far, the continuing availability of decommissioning funding has been protected in these cases. For example, the Cajun Electric Cooperative owned 30 percent of the River

[7]See Annual Energy Outlook 1998 With Projections to 2020, (EIA).

[8]Special Comment: "Stranded Cost Will Threaten Credit Quality of U.S. Electrics," (Moody's Investors Service).

Bend, Louisiana, plant. The Cooperative went bankrupt in 1994, and a bankruptcy settlement was approved on August 26, 1996. The settlement provided for the transfer of $125 million to an external trust to satisfy Cajun's share of River Bend's estimated decommissioning cost of $419 million (in 1996 dollars). But the settlement left the successor to Cajun's share of the plant open. The court order provided that the bankruptcy trustee and parties to the settlement were to take all necessary and appropriate actions to consummate the settlement by June 1, 1997, including finding a buyer for Cajun's share of River Bend. On November 28, 1997, NRC's staff approved the transfer of Cajun's portion of River Bend's license to Entergy Gulf States, Inc., which is now the sole owner of this plant. NRC's staff concluded that Entergy Gulf States was financially qualified to contribute appropriately to the plant's decommissioning.

Another bankruptcy case involved the El Paso Electric Company, which owns 16 percent of the three-unit Palo Verde Nuclear Generating Station in Arizona. The company filed for bankruptcy protection in 1992, primarily because of excess generating capacity and insufficient rates to cover the costs of power. The settlement of the bankruptcy filing became effective in 1996, at which time, the company emerged with reduced debt and a stronger financial position. During the bankruptcy proceeding, according to an NRC official, the company continued to make its required decommissioning payments.

Effects of Cost Uncertainties on Rate of Fund's Accumulation

For our funding analyses, we assumed, among other things, that current estimates of decommissioning costs are accurate. Because actual decommissioning experience is limited, however, actual costs could be lower or higher. From 1990 through 1997, cost estimates increased rapidly for both site-specific studies by licensees and calculations using NRC's cost-estimating formula. Moreover, uncertainties about the actual scope of decommissioning affects costs. Utilities, for example, sometimes consider the cost to empty a spent fuel storage pool (to permit dismantling a retired plant) as a decommissioning cost. NRC, however, excludes the cost of emptying the storage pool from the scope of its formula for estimating decommissioning costs. The storage of spent fuel in facilities outside of the plant's storage pool, and the cost of such storage, are addressed in parts of NRC's regulations that are not directly related to decommissioning. In addition, the eventual resolution of a protracted dispute between NRC and EPA over appropriate radiation standards for decommissioned sites

could affect the scope of decommissioning and, therefore, total decommissioning costs.

Decommissioning Cost Estimates Are Increasing

Cost estimates since 1990, developed through both NRC's formula and licensees' site-specific cost estimates, show that both estimates have increased. Although NRC has not routinely monitored the amounts of decommissioning funds that its licensees have been accumulating, its 1988 regulations required licensees to annually calculate the minimum amount of funds that must be accumulated to pay future decommissioning costs. For each plant using NRC's mathematical formula, the utility must make an initial calculation in 1986 dollars that is based on the size and type of plant. Then, the utility must escalate the initial calculated value to that of the current year on the basis of prescribed escalation factors. Also, to support proposed charges to electricity customers, plant owners periodically develop detailed estimates of the cost to decommission their specific plants and submit the estimates to their public utility commission regulators. In the absence of significant actual experience, site-specific estimates of decommissioning costs provide the best check on the reasonableness of NRC's formula for calculating potential decommissioning costs.

Since 1990, decommissioning cost estimates prepared on a site-specific basis and calculated using through NRC's formula have increased substantially. For example, site-specific cost estimates (excluding costs that licensees may incur during decommissioning, such as spent fuel storage costs, that NRC does not consider to be decommissioning costs) have increased, on average, at a rate of about 6.6 percent per year. One reason for this increase is the expansion of the scope of decommissioning. The estimates made through NRC's formula are now, on the average, about one-third higher than the site-specific estimates for the same plants. The main reason for this condition is that the waste disposal part of NRC's formula was not designed to reflect licensees' efforts to reduce the volume of waste from decommissioning in response to increasing prices for disposal that have traditionally been based on waste volume. In December 1998, NRC corrected this weakness, which brought calculations through its formula more in line with licensees' site-specific cost estimates.

Uncertainty Related to Spent Fuel Management Costs

Largely because DOE is not taking spent fuel from licensees' nuclear power plants, licensees that intend to immediately dismantle their retired plants must store their spent fuel outside of their plants. For the purpose of

estimating and accounting for decommissioning costs, some licensees treat storage costs related to the retirement of their plants as decommissioning costs. The inclusion by licensees of these storage costs in their decommissioning costs is a major reason why licensees' cost estimates have increased in recent years. A second reason is that licensees may include the cost to dismantle nonradioactive structures, such as administrative buildings, in their estimates of decommissioning costs.

In contrast, NRC excludes both spent fuel management costs and non-radioactive-related cleanup costs from its formula for calculating the funds that licensees must accumulate to decommission their nuclear power plants. NRC's reasons for excluding these types of costs are that it (1) regulates independent spent fuel storage facilities (facilities that are separate from the spent fuel pool, which is an integral part of a nuclear power plant) under regulations that are separate from those applicable to the construction, operation, and decommissioning of nuclear power plants and (2) only regulates the possession, use, and disposal of radioactive materials. Nevertheless, spent fuel management costs have been and will continue to be a real cost for utilities that choose to immediately dismantle their retired plants. For example, in 1995 the licensee for the retired Trojan plant in Oregon estimated that spent fuel management costs to construct, operate, and maintain a dry storage facility at that plant would cost about $102 million (in 1993 dollars).

Uncertainty Related to Standards for Residual Radiation

Uncertainty over the standards for residual radiation that utilities will have to meet in cleaning up the sites of their retired nuclear power plants affects the accuracy of the current estimates of future decommissioning costs.

EPA is responsible for setting acceptable radiation limits outside of the boundaries of nuclear facilities and for developing residual radiation standards to protect the health and safety of the public and to protect the environment. EPA has been responsible since 1970 for establishing radiation standards for all aspects of decommissioning, including acceptable levels of residual contamination. To date, however, EPA has not issued such standards.

In the absence of EPA standards, NRC, which is responsible for regulating the level of radiation within plant boundaries, issued, on July 21, 1997, its final radiological standard for license termination. The standard states that:

"A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation does not exceed 25 [millirem[9]] per year, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable."

EPA does not agree with NRC's standard. In fact, the disagreement between the two agencies has been characterized by both its length and its acrimony. EPA started to develop residual radiation standards in 1984 but has not yet finalized these standards. Nevertheless, EPA's position is that NRC's licensees should be required to decontaminate nuclear plant sites to a residual radioactivity level of 15 millirems per year and to limit the exposure to an individual from his/her consumption of groundwater to 4 millirems per year. Most recently, EPA's administrator stated that the agency would apply the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 to sites that are being decommissioned if NRC and EPA do not reach an agreement on applicable standards. Also, in April 1998, one of NRC's commissioners publicly commented that the impasse between EPA and NRC over appropriate radiation protection standards may have to be resolved by the Congress. In fact, to resolve this disagreement, NRC has sought legislation that would eliminate the overlap in the standard-setting authority of NRC and EPA.

Currently, NRC's licensees are using NRC's regulations and related guidance on decommissioning the sites of retired nuclear facilities to plan and/or implement the decommissioning of their nuclear power plants and related nuclear fuel facilities. If, however, EPA's residual radiation standards are ultimately used in lieu of NRC's standards, licensees may have to perform additional cleanup when decommissioning their nuclear plant sites. If this occurred, it would increase decommissioning costs, but by how much is uncertain. According to both NRC and EPA officials, retroactively applying more stringent EPA standards to nuclear plant sites that have already been decommissioned according to NRC's standards could be very costly.

[9]The level is small when compared to the average level of natural background radiation in the United States, which is about 300 millirem/year.

Effectiveness of Amendments to Financial Assurance System Will Depend Upon Financial Reviews by NRC

Late in 1998, NRC amended its decommissioning regulations in anticipation of the deregulation and restructuring of the electricity industry. The amended regulations do not allow licensees to rely exclusively on their external sinking funds to ensure that funds are available for decommissioning if its regulators no longer guarantee that moneys can be collected from the licensees' customers through electricity rates. In such a case, NRC now requires a licensee to provide additional financial assurance for the portion of the licensee's estimated decommissioning cost that would not be guaranteed. There is, however, uncertainty over the availability and affordability of some of these additional options for providing financial assurance. NRC will also now require licensees to periodically report financial information on decommissioning; however, NRC did not specify how it would use this information.

NRC Amends Decommissioning Financial Assurance Regulations

Effective November 23, 1998, NRC amended its decommissioning financial assurance regulations out of concern that the deregulation and restructuring of the electricity industry could reduce confidence that the owners of nuclear power plants will be able to accumulate sufficient funds to decommission their plants. The new regulations provide that, to the extent that the collection of estimated decommissioning costs from customers is no longer guaranteed, a licensee may not exclusively rely on external sinking funds to provide adequate financial assurance of decommissioning. For any portions of decommissioning costs for which the collection of funds is not guaranteed, licensees will have to provide one or more additional types of financial assurance.

Additional Methods of Financial Assurance

Electric utilities have almost exclusively relied on the collection of fees from their electricity customers, deposited into externally managed sinking funds, to provide decommissioning financial assurance. In anticipation of electricity deregulation initiatives, NRC, in September 1998, amended its regulations (effective in Nov. 1998) to address situations in which a licensee's continued collection of decommissioning fees from its electricity customers may no longer be guaranteed by the economic regulation of electricity rates. To the extent that the collection of decommissioning funds is no longer guaranteed, a licensee may provide up-front financial assurance. The options available to licensees include the prepayment of the estimated decommissioning cost or purchase of surety bonds or insurance to cover decommissioning costs. The assurances may also be in the form of guarantees of payments by the licensees or, as appropriate, their parent company, provided that such guarantees are

accompanied by the passing of specified financial tests. Both NRC and the nuclear industry have expressed concern about whether these up-front payment methods would be affordable for licensees. However, in commenting on our draft report, NRC stated that the terms for the recent sales of the Three Mile Island Unit 1, Pilgrim, and Seabrook (partial sale) nuclear power plants have included the prepayment of all estimated decommissioning costs. NRC added that it believes that the prepayment option will likely be the preferred means of assuring decommissioning funds in future sales transactions.

When NRC published its proposed amended regulations for public comment in September 1997, it expressed concern that surety instruments and insurance may not be available to some nuclear power plant licensees; therefore, NRC specifically asked for comments on this issue. In response, some commenters said they were concerned about the feasibility of the up-front methods (prepayment, surety instruments, and insurance) for assuring decommissioning funding. For example, the Edison Electric Institute, which represents electric utilities, stated that it could be difficult, if not impossible, for licensees to provide such assurances. Also, seven licensees jointly stated that these funding methods would bar prospective new owners from purchasing interests in nuclear power plants. The seven utilities added that the (then) proposed regulations could impose a financial burden that would likely prevent the sale of a nuclear plant. Finally, the utilities stated that (1) it is uncertain if an insurance product or a surety bond could be procured to secure a nonelectric utility's share of decommissioning costs, and (2) the cost of procuring such a bond could potentially exceed the cost of prepaying decommissioning expenses.

The difficulty in obtaining a surety bond or insurance product is illustrated by the experience of one of NRC's licensees. Great Bay Power Corporation, which owned 12 percent of the Seabrook nuclear power plant in New Hampshire, was formed out of bankruptcy proceedings involving four former part-owners of the Seabrook plant. NRC concluded that Great Bay, as a part owner of the plant, did not appear to meet the definition of an "electric utility" because its ability to collect funds for decommissioning from its electricity customers was not guaranteed by the traditional regulation of electricity prices.[1] Therefore, according to NRC's regulation, Great Bay could not rely exclusively on external sinking funds to provide decommissioning financial assurance. Although NRC gave Great Bay until July 1998 to obtain a surety bond or other financial guarantee to fulfill its

[1]According to Great Bay, it has always believed and continues to believe that it is an "electric utility" under the definition contained in NRC's decommissioning regulations.

decommissioning obligations, the company was unable to obtain such a guarantee. Out of concern for the possible bankruptcy of Great Bay if NRC were to mandate that the company prepay its decommissioning obligation, the state of New Hampshire, in June 1998, passed legislation that would make the co-owners of Seabrook proportionately responsible for making Great Bay's decommissioning payments if the company defaults on this obligation. According to NRC, this approach qualifies as an acceptable "other method" of providing decommissioning financial assurance.

In addition to the traditional financial assurance methods discussed above, NRC adopted other methods that licensees may use to provide decommissioning financial assurance.

- Other guarantee methods, including parent company guarantees and self-guarantees coupled with financial tests. For parent company guarantees, a licensee's parent company must, among other things, have net working capital, tangible net worth, and assets located in the United States worth at least six times the amount of decommissioning funds being assured by the parent company for all of its nuclear power plants. Tangible net worth must exclude the net book value of the nuclear unit(s). For self-guarantees, tangible net worth and assets located in the United States must be 10 times the amount of the decommissioning funds being assured.
- Contractual obligations of a licensee's customers to purchase enough electricity to provide the licensee's total share of uncollected funds for decommissioning.
- Any other method, or combination of methods, that provides, as determined by NRC upon its evaluation of the specific circumstances, assurance of decommissioning funding equivalent to that provided by the other acceptable methods.

These methods are similar to financial assurance methods that NRC permitted in its 1988 decommissioning regulations for other types of licensees, such as operators of nuclear fuel facilities.

NRC Adopts Financial Reporting Requirements

Prior to November 1998, NRC had reserved the right to inspect licensees' decommissioning fund arrangements and status. Under the 1998 amendments, NRC also explicitly reserved the right to take additional action, either independently or in cooperation with economic regulators. These actions could include modifying a licensee's schedule for accumulating additional funds. In addition, NRC's 1998 decommissioning regulations required licensees, beginning by the end of March 1999, to

report to NRC, every 2 years, certain financial information that would ensure that licensees are collecting their required decommissioning funds.

Information that must be provided in licensees' financial reports includes (1) the amount of decommissioning funds estimated to be required according to NRC's formula; (2) the funds accumulated as of the end of the year prior to the report date; (3) the annual amounts remaining to be collected; (4) the assumptions used to escalate decommissioning costs, project rates of earnings on investments of external sinking funds, and discount funding projections; and (5) modifications to external sinking fund agreements. Utility representatives have not opposed financial reporting. For example, the Edison Electric Institute told NRC that periodic reporting on the status of external sinking funds for decommissioning is appropriate. In addition, in commenting on the proposed regulations, a group of seven utilities stated that a comprehensive reporting requirement is long overdue and is particularly appropriate, given that economic regulators have not been actively monitoring the status of licensees' external sinking funds on an ongoing basis.

When NRC published its final regulations, it stated that, after licensees have submitted their initial reports by the end of March 1999, it would review the reports and consider whether to issue additional guidance on the format and content for subsequent licensee reports. Also, in June 1997, when NRC's commissioners approved the proposed regulations for public comment, the commissioners stated that after NRC's staff has reviewed licensees' initial reports, the staff should advise the commissioners on the need for further rulemaking. When NRC issued the 1998 amendments to its decommissioning regulations, however, it did not explain when and how it intends to act on the financial information reported by individual licensees if that information does not clearly demonstrate that an individual licensee is accumulating decommissioning funds at a satisfactory rate.

The lack of any criteria for acting on licensees' decommissioning financial reports contrasts with the agency's ongoing efforts to establish a more objective, understandable, and predictable approach to safety oversight of nuclear power plants. According to NRC, an independent regulatory oversight process is based on unbiased assessments of licensees' performances; logical, coherent, and predictable actions by NRC; clear ties to NRC's regulations and goals; and opportunities for public awareness of process results. The new safety oversight process should, according to NRC,

- allow for the integration of various information sources relevant to a licensee's safety performance,
- make objective conclusions regarding the significance of the integrated performance information,
- take actions based on these conclusions in a predictable manner, and
- effectively communicate these results to the licensees and to the public.

Therefore, NRC is in the process of establishing a new oversight approach in which it will, among other things, use indicators of nuclear power plants' performance to establish thresholds for clearly identifying acceptable levels of performance. In conjunction with this, NRC plans to establish criteria for identifying and responding to unacceptable licensee performance.

A similar approach in the area of providing adequate financial assurances for decommissioning would appear to offer the same benefits of objectivity and predictability that NRC seeks in its safety oversight of nuclear power plants.

NRC Did Not Address Early Plant Retirements or Bankruptcy in Its Amended Regulations

NRC's new financial assurance regulations do not address the option of accelerating the rate at which licensees must accumulate decommissioning funds on the basis of the actual longevity of plants. NRC rejected this option because it believes that some plants will probably continue operating for their licensed operating period of up to 40 years and, with license extensions, beyond 40 years. Therefore, NRC said, requiring all licensees to accelerate their accumulation of decommissioning funds because of some premature plant retirements would be arbitrary and lead to widely varying effects on licensees. Thus, NRC intends to continue its practice of addressing early plant retirements on a case-by-case basis. NRC's position, as expressed in the supplementary information accompanying the publication of its amended decommissioning regulations, is that accelerated funding is inequitable. NRC believes that accelerated funding places too much of the financial burden on current utility ratepayers and a lesser burden on ratepayers in the later years of a nuclear power plant's operation. However, when licensees have retired plants before the plants' operating license expired, the licensees' electricity customers have had to pay decommissioning costs for plants from which they no longer receive electricity. The Trojan, Maine Yankee, and Zion cases, discussed earlier, demonstrate this fact. During the years that the Trojan and Zion plants operated, the respective licensees' customers paid for less than half of the costs to decommission

the plants. The customers of the Maine Yankee plant paid for 53 percent of the decommissioning cost. Now, although these retired plants no longer generate electricity, the current and future customers of the licensees will pay the remaining decommissioning costs without receiving comparable benefits from the plants.

NRC elaborated on its reasons for opposing accelerated decommissioning funding in its comments on our draft report. NRC said that requiring accelerated funding for decommissioning would cause substantial cost increases to be incurred by either licensees' stockholders or their ratepayers. Also, there would be a myriad of difficulties in determining the appropriate rate of acceleration; for example, at what rate should the collection of funds be accelerated? These issues, NRC added, were considered in its evaluation of accelerated funding as part of its process of amending its decommissioning regulations. NRC concluded that accelerated funding does not provide sufficiently increased decommissioning funding assurance commensurate with its potential cost impacts.

State legislatures, state public utility commissions, and FERC appear to be addressing assurances for decommissioning funding in their electricity deregulation initiatives. Utility officials in Illinois, New Hampshire, and Oregon, for example, pointed out that laws in those states provide for the collection of necessary and prudent funds for decommissioning nuclear power plants regardless of whether the plants operate until their current licenses expire or are retired prematurely. Thus, licensees have continued collecting from electricity customers the fees earmarked for decommissioning three prematurely retired plants in Illinois and one in Oregon. Similar examples are occurring in California and Massachusetts.

With respect to the bankruptcy of licensees, New York's Public Service Commission, in commenting on NRC's proposed amendments to its decommissioning regulations, urged NRC and states to consider proposing legislation that would make decommissioning liabilities a first priority in the event of the bankruptcy of a private nuclear facility owner. Current bankruptcy law does not make the subject of nuclear decommissioning costs a priority, but NRC has said it does enter bankruptcy proceedings to protect the integrity of decommissioning funding. Moreover, at NRC's request, the Administration included a provision in its 1999 electricity deregulation bill that would give priority to funding decommissioning of nuclear power plants in bankruptcy proceedings involving licensees.

Conclusions

Several factors have come together at this time that make it imperative for NRC to ensure that its licensees accumulate sufficient funds to decommission their plants regardless of when they are permanently shut down. Specifically, some licensees have not set aside sufficient amounts of funds for decommissioning, and there is uncertainty over the availability and affordability of the up-front payment methods of providing financial assurance. With electricity deregulation emerging, the possibility exists that a licensee may, in the future, prematurely retire a plant and be faced with paying the remaining decommissioning funds from its own resources. The ability of the licensee to do so might then depend upon its overall financial condition. Thus, self-guarantees that decommissioning funds will be available are only as good as the financial condition of the licensee. (We recognize that to date, early plant retirements have not resulted in a shortfall in decommissioning funds because regulators have allowed licensees to continue collecting funds after plants have been retired.)

To NRC's credit, it recognized its need to increase its oversight of decommissioning financial assurance when it modified its decommissioning regulations by requiring licensees to provide financial reports every 2 years. NRC did not, however, explain what it intends to do with these reports. For example, NRC did not establish the thresholds for clearly identifying acceptable levels of financial assurances or establish criteria for identifying and responding to unacceptable levels of assurances. In the absence of such explanations, there is no logical, coherent, and predictable oversight of licensees' financial assurance for decommissioning their nuclear power plants.

Recommendation

After NRC reviews licensees' initial reports on decommissioning financial assurances, we recommend that the Chairman, NRC, provide licensees and the interested public with information on the (1) objectives, scope, and methodologies of NRC's reviews of the reports; (2) thresholds for identifying, on the basis of these reviews, acceptable, questionable, and unacceptable indications of financial assurances; and (3) criteria for the actions to be taken on the results of these reviews.

Agency Comments and Our Evaluation

We provided NRC with a draft of our report for review and comment. NRC said that our recommendation merits serious consideration with respect to its future uses of licensees' biennial reports on decommissioning funds. NRC added, however, that it is premature to expend significant staff resources on establishing thresholds for identifying problems with

licensees' financial assurances for decommissioning until NRC knows, on the basis of its reviews of the initial status reports from licensees, that such problems exist. Thus, NRC differs with us not on the substance of our recommendation but on the timing of its implementation. NRC's position is that it does not need to establish performance thresholds unless actual performance problems exist. In our opinion, a proactive, rather than reactive, approach would more appropriately provide licensees and the public with a more complete understanding of NRC's expectations in the area of financial assurance for decommissioning.

NRC also stated that our report does not adequately represent the complex changes that are occurring in the electric utility industry and the interactions among NRC, state public utility commissions and FERC, and the nuclear power industry. According to NRC, a host of complex, interrelated variables must be analyzed before any threshold for determining funding shortfalls can be established. These variables include, NRC added, (1) the actual rates that licensees are accumulating for decommissioning funds, (2) the stated intents of rate regulators (such as state public utility commissions) on allowing the ultimate collection of decommissioning funds, (3) the provisions for decommissioning funding in state deregulation initiatives, and (4) for licensees no longer subject to the traditional regulation of their electricity rates, the extent to which the future collection of decommissioning funds may be based on non-bypassable wire charges. Where appropriate, we have either added NRC's comments to, or revised the text of, our report. The full text of NRC's written comments and our response appear in appendix II.

Scope, Methodology, and Results of Analyses of Licensees' Decommissioning Funds

This appendix describes the scope, methodology, and results of our analyses of the following two questions:

- When such economic factors as inflation, interest, and others are taken into account, have licensees accumulated decommissioning funds at a rate consistent with the expended portions of the licensed operating life of their nuclear power plants?
- Are licensees currently adding moneys to their decommissioning funds at the rates necessary to have sufficient funds available to decommission their plants when the plants are retired?

The answer to the first question provides a backward look at the funding issue; in contrast, the answer to the second question provides a look forward. Together, the answers to these two questions answer the more general question of whether or not the Nuclear Regulatory Commission's (NRC) licensees are accumulating decommissioning funds at growth rates that, if maintained, should provide sufficient funds to decommission their nuclear power plants when the plants are retired.

Have Licensees Accumulated Decommissioning Funds at Rates Consistent With the Expended Portions of the Licensed Operating Life of Their Plants?

For each licensee owning one or more nuclear power plants, we calculated the respective amount of funds that the licensee would be expected to have accumulated over the expended portion of each plant's operating life. We then compared the actual funds accumulated by the licensee with the sum of these expected amounts. In a hypothetical case, a licensee might have begun operating a plant on December 31, 1974, with a 40-year operating license expiring at the end of 2014. By the end of 1997—an operating period of 23 years—the licensee would be expected to have collected 23/40ths of the present value of the estimated cost to decommission the plant upon its retirement. The balance of the decommissioning funds would be collected over the remaining 17 years of the plant's operation.[1]

In this hypothetical example, the amount of moneys collected from ratepayers each year is typically invested to earn income until the fund is needed to pay decommissioning costs. This rate of interest, or the discount rate, is the assumed annual-average after-tax rate of return on the fund's financial assets. In effect, each annual contribution to the decommissioning fund would ideally be 1/40th of that year's present value of the estimated future decommissioning cost (in 2014 current dollars)

[1]How a licensee would be expected to accumulate such moneys in future years constitutes our second analysis, which is discussed later in this appendix.

because that sum would be invested and would grow over the remaining life of the plant to equal 1/40th of that future cost. This future cost is estimated by "inflating" an initial decommissioning cost estimate by an assumed annual-average cost-escalation factor from the year of the cost estimate to the final year of the plant's operating license.

It was not practicable for us to obtain plant-specific information on the status of decommissioning funds for use in our analysis. Plant-specific information was not readily available because NRC has not systematically collected this type of information. Also, licensees' published financial statements do not always contain plant-specific financial information on decommissioning, and time and resource constraints precluded us from collecting this information from each licensee.

We were, however, able to collect information on the status of decommissioning funds at the corporate level. This information enabled us to analyze the status of each licensee's efforts to accumulate funds to decommission all of the nuclear power plants for which it had an ownership interest. Specifically, the financial firm of Phoenix, Duff & Phelps had compiled, as of the end of 1997, information on the status of decommissioning funds on a company-by-company basis for 76 licensees (or parent companies of licensees) owning all or parts of 118 operating and retired plants.[2] For each licensee, the compilation showed the balance of decommissioning funds for all of its plants on December 31, 1997, and the total payments into the funds for 1997.

Because many nuclear power plants are owned by more than one licensee, we obtained information from NRC on the ownership of each plant and used this information to apportion the estimated cost to decommission a plant among the plant's owners. In addition, licensees' decommissioning funds may contain funds to be used for managing spent fuel during the dismantling of a plant and/or for nonradiological cleanup activities that are not regulated by NRC. Therefore, it was necessary for us to adjust fund balances and payments in 1997 into the fund to reflect the inclusion of funds for cost activities that NRC does not include within the scope of decommissioning.

In summary, for our first analysis, to determine if licensees have accumulated decommissioning funds at rates consistent with the

[2]From discussions with officials of Phoenix, Duff & Phelps and subsequent selective verification, we confirmed that the information on each company was derived from published financial statements.

expended portions of the licensed operating life of these plants, we constructed a spreadsheet simulation model as follows for each licensee:

- We listed the operating license issue and expiration year, and its ownership share, for each of the licensee's nuclear power plants (reactors).
- Using a recent estimate of the cost to decommission each plant, the year of this estimate, and a selected cost-escalation rate, we escalated this initial cost to the year that the plant would be retired (usually at the expiration of its operating license).
- At the end of the current year (1997), for each plant, we calculated the present value of its future decommissioning cost and multiplied this result by the fraction of the license period already used up. This calculation represents the level of funds (for the plant) that ideally should have been accumulated by the end of 1997 (the expected amount). (As a result of continuing this process in future years, the fund balance would equal the estimated decommissioning cost when the plant is retired.)
- For each licensee, we summed these expected fund amounts (as of the end of 1997) for each of its plants and compared this sum with the total amount of the licensee's decommissioning funds at that point in time. If the funds actually accumulated are less than the expected amount, then the licensee has been accumulating funds at a rate insufficient to decommission its plants. Fund balances that exceeded the expected levels had the opposite effect.

Key Factors in the Analysis

In our first spreadsheet simulation model, our analysis uses five key factors, or assumptions, whose assigned values can affect the results. These factors are (1) the initial estimated cost to decommission a nuclear power plant, (2) the cost-escalation rate, (3) the after-tax rate of return on the fund's assets (discount rate), (4) the expected operating life of each plant, and (5) the portion of a licensee's decommissioning fund that is available to pay decommissioning costs as defined in NRC's regulations. An analysis of possible conditions tens of years into the future is inherently uncertain. Therefore, we assigned likely future values to the five key factors (assumptions) to develop a baseline (most likely) scenario.[3] Then, to reflect the range of unfavorable and favorable conditions that licensees

[3]We also performed simulation sensitivity analysis on these five factors using this baseline scenario. Changing the values of each of these factors, one at a time, changes the results of the analysis. For example, the cost-escalation rate was increased and decreased by 1 percentage point, the after-tax rate of return was increased and decreased by 1 percentage point, the life of plants was decreased and increased by 2 years, and so on. These sensitivity results yielded values that we had expected, but these results are not presented in this report.

might face, we bounded the baseline values with pessimistic and optimistic values for each of the five factors. (The specific values we used for our baseline, pessimistic, and optimistic assumptions are discussed below.) Our pessimistic scenario reflects these pessimistic values, such as a low after-tax rate of return and a high rate of cost escalation, and would negatively affect the accumulation and measured sufficiency of decommissioning funds. Our optimistic scenario, reflecting optimistic values, would have the opposite effect. Because all of the assumptions are pessimistic for the pessimistic scenario and optimistic for the optimistic scenario, our model's results for each of these two scenarios can be considered as extreme in both the pessimistic and optimistic directions, respectively.

Initial Decommissioning Cost Estimates

In our baseline and optimistic scenarios, we used, where available, licensees' most recent site-specific estimates of the costs to decommission each of their nuclear power plants. We used the site-specific estimates for 91 of the 118 plants that were prepared for the licensees by TLG Services, Inc.. According to senior officials of this firm, these cost estimates typically include the costs that NRC does not include within the scope of decommissioning. These types of costs include costs to manage spent fuel at retired plants and the costs to dismantle structures that are not contaminated with radioactivity. At our request, TLG Services, Inc., separated out, where possible, these two portions of the cost estimate for each plant. We used only the NRC-qualified portions of the site-specific cost estimates for these 91 plants. Also, using TLG Services' cost estimates across all 91 plants and all years for which the firm made cost estimates for these plants, we estimated for an average plant, the percentages of the total decommissioning cost estimate represented by (1) decommissioning costs, as defined by NRC; (2) spent fuel management costs; and (3) the costs to dismantle nonradioactive structures and restore the site. NRC-qualified decommissioning costs represented about 82 percent of TLG Services' total site-specific decommissioning cost estimates. Spent fuel management costs were about 5 percent, and non-radiation-related costs about 13 percent of these total cost estimates. However, the officials of TLG Services said that these cost data and, therefore, our percentage estimates from these data should be considered as approximations.

For each of the remaining 27 plants, we calculated, using NRC's generic cost-escalation formula, the estimated decommissioning cost (in 1997) that determines the minimum level of funds that NRC requires the plant's licensee to have accumulated by the time the plant's license expires. NRC's formula overstated low-level waste disposal costs, but NRC

recently corrected this problem for 1998. Therefore, we also used NRC's recent waste burial correction for 1998 in calculating the estimated decommissioning cost for each of the 27 plants in 1997. For both the site-specific and generic-formula procedures, the costs are estimates of what it would cost to decommission a plant in the year that the estimate was prepared. Thus, these estimates represent "initial" decommissioning cost estimates that we escalated to the years that the plants' licenses expire.

In our pessimistic scenario, we used NRC's generic cost-escalation formula to calculate, for each of the 118 plants, the decommissioning cost estimates in 1997 and then escalated these cost estimates to the year of the license's expiration for each plant. (Here, we did not use NRC's waste burial correction for 1998 for these 1997 estimates.) We selected this approach because before NRC corrected the weakness in its formula for this calculation, calculations that were used in the formula generally produced results that were, on average, about one-third higher than TLG Services, Inc.'s, site-specific cost estimates for the same year.

Annual Average Cost-Escalation Rate

Our analysis required that we estimate the costs to decommission nuclear power plants at the end of their license expiration year. Therefore, we escalated the "initial" cost estimates from their values when they were prepared to forecast what the current-dollar cost might be at the end of each plant's life span. (For all plants that are already retired but not yet decommissioned, the "future" decommissioning costs are for the current year [1997].)

Our estimate of an annual average cost-escalation rate reflects two conditions: price inflation and changes in the scope and/or technology of decommissioning. The effect of price inflation on increasing future current-dollar costs is self-evident. Changes in the scope and/or technology of decommissioning could either increase or decrease future decommissioning costs. For example, future costs will decrease if more efficient technologies are used in the decommissioning process but will increase if experience shows that more activities must be performed.

In the site-specific cost information for the 91 nuclear power plants that TLG Services, Inc., provided us with, the company had prepared more than one site-specific cost estimate for 43 plants. Therefore, for each of the 43 plants, we calculated the annual average cost-escalation rate from the year of the earliest cost estimate to the year of the most recent cost estimate. We used only the costs identified by TLG Services as being within the

scope of NRC's decommissioning regulations. We then calculated the simple average of the 43 annual-average cost (estimation) increases. The calculated average was 6.6 percent.

For our annual-average cost-escalation rate assumption, we used the following methodology to estimate an upper-bound, middle, and lower-bound rate for the pessimistic, baseline (most likely), and optimistic scenarios, respectively. For the 1990 through 1997 period of the site-specific estimates, we calculated a broad-based measure of inflation during the period using the Gross Domestic Product (GDP) Implicit Price Deflator data contained in the February 1998 Economic Report of the President. Inflation over this period was at an annual-average rate of about 2.5 percent. Thus, over the period, TLG Services' cost estimates escalated, on average, at a rate about 4 percentage points (6.6 percent minus 2.5 percent) above the rate of inflation. By averaging forecast data from Standard & Poor's/DRI and WEFA Group for the 1997 through 2018 period, we estimated that the GDP price deflator would grow over this period (the approximate average life expectancy of a nuclear plant) at an annual-average rate of 2.5 percent.

We assumed that this historical 4-percentage-point margin in the rate of increase in estimated decommissioning costs above the forecast rate of inflation would represent our worst case in cost escalation. This is because many experts believe that increased decommissioning experience will help to reduce substantially the future growth in decommissioning costs. Therefore, for our pessimistic scenario, we assumed a cost-escalation rate of 6.5 percent—the 2.5-percent forecast inflation rate plus the full 4-percent margin. For the baseline scenario, we assumed a mid-point rate and reduced this margin to 2.5 percent, for a 5-percent annual average cost-escalation rate. For the optimistic scenario, we assumed a 1-percent margin, for a 3.5-percent annual average cost-escalation rate. For our optimistic case, we believe that this 3.5-percent rate-assumption represents a reasonable lower bound because decommissioning costs include a large portion of services, and services generally have higher inflation rates than those of the GDP deflator.

After-Tax Rate of Return (Discount Rate)

Traditionally, regulated utilities were required to invest their funds conservatively in federal, state, and local securities. In recent years, however, utilities have been permitted to invest some of their funds in higher-risk, but potentially more profitable, financial instruments. From a review of eight licensees' recent financial statements, we determined that the after-tax rate of earnings from investments of decommissioning funds

varied from 5.5 to 7.3 percent. About 6 percent or slightly above was typical. Therefore, we assumed an after-tax rate of return on fund assets of 6.25 percent for our baseline scenario and rates of 5.5 and 7 percent, respectively, for our pessimistic and optimistic scenarios. In the baseline, the licensees' effective (with respect to their own decommissioning costs) real after-tax rate of return is, therefore, 1.25 percent (6.25 percent minus a 5.0-percent cost-escalation rate) and in the optimistic scenario, the real rate of return is 3.5 percent. In the pessimistic scenario, this real rate is negative, (–1 percent).[4] For a given plant's license expiration year, the larger the real after-tax rate of return, the better will be our measures of funding sufficiency for the licensee of this plant.

Nuclear Plant's Operating Life

Various experts believe that some nuclear power plants will not operate for the full length of their operating licenses because of, for example, the expected introduction of competition into the electricity markets. Conversely, two licensees have filed applications with NRC to extend the operating life of five plants, and other licensees may also seek license extensions. Because of this uncertainty, we included in our analysis the ability to reduce (or increase) each plant's life. A decrease in the expected life of a plant would require the licensee to increase the rate that it accumulated funds over the shortened life of the plant, and, conversely, an increase in the operating life would reduce the amount of funds needed to be put aside each year.[5]

Our baseline scenario assumes that all plants operate for their licensed periods except for six plants that Standard & Poor's/DRI[6] projects will be retired early.[7] For our pessimistic scenario, we assume that these six plants plus each of 20 other plants characterized by Standard & Poor's/DRI as "at risk" of early retirement will permanently shut down in 2002.[8] For our optimistic scenario, we assume that each plant will operate for its

[4]A negative real rate means that a licensee's plant decommissioning costs will increase faster than the licensee's after-tax fund earnings.

[5]Strictly speaking, a decrease in the expected life of a plant would increase the present value of that plant's future decommissioning cost only when the licensee's after-tax real rate of return is positive. If it is negative, as in our pessimistic scenario, this total present-value cost is actually decreased when the expected license expiration year is made earlier. However, even with this lower present-value cost, that cost must be paid for over fewer years. Thus, the present-value cost per year would still be higher over these fewer years.

[6]World Energy Service: U.S. Outlook, Standard & Poor's/DRI (Apr. 1998), p. 25, tables 5 and 6.

[7]One of the six plants—Millstone 1 in Connecticut—was retired in 1998.

[8]These extra 20 "at-risk" plants are listed in chapter 2 (table 2.2).

licensed operating life. (We implicitly assume that any increases in a plants's life will be offset by decreases in the life of other plants.)

Portion of Funds Available for NRC-Defined Costs

As discussed above, licensees' decommissioning costs can encompass not only costs that are within the scope of NRC's definition of decommissioning but also spent-fuel management costs and nonradiological costs. Licensees, however, may accumulate funds for all of these types of costs in their decommissioning funds because, from the licensees' point of view, all of these types of costs may be essential to decommissioning their plants. Our analysis included only those costs that are within the scope of decommissioning as defined by NRC. Therefore, in our three scenarios, we varied the percentage of each licensee's decommissioning fund that would be available to pay for NRC-defined decommissioning costs.

For our optimistic scenario, we assumed that all of each licensee's decommissioning fund is available to pay NRC-defined decommissioning costs. The expenditures for spent-fuel management and other nonradiological decommissioning costs must therefore come from other sources. For our baseline scenario, we assumed that all of the licensee's decommissioning fund would be used to pay for decommissioning costs as defined by NRC and for nonradiation costs. As discussed earlier, these types of costs represent 82 and 13 percent, respectively, of the total estimated cost to decommission an average plant. We assumed that spent-fuel management costs, which make up the remaining 5 percent of the average plant's decommissioning cost, would be paid from some other source of funds. Under these assumptions, 86 percent (82 percent divided by 95 percent) of the decommissioning fund would be used to pay decommissioning costs as defined by NRC and the remaining 14 percent (13 percent divided by 95 percent) of the fund would be used for non-radiation-related costs.

For our pessimistic scenario, we assumed that each licensee would pay for all three of these types of costs from its decommissioning fund. Thus, we assumed that the percentage of a licensee's fund available to pay for NRC-definition costs would equal the percentage of NRC-definition costs that we estimated for total decommissioning costs, or about 82 percent. To compute each of our above estimated percentages, we used the decommissioning cost data derived from TLG Services' breakdown of site-specific cost estimates into the NRC-related, spent fuel management, and nonradiological portions. Finally, for 15 of the 76 licensees, the information we obtained from Phoenix Duff & Phelps disclosed that the balances in the licensees' decommissioning funds at the end of 1997

included amounts actually held in internal reserve accounts rather than in externally managed funds restricted for eventual use in decommissioning their plants. For our analysis, we included these internal reserves in our totals for the decommissioning funds for each of these licensees.

Fund Balance Adequacy Analysis: Results

Table I.1 shows the results of our first spreadsheet analysis of each of the 76 licensee's decommissioning fund balances as of the end of 1997. The table shows whether these fund balances are more or less than the amounts that the licensees would have been expected to accumulate by then—namely, for each plant, the percentage of life used multiplied by the present value of the plant's future decommissioning cost. The table shows, for our three scenarios, the percentage that each licensee is above or below its expected fund level. As the table shows, there is a wide range of results for each individual licensee among the baseline, pessimistic, and optimistic scenarios and among all licensees within each scenario. The results for the baseline scenario should be viewed as the most likely outcomes, and the results in the pessimistic and optimistic scenarios should be viewed as lower and upper bounds, respectively. Not all of the five key factors would likely be simultaneously pessimistic, and not all likely simultaneously optimistic. Therefore, the most likely results will lie much closer to our baseline results than to those of either of our two extreme scenarios.

Given the inherent uncertainty embodied in this analysis and the various assumptions employed, the results are best used as a general guide to the relative positions of the 76 licensees in accumulating decommissioning fund balances by December 31, 1997. In the baseline scenario, 36 of the 76 licensees had not accumulated funds at a rate that is sufficient for eventual decommissioning. In addition, in table I.1, the eight licensees showing available fund balances at less than their expected levels even under the optimistic scenario are a cause for concern because future conditions will likely be worse than those assumed in the optimistic scenario. Conversely, the four licensees showing fund balances above their expected levels, even in the pessimistic scenario, suggest that these licensees may be able to reduce their funding in the future because conditions are likely to be better than those assumed in the pessimistic scenario.

For all 76 licensees combined, licensees have accumulated, on average, only 3 percent less than their expected amounts in our baseline (most likely) scenario. The present value of the total future decommissioning costs for all licensee plants is $30 billion. Because all of the five key

factors, or assumptions, are pessimistic in the pessimistic scenario and all are optimistic in the optimistic scenario, the results are much worse and better, respectively, in these other two scenarios. In the pessimistic scenario, licensees, on average, have balances that are 57-percent below their expected levels and have a present value of total future decommissioning costs of $67 billion. In the optimistic scenario, licensees, on average, have balances that are 63-percent above their expected levels and have total present-value costs of $20 billion.

Table I.1: Licensees With More Than or Less Than Expected Fund Balances (by Percentage Above or Below), as of December 31, 1997

	Scenario		
Licensee	**Baseline**	**Pessimistic**	**Optimistic**
American Electric Power	++	• •	++++
Atlantic Energy	+	• •	++++
Baltimore Gas & Electric	• •	• • •	+
Boston Edison	•	• • •	+
Carolina Power & Light	•	• • •	+++
Central and Southwest	++	• •	++++
Central Hudson Gas & Electric	+++	• •	++++
Central Iowa Power Corporation	• • •	• • •	• •
City of Austin	+++	• •	++++
City of San Antonio	+++	•	++++
CMS Energy	•	• • •	+
Commonwealth Edison	• •	• • •	+
Connecticut Yankee Atomic Power Corporation	•	• •	++
Consolidated Edison	• •	• • •	•
Corn Belt Power Cooperative	•	• • •	++
Delmarva Power	•	• • •	+++
Detroit Edison	• •	• • •	•
Dominion Resources	++++	• • •	++++
DQE, Inc.	• •	• • •	+
Duke Power Company	+	• • •	++++
El Paso Electric	+	• •	++++
Entergy	•	• • •	++++
First Energy	•	• • •	+++
Florida Municipal Power Agency	++	• • •	++++
Florida Progress	+++	• •	++++
FPL Group	+++	•	++++
GPU	• •	• • •	•
Houston Industries	++++	•	++++

(continued)

	Scenario		
Licensee	**Baseline**	**Pessimistic**	**Optimistic**
IES Utilities	•	• • •	++
Illinois Power	• •	• • •	+++
Kansas City Power & Light	•	• • •	++++
Long Island Lighting	++	• • •	++++
Los Angeles Department of Water and Power	++++	++	++++
Madison Gas & Electric	+++	•	++++
Maine Yankee	• •	• • •	• •
MidAmerican Energy	•	• • •	++
Municipal Electric Authority-GA.	+	• • •	++++
Nebraska Public Power Company	•	• • •	++
New York Power Authority	+++	• •	++++
New York State Electric & Gas	•	• • •	++++
Niagara Mohawk	+	• • •	+++
North Carolina Electric Corporation	++++	•	++++
North Carolina EMPA	• •	• • •	+
North Carolina Municipal Power	++++	++	++++
Northeast Utilities	• •	• • •	•
Northern States Power	+	• • •	+++
Oglethorpe Power	•	• • •	++
Old Dominion Electric Cooperative	++++	• •	++++
Omaha Public Power District	+	• • •	+++
Orlando Utilities Commission	++	• •	++++
Pacific Gas & Electric	++++	•	++++
PECO Energy	• • •	• • •	• •
Pennsylvania Power & Light	• •	• • •	+++
Piedmont Municipal Power Agency	++	• • •	++++
Pinnacle West	•	• • •	++++
PS Enterprise Group	+	• • •	++++
Public Service of New Mexico	+	• • •	++++
Rochester Gas & Electric	•	• • •	++
Salt River Project	+++	•	++++
Saluda River Power	++++	•	++++
San Diego Gas & Electric	++++	+++	++++
Scana Corporation	•	• • •	+++
Seabrook	• •	• • •	++
South Carolina Public Power	+++	• •	++++
Southern California Edison	+++	+	++++
Southern Company	•	• • •	+++

(continued)

	Scenario		
Licensee	Baseline	Pessimistic	Optimistic
Tennessee Valley Authority	• •	• • •	+
Texas Utilities	++++	• •	++++
Union Electric Company	+	• • •	++++
Vermont Yankee	+	• • •	+++
Washington Public Power	• •	• • •	+
Western Resources	• •	• • •	+
Wisconsin Energy	++	• • •	++++
Wisconsin Public Service	+++	•	++++
WPL Holdings	++	•	++++
Yankee Atomic	• • •	• • •	• • •

Legend

"+" means that fund balance was 1 to 25 percent more than expected.

"++" means that fund balance was 26 to 50 percent more than expected.

"+++" means that fund balance was 51 to 100 percent more than expected.

"++++" means that fund balance was over 100 percent more than expected.

"•" means that fund balance was 1 to 25 percent less than expected.

"• •" means that fund balance was 26 to 50 percent less than expected.

"• • •" means that fund balance was 51 to 100 percent less than expected.

Are Licensees Now Accumulating Funds at Sufficient Rates to Pay Unfunded Decommissioning Costs?

To answer this second question, we performed a second analysis using another spreadsheet simulation model that is similar to and is linked to our first model. We applied our second analysis for all three scenarios: pessimistic, baseline, and optimistic. In this second model, we used the same assumptions and the same basic analytic approach that we described previously for the first model. Unlike the first question and related model, which address the adequacy of the accumulation of decommissioning funds by the end of 1997, this question and related model focus on future performance. Specifically, we compared each licensee's available contribution[9] to its decommissioning fund in 1997 with the annual average

[9]For each licensee, the available contribution—meaning funds available to pay NRC-defined decommissioning costs—is calculated in the same way as in our first analysis. For the optimistic scenario, the available contribution in 1997 is the actual contribution; for the baseline scenario, 86 percent of the actual contribution; and for the pessimistic scenario, 82 percent of the actual contribution.

present-value of the future amounts that the licensee needs to contribute each year until its last plant has been retired.[10]

The comparison above is a simplified measure of the adequacy of a licensee's 1997 contribution. We compared the available portion of this contribution with hypothetical future contributions in 1998 through the final year of the licensee's last plant to be retired. We assumed that these expected future contributions will grow at the licensee's after-tax rate of return on its decommissioning fund. This measure of funding adequacy for 1997 was simplified so that we could easily list the model results for each of the 76 licensees. In general, however, the expected future funding stream for each of the 76 licensees is more complex than is assumed in the simplified results and follows a different "sawtooth-shaped" pattern for each licensee.

To undertake this analysis, we first listed the licensee's plants, beginning with the first plant to be retired and successively listed plants until the licensee's last plant to be retired. For example, if the earliest retirement of a licensee's two plants is a plant to be retired in 2007, this plant requires future funding to pay for the unfunded portion of its future decommissioning cost. The algorithm in our second simulation model accounts for this unfunded amount over the next 10 years, starting with 1998. As with the analysis in our first model, the expected contribution each year for this plant should equal 1/10th of that year's present value of the unfunded portion of the future decommissioning cost for this plant. These yearly contributions will increase in current dollars at the fund's after-tax rate of return. Once in the fund, each of these expected future amounts will continue to grow in current dollars at that same rate until the expiration of the plant's license. At the end of 2007, these 10 payments will have grown in sum to exactly equal the unfunded portion; the licensee's future payments for this plant then drop to zero.

Furthermore, if this licensee's second plant is to be retired in 2017, similar future funding for it will proceed over 20 years—from 1998 through 2017. Because we assumed in our example that the licensee's fund balance in 1997 could pay for only part of the future decommissioning cost for the first plant—hence, our "unfunded portion" for this first plant—the future funding for this second plant must pay for all of its future

[10]For those licensees whose contribution to their fund was less in 1997 than in 1996, the results of our second analysis are somewhat too negative, since these licensees did contribute more in 1996. However, for most licensees, the contributions in 1997 were either greater than or equal to the contributions in 1996.

decommissioning costs from 1998 through 2017.[11] Thus, this licensee's combined expected future payment stream in current dollars for both plants grows at the after-tax rate of return until 2007. The stream then drops in 2008 because the first plant will have been fully funded but will then grow at the after-tax rate of return until 2017. In 2018, the unfunded balance will decline to zero, and funding will cease.

Because of the volume of these calculations for 76 licensees, for our baseline, pessimistic, and optimistic scenarios, respectively, we present, for each licensee, simplified results for this second analysis. For each licensee, we compared the available portion of its 1997 contribution to its fund with the annual average of the present value of its total unfunded future decommissioning cost. This total present-value cost equals the total present value of the licensee's required future payments to fund decommissioning for all of its plants. For example, in the hypothetical case discussed above, if the present value of the unfunded future cost were $200 million, then the annual-average future payment in present-value over 20 years would be $10 million.[12] And if this licensee had funded $10 million in 1997, it would be on track to meeting its decommissioning obligations by 2017. If its 1997 payment were below $10 million, it would have to increase its future yearly funding amounts by more than the fund's after-tax rate of return. Conversely, if its 1997 payment were above $10 million, it could increase its future payments by less than the after-tax rate of return to achieve the funds needed to decommission its plants.

For licensees owning only one plant having an unfunded portion of its decommissioning cost or owning multiple plants with unfunded portions that are to be retired in the same year, our simplified analysis yields results exactly the same as our algorithm results. In these cases, the sawtooth-shaped future funding pattern does not result, and the expected future funding should grow steadily at the fund's after-tax rate of return over the life of its last plant to be retired. But, for licensees with the more typical sawtooth-shaped expected funding patterns, as in our example, our

[11]Simply put, for each licensee, to compute the expected future funding stream, the algorithm looks at the first plant to be retired and calculates whether the licensee has accumulated enough money to pay for decommissioning this plant. In our example, it did not, so there was an unfunded portion. The algorithm then funds this unfunded portion over the remaining 10 years for this plant. Because the first plant had an unfunded portion, the algorithm then "knows" that the second plant will require full funding; that is, no fund balances are remaining for funding this second plant. This second plant is then fully funded over its remaining 20 years. For licensees with more than two plants, the algorithm proceeds and asks these same questions for each successive plant and funds each plant accordingly until there are no more plants remaining for the licensee.

[12]The total future decommissioning cost in 2017 current dollars would be the future cost of $200 million in 20 years or $672 million at our baseline-assumed after-tax rate of return of 6.25 percent.

simplified analysis effectively "transforms" such multiplant licensees into one-plant companies. The present values of unfunded costs for these multi-plant licensees are the same as for this single-plant licensee; however, this "transformed" company with multiple plants has effectively "postponed" accumulating enough money to pay its decommissioning costs until the last plant owned by the licensee has been retired. In such cases, the algorithm's expected future funding will be higher in the early years but lower in the later years than the funding implied by our simplified analysis. In the early funding years, our simplified results for these licensees will therefore be better than is warranted by their algorithm results.

Current (1997) and Future Funding Adequacy Analysis: Results

Table I.2 shows, for our baseline, pessimistic, and optimistic scenarios, the results of our analysis of whether each of the 76 licensees is currently on track to accumulate sufficient funds in the future to decommission its nuclear power plants. The table shows, for each licensee, whether its funding in 1997 for NRC-defined decommissioning costs was more or less than the annual-average present value of its total unfunded future decommissioning costs for all of its plants.

Our analysis of the second question shows a wide range of results among the three scenarios for each individual licensee and among all licensees within each scenario. As with the first analysis, the results for the pessimistic and optimistic scenarios should be viewed as extreme lower and upper bounds, whereas the baseline scenario indicates the most likely results.

For all 76 licensees combined, in 1997 licensees contributed, on average, 46 percent above the expected level of funds in the baseline scenario. This percentage is associated with a $14 billion present value of unfunded future decommissioning costs. Recall that the average available fund balance for all licensees at the end of 1997 was about 3 percent less than the expected balance. Therefore, these two results suggest that licensees have currently increased the rates at which they are accumulating funds to

offset previous underfunding.[13] Viewed as a lower bound, in the pessimistic scenario, licensees, on average, contributed funds in 1997 at 60 percent below the expected amount (with a $51 billion present value of unfunded cost). Viewed as an upper bound, in the optimistic scenario, the licensees contributed funds in 1997 at 262 percent above the expected amount (with a $1 billion present value of unfunded cost).

For all three scenarios, most licensees' funding in 1997, relative to their expected levels, was better than their respective funding up until the end of 1997. In the baseline scenario, only 17 of the 76 licensees had not added sufficient funds in 1997 for eventual decommissioning. Nonetheless, the fact that four licensees contributed funds in 1997 below their expected levels in our optimistic scenario (see table I.2) may be cause for concern. Conditions may be worse than those assumed in that scenario. This is particularly so if retail competition in the electricity markets lowers electricity rates and profits. Conversely, the fact that 10 licensees contributed funds above their expected amounts in 1997 in the pessimistic scenario suggests that these licensees may be able to reduce their funding in the future because future conditions will likely be better than those assumed under this scenario.

Table I.2: Licensees That Accumulated More or Less Funds (by Percentage Above or Below) in 1997 Than the Annual-Average of the Present Value of the Future Amounts Required

	Scenario		
Licensee	**Baseline**	**Pessimistic**	**Optimistic**
American Electric Power	++++	• •	++++
Atlantic Energy	++++	+	++++
Baltimore Gas & Electric	+++	• • •	++++
Boston Edison	+	• • •	++++
Carolina Power & Light	+++	• • •	++++
Central and Southwest	+	• • •	++++
Central Hudson Gas & Electric	+++	• • •	++++
Central Iowa Power Corporation	• • •	• • •	• •
City of Austin	++++	• •	++++

(continued)

[13]As stated earlier, for many licensees our simplified results from the second analysis will be better than are warranted by our algorithm results. However, this simplification improves the results substantially for only a few of the 76 licensees. For example, for only three licensees in the baseline scenario do their 1997 contributions (1) fall short of the present value of their 1998 ideal contributions but (2) exceed the annual-average present-value of their future contributions. Thus, our results listed in table I.2 for the adequacy of future funding may be too favorable for Commonwealth Edison, Detroit Edison, and Northeast Utilities. These types of licensees have plants with unfunded future decommissioning costs whose licenses will expire early in the future but have other unfunded plants whose licenses will expire much further in the future. The percentage that the 1997 contribution falls short of the algorithm's 1998 contribution reflects this need for an early accumulation of funds to pay for those plants to be retired relatively early.

	Scenario		
Licensee	**Baseline**	**Pessimistic**	**Optimistic**
City of San Antonio	++++	• •	++++
CMS Energy	++++	• • •	++++
Commonwealth Edison	++	• • •	++++
Connecticut Yankee Atomic Power Corporation	++++	• •	++++
Consolidated Edison	++	• • •	++++
Corn Belt Power Cooperative	+	• • •	++++
Delmarva Power	+++	• • •	++++
Detroit Edison	++++	• • •	++++
Dominion Resources	++++	• • •	++++
DQE, Inc.	+++	• •	++++
Duke Power Company	++++	• •	++++
El Paso Electric	+++	• •	++++
Entergy	++++	• •	++++
First Energy	++	• • •	++++
Florida Municipal Power Agency	•	• • •	++++
Florida Progress	++++	• • •	++++
FPL Group	++++	++	++++
GPU	•	• •	++++
Houston Industries	++++	+	++++
IES Utilities	•	• • •	++++
Illinois Power	• •	• • •	+++
Kansas City Power & Light	•	• • •	++++
Long Island Lighting	+++	• • •	++++
Los Angeles Department of Water and Power	++++	++++	++++
Madison Gas & Electric	++++	+++	++++
Maine Yankee	• • •	• • •	• • •
MidAmerican Energy	+++	• • •	++++
Municipal Electric Authority-GA.	++	• • •	++++
Nebraska Public Power Company	++++	• •	++++
New York Power Authority	++++	• • •	++++
New York State Electric & Gas	++	• • •	++++
Niagara Mohawk	++++	•	++++
North Carolina Electric Corporation	++++	• •	++++
North Carolina EMPA	• • •	• • •	+
North Carolina Municipal Power	++++	• •	++++
Northeast Utilities	++++	+	++++
Northern States Power	++++	• • •	++++

(continued)

	Scenario		
Licensee	**Baseline**	**Pessimistic**	**Optimistic**
Oglethorpe Power	• • •	• • •	•
Old Dominion Electric Cooperative	++++	• • •	++++
Omaha Public Power District	++++	• • •	++++
Orlando Utilities Commission	++++	•	++++
Pacific Gas & Electric	++++	•	++++
PECO Energy	• •	• • •	+
Pennsylvania Power & Light	• •	• • •	++++
Piedmont Municipal Power Agency	++	• • •	++++
Pinnacle West	+++	• •	++++
PS Enterprise Group	+++	• •	++++
Public Service of New Mexico	+++	• •	++++
Rochester Gas & Electric	++++	•	++++
Salt River Project	++	• • •	++++
Saluda River Power	++++	•	++++
San Diego Gas & Electric	++++	++++	++++
Scana Corporation	•	• • •	++++
Seabrook	++++	• •	++++
South Carolina Public Power	++++	• • •	++++
Southern California Edison	++++	++++	++++
Southern Company	+++	• •	++++
Tennessee Valley Authority	• • •	• • •	++
Texas Utilities	++++	• • •	++++
Union Electric Company	•	• • •	++++
Vermont Yankee	++++	• • •	++++
Washington Public Power	•	• • •	++++
Western Resources	• • •	• • •	+
Wisconsin Energy	++++	• • •	++++
Wisconsin Public Service	++++	++++	++++
WPL Holdings	++++	+++	++++
Yankee Atomic	• • •	• • •	• • •

(Table notes on next page)

Legend:

"+" means that the licensee accumulated from 1 to 25 percent more funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

"++" means that the licensee accumulated from 26 to 50 percent more funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

"+++" means that the licensee accumulated from 51 to 100 percent more funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

"++++" means that the licensee accumulated over 100 percent more funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

"•" means that the licensee accumulated from 1 to 25 percent less funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

"• •" means that the licensee accumulated from 26 to 50 percent less funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

"• • •" means that the licensee accumulated from 51 to 100 percent less funds in 1997 than the annual average of the present value of the amounts required in 1998 and each subsequent year until the licensee's last plant is retired.

Comments From the Nuclear Regulatory Commission

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 26, 1999

Ms. Gary L. Jones, Associate Director
Energy, Resources, and Science Issues
United States General Accounting Office
Washington, D.C. 20548

Dear Ms. Jones:

Thank you for your letter of March 16, 1999, in which you requested the U.S. Nuclear Regulatory Commission's (NRC) comments on the General Accounting Office's (GAO's) draft report, Better Oversight Needed to Ensure Accumulation of Funds to Decommission Nuclear Power Plants (GAO/RCED-99-75).

The GAO report contains recommendations that merit serious NRC consideration with respect to future NRC use of the decommissioning fund status reports, which power reactor licensees are required to submit for the first time by March 31, 1999. However, I also believe that the GAO report does not adequately represent the complex changes that are occurring in the electric utility industry and the interactions among the NRC as a safety regulator, State public utility commissions (PUCs) and the Federal Energy Regulatory Commission (FERC) as rate regulators, and the nuclear power industry. Thus, the enclosed comments are directed toward adding to the GAO report both a more comprehensive summary of the NRC's recently amended decommissioning funding assurance requirements and a perspective on some recent developments in the nuclear power industry and State deregulation initiatives that have a direct bearing on NRC oversight of decommissioning funding assurance. In some cases, Appendix I to the GAO report contained information that was not reflected in the conclusion sections of the report. I believe that the inclusion of the additional information and the perspectives provided in the enclosed comments will put GAO's concerns in the proper perspective.

Sincerely,

Shirley Ann Jackson

Enclosure: **As stated**

COMMENTS ON THE GENERAL ACCOUNTING OFFICE'S (GAO) DRAFT REPORT,
"BETTER OVERSIGHT NEEDED TO ENSURE ACCUMULATION
OF FUNDS TO DECOMMISSION NUCLEAR POWER PLANTS"

See comment 1.

Now on p. 34.

1. At several points in the draft report and executive summary, GAO states that "the NRC did not establish thresholds for clearly identifying and responding to unacceptable levels of assurances. In the absence of such explanations, there is no logical, coherent, and predictable oversight of licensees' financial assurance for decommissioning their nuclear power plants" (GAO draft report, p. 36). Although this statement is true, it does not reflect the Commission's stated intent of examining the results of the initial decommissioning fund status reports before determining an appropriate course of action. As GAO correctly points out, until the NRC promulgated requirements for submitting decommissioning funding status information on September 22, 1998 (63 FR 50465), the NRC had no systematic means of determining the status of licensees' decommissioning funding assurance. Thus, as noted in the statements of considerations accompanying the advance notice of proposed rulemaking, the proposed rule, and the final rule that address decommissioning funding assurance, one of the primary reasons for implementing the reporting requirement was to determine the status of funds. When that status is determined and any funding assurance problems are identified, it would then be appropriate to develop thresholds for identifying shortcomings in assurance.

   The Commission explicitly recognized this situation in its memorandum to the NRC staff of June 30, 1997, "Staff Requirements - SECY-97-102 - Proposed Rule on Financial Assurance Requirements for Decommissioning Nuclear Power Reactors." Item 4 of this memorandum directed the staff to advise the Commission as to the need for further rulemaking after the staff had reviewed the initial status reports. To develop and justify any recommendation for rulemaking, the staff would, of course, have to identify any funding assurance shortcomings. The NRC believes that it would be premature to expend significant staff resources on establishing thresholds for identifying assurance problems until the NRC knows, in fact, that such problems exist, as revealed by its review of the first cycle of status reports.

See comment 2.

2. In the context of our first comment, a host of complex, interrelated variables must be analyzed before any threshold for determining funding shortfalls can be established. It is not sufficient merely to identify those licensees of nuclear plants that may not have accumulated sufficient funds on the basis of a straight-line schedule of funds accumulation. (For example, a licensee whose plant has operated half of its licensed life might be expected to have half of its estimated decommissioning funds accumulated on a present-value basis.) The NRC's decommissioning regulations explicitly recognize that State public utility commissions (PUCs) and the Federal Energy Regulatory Commission (FERC) have rate-making authority, including the authority to determine the amortization rate for accumulating decommissioning funds. (See 10 CFR 50.75(a) and 53 FR 24018 at 24038, June 27, 1988.) A rate regulator may determine that decommissioning funding will be paid proportionately more by future ratepayers. Such a decision is its, and not the NRC's, prerogative. In this sense, as long as a rate regulator is providing for ultimate recovery of decommissioning costs from ratepayers, there

Enclosure

cannot be underfunding, as GAO asserts, because reasonable assurance of future funding has been identified.

The GAO report suggests that this approach may have worked adequately in a rate-regulated environment, but that it will not work well as licensees become rate deregulated. The NRC has explicitly reserved the right in the 1998 decommissioning funding assurance rule to take steps to ensure adequate accumulation of decommissioning funds. However, to make such a determination, the NRC will need the first cycle of reports to determine the actual rate of accumulation, the rate regulator's stated intent with respect to allowing the ultimate collection of decommissioning funds, provisions for decommissioning funding in State deregulation initiatives, and other factors unique to a particular licensee.

Now on p. 30.

For example, the GAO report did not, apparently, factor in provisions for non-bypassable wires charges to recover decommissioning costs by deregulated licensees. (See the discussion on p. 32 of the draft GAO report.) Those States that have enacted rate deregulation for their electric generators have imposed such charges to recover decommissioning costs. The NRC's 1998 decommissioning funding rule explicitly recognized this as an acceptable assurance mechanism. (See 10 CFR 50.75(e)(1)(ii)(B).) Such non-bypassable charges may be structured in a variety of ways (e.g., funds are accumulated at an accelerated rate or may be deferred toward the end of reactor life but are nevertheless guaranteed to be collected, even if a reactor shuts down prematurely.) Again, until the NRC receives and evaluates the first cycle of decommissioning fund status reports and determines the extent to which future funds collections are based on such non-bypassable charges, it cannot determine the existence or magnitude of funding shortfalls. Similarly, it would be very difficult and labor-intensive to develop thresholds for evaluating funding assurance adequacy for non-bypassable charges, given the potentially great variety of alternative structures of those charges.

See comment 3.
Now on p. 5.

3. The draft GAO report does not address three recent agreements to purchase all or parts of nuclear plants in which the assurance option of prepayment of decommissioning costs is being used. On page 6 of the report, GAO states that licensees have not used prepayment as a decommissioning funding assurance option. However, the sales of Three Mile Island, Unit 1; Pilgrim; and part of Seabrook have each stipulated prepayment of all estimated decommissioning costs as part of the terms of sale. In each of these cases, the prepayment will be sufficient to provide full decommissioning funds, even in the event of premature shutdown. Although the NRC cannot predict that prepayment will be used in all future sales of nuclear plants, it believes that this option is viable and will likely be the preferred means of assuring decommissioning funds in such transactions.

See comment 3.
Now on p. 22.

4. In the context of comment 3, the NRC notes that one of the plants that GAO lists as likely to shut down prematurely is Pilgrim (p. 24, Table 2.2). However, Pilgrim is in the process of being sold to Entergy Nuclear Company, which intends to operate it as a merchant plant not subject to ratemaking. According to Entergy Nuclear's studies submitted with its application to transfer the Pilgrim license, Entergy Nuclear intends to operate Pilgrim for its full license term and will consider license extension for Pilgrim in

See comment 3.

the future. Thus, it is unlikely that Entergy Nuclear would buy this plant if it expected to have to shut Pilgrim down prematurely. Of course, there is no guarantee that Pilgrim will be able to operate for its 40-year license term. However, this example serves to illustrate both the speculative and controversial nature of projections of premature shutdown and the fact that decommissioning is likely to be fully funded soon for Pilgrim.

Now on pp. 32 and 33.

5. On pages 34 and 35 of the report, GAO discusses the issue of using accelerated funding as a method of assuring decommissioning funds for plants that shut down prematurely. We believe that this discussion is incomplete for two reasons. First, it only indirectly addresses the impact on licensees by indicating that it would have widely varying effects on licensees. However, the impact would be to cause substantial cost increases to be incurred by either licensees' stockholders or their ratepayers. Again, in the context of our first comment, if a PUC has determined that it will allow collection of any uncollected decommissioning costs from ratepayers but does not allow accelerated funding, a substantial burden could be imposed on a licensee's stockholders without any significant increase in funding assurance. Second, the discussion of the potential impacts of accelerated funding does not address the myriad difficulties in determining the appropriate rate of acceleration. Should the rate be 5 years, 10 years, etc.? (There is an inverse relation between the length of the acceleration period and annual cost.) How may the rate be determined generically, if it is meant to address the risk of premature shutdown at specific plants? (Estimating such risk would be complicated and speculative. It would involve objective factors, such as the remaining licensed life and the status of funds accumulated, but would also involve such subjective factors as the likelihood of premature shutdown in a given electric market and estimating future performance at individual reactors.) Also, if a generic rate is selected to enhance objectivity and predictability, how can such an approach be reconciled with the need for flexibility to address case-specific considerations? These issues were considered by the NRC in its evaluation of accelerated funding. Given the history of PUC and FERC allowance of decommissioning funds in rates, the NRC concluded that accelerated funding did not provide sufficiently increased decommissioning funding assurance commensurate with its potential cost impacts.

See comment 4.

6. GAO compares NRC efforts to establish a more objective, understandable, and predictable approach to safety oversight of nuclear power plants with the lack of any criteria for acting on licensees' decommissioning financial reports. We believe that such a comparison is erroneous. The NRC's efforts to establish a more objective, understandable, and predictable approach to safety oversight of nuclear plants are directed to safety requirements themselves, not to the reports that provide the NRC with information on how licensees are complying with those standards. Thus, the NRC standards of decommissioning funding assurance (i.e., the assurance mechanisms themselves and the cost-estimating formulas in 10 CFR 50.75(c)) are appropriate candidates for evaluation of their objectivity, understandability, and predictability. As indicated in comment 1, if the NRC determines that there is a problem with licensee compliance with decommissioning funding assurance requirements after it reviews the first cycle of status reports, it will then have the information necessary to determine whether its regulations need to be changed or its regulatory practices modified to address any funding assurance shortfalls.

Now on p. 41.

See comment 5.

7. On page 43 of the GAO report, the discussion on after-tax rates of return on decommissioning trust funds refers to an "optimistic" rate of 7 percent. We note that the historic long-term rate on stocks has been about 10 percent. Since stock earnings are typically capital gains that are not taxed until such gains are realized and, when taxed, are taxed at a rate of 20 percent in a "qualified" decommissioning fund, the overall "optimistic" rate could be closer to 8 or 9 percent.

The following are GAO's comments on the Nuclear Regulatory Commission's letter dated March 26, 1999.

GAO's Comments

1. NRC commented that, although our statement that it did not establish thresholds related to unacceptable levels of financial assurances is true, the statement does not reflect NRC's stated intent to examine the results of the initial licensee's financial reports before determining an appropriate course of action. We did, however, recognize NRC's intention in our report. Moreover, both our draft and final report preface our recommendations with the statement that NRC should act after reviewing licensees' initial reports. Accordingly, we did not revise this aspect of our report.

2. NRC stated that, as long as a rate regulator (such as a state public utility commission) is providing for the ultimate recovery of decommissioning costs from ratepayers, our assertion that under-funding is occurring is incorrect, because the reasonable assurance of future funding has been identified. NRC's comment is misleading. We recognize in our report that, as a matter of policy, NRC defers the establishment of the details of licensees' decommissioning funding to rate regulators as long as those details would lead to the accumulation of at least the amounts calculated in NRC's formula by the time plants' operating licenses expire. We did not assert, as NRC stated, that any licensee was underfunded in the sense of not being in compliance with the regulatory requirements of NRC or its rate regulators. What we did say was that to have "sufficient" or "expected" amounts of funds, licensees would need to accumulate increasing (but constant present-value) amounts annually and that the sum of these annual amounts, plus earned income, would equal the total estimated decommissioning costs when the licensees' plants' operating license expires. Therefore, we did not revise our report.

3. We added additional material to our report in response to NRC's comment.

4. NRC characterized as "erroneous" our assertion that of its safety oversight initiative for nuclear power plants reflects NRC's lack of criteria for acting on licensees' decommissioning financial reports. NRC said the safety oversight initiative is directed to actual safety requirements and not to the reports that provide NRC with information on how licensees are complying with those requirements. NRC's comment too narrowly describes the scope of its safety oversight initiative. In particular, the comment is silent on the initiative's efforts to develop improved

assessment methods, such as integrating data on licensees' performances and the results of NRC's inspections, determining appropriate actions by NRC on the basis of assessment results, and communicating results to licensees and the public. Our assertion was intended to illustrate the fact that, although NRC has begun requiring biennial financial reports, it has not publicly stated what actions it would expect to take if the information in a licensee's report indicates that the licensee may not be meeting NRC's financial assurance requirements for decommissioning. Therefore, we did not revise our report.

5. NRC stated that the "optimistic" after-tax rate of return on investments of decommissioning funds could be 8 or 9 percent, rather than the 7-percent rate of return that we used, because the historic long-term rate of return on stocks has been about 10 percent before taxes. Predicting the rate of return on investments for 20 years or more into the future is essentially speculative. We chose the 7-percent rate for our optimistic case because regulated utilities were traditionally required to invest conservatively in government securities and only recently have been permitted to invest some of their funds in higher-risk, potentially more profitable, financial instruments. In this regard, NRC's guidance for its staff on evaluating a licensee's decommissioning funding assurances notes that ". . .corporate or municipal bonds or preferred stocks should be rated at least 'BBB' by Moody's or an equivalent rating by another bond rating agency." The guidance also states that (1) although NRC does not explicitly prohibit investments in common stocks, speculative issues should be avoided and (2) as long as the fund is invested in a diversified portfolio, losses in any one issue of stocks, bonds, or other investments should not significantly affect the value of the decommissioning fund. A diversified portfolio would contain bonds and preferred stocks, as well as common stocks. Such a portfolio would likely achieve a lower after-tax rate of return in the long run than the return on a portfolio containing only common stocks. This portfolio would, however, have the benefit of a lower market risk. In any case, our assumption of a 7-percent rate of return is just one of the optimistic assumptions used in our optimistic scenario. In this scenario, we assume optimistic values for all five of our key assumptions. Therefore, the results for each licensee should be viewed as very optimistic upper bounds.

For these reasons, we continue to believe that our use of an after-tax rate of return of 7 percent for our optimistic scenario is appropriate and therefore did not revise our report.

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Related Products

Nuclear Regulation: Slow Progress in Identifying and Cleaning Up NRC's Licensees' Contaminated Sites (GAO/RCED-95-95, Apr. 24, 1995).

Nuclear R&D: Research Efforts Under Way to Support Nuclear Power Plant License Renewal (GAO/RCED-91-207, Sept. 25, 1991).

Nuclear Research and Development: Shippingport Decommissioning—How Applicable Are the Lessons Learned? (GAO/RCED-90-208, Sept. 4, 1990).

Nuclear R&D: Usefulness of Information From Shippingport Decommissioning for Rancho Seco (GAO/RCED-90-171, June 7, 1990).

Nuclear Regulation: NRC's Decommissioning Procedures and Criteria Need to Be Strengthened (GAO/RCED-89-119, May 26, 1989).

Nuclear Regulation: License Renewal Questions for Nuclear Plants Need to Be Resolved (GAO/RCED-89-90, Apr. 3, 1989).

Nuclear Regulation: NRC's Decommissioning Cost Estimates Appear Low (GAO/RCED-88-184, July 29, 1988).

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