SHUTDOWN ASSESSMENT

OF THE

VERMONT YANKEE NUCLEAR POWER FACILITY

INTERIM REPORT

TO THE

VERMONT GENERAL ASSEMBLY

State of Vermont
Department of Public Service
Technical Report No. 12

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EXECUTIVE SUMMARY

Background

In May, 1987, the Vermont General Assembly passed a bill (H.173) requesting a comprehensive impact assessment of a Vermont Yankee shutdown. With assistance from various state agencies, local officials, utilities and Vermont Yankee, the Department of Public Service has undertaken this assessment. The General Assembly requested two reports: a final report by December of 1988 and an interim report. This study provides preliminary findings of the Department's investigation into the questions raised in the legislation and some recommendations for completing the final report.

The investigation was conducted using the resources available within the Department and to the agencies which assisted in preparing this report. The bill's questions covered a variety of issues ranging from the state's ability to cause a shutdown of the Vermont Yankee facility to the effects such a shutdown (state-initiated or otherwise) would have on ratepayers, local communities and state tax revenues. These questions raised novel and complex legal and economic issues involving many uncertainties. Conclusions reached in this report are, therefore, tentative assessments and generally require further research and refinement.

Conclusions

The fundamental conclusions of the Department's interim analysis may be summarized as follows. Federal and state case law appear to indicate the possibility that a state effort to close an operating nuclear power plant may not be preempted if the action is not taken on safety grounds. This possible reading is, however, an extrapolation into an area where there is no precedent and is, therefore, not secure. Also, any such attempt would face further legal hurdles flowing from the Commerce and Takings Clauses of the U. S. Constitution, as well as the law of condemnation, making it exceptionally difficult to predict the outcome. Furthermore, were Vermont Yankee to shut down, whether through state action or otherwise, the economic analysis, so far, projects substantial immediate and long term costs to Vermont which must be weighed against any benefits.

Regardless of the answer to the state authority question, Vermont Yankee is subject to some risk of a permanent or lengthy shutdown at any time for a wide

variety of reasons. Vermont utilities do not, in fact, have a specific contingency plan for such an event. Nor do they, as individual utilities, have integrated, long range plans identifying and evaluating options (which would be available for use after a shutdown) in place as called for by the Department's proposed Twenty-Year Plan. Thus, it would seem that quality of planning may be a matter of more concern to Vermont than the legal authority issue. Such planning cannot be effective without a thorough understanding of the resources likely to be available. But it is not enough to understand what the resources are; we must also see how they could be accessed. Transmission systems, especially those owned by VELCO, GMP and CV must, therefore, be considered. This interim report identifies a number of questions that should be answered by Vermont utilities. To support orderly inclusion in the final report, their responses should be received by May 1, 1988.

Summarized in the table below are the Department's preliminary estimates of the costs to the state of a shutdown in the event of a state taking or a shutdown due to unspecified causes other than a forced closing by the state. The Department estimates that the costs of a forced shutdown would be roughly $569 to $612 million in present value 1988 dollars. A shutdown not due to a state action would cost Vermont roughly $343 million.

PRESENT VALUE COST TO VERMONT OF AN EARLY SHUTDOWN OF THE VERMONT YANKEE FACILITY IN 1988
(Millions of 1988 Dollars)

STATE TAKING	CLOSING DUE TO CAUSES OTHER THAN A TAKING
$569-$612	$343

The difference in costs between a state-initiated shutdown and a closing due to other reasons (e.g., accident, federal regulation or management decision.) follows from obligations the state might assume as the new owner in the event of a state taking. If Vermont Yankee were to close early due to reasons other than a taking, Vermont utilities would face the added costs of replacement power in addition to their present share of plant capital and other ongoing facility costs. In the event of a state taking, the state, as the new owner, would bear all those costs and might also bear the added burden of the shares of plant capital costs and ongoing facility costs now paid by out-of-state utilities, perhaps through a condemnation payment. Additionally, a state action forcing a shutdown of the facility could possibly leave the state financially exposed to claims for any "loss" due to the cost of replacing the

out-of-state share of Vermont Yankee power. These estimates do not reflect the costs of potential litigation, foregone benefits from power sales or the costs or avoided costs associated with an accident.

The Department's estimates of shutdown costs are based in large part on the expense projections supplied by Vermont Yankee, which assume condemnation of the facility by the state. The difference between the two estimates in the above table is due largely to assumptions about who bears the out-of-state shares of plant capital, ongoing facility, and replacement power costs. It reflects one possible cost scenario and could change significantly with the circumstances following such a closing.

H.173 Questions

The first question raised in the legislation asked what authority the state has to shut down the Vermont Yankee facility. Because no state government has taken such a step, no legal precedent exists that addresses the precise issues which would arise from attempts by a state to force a shutdown of an operating facility. Legal research reveals that the state would appear to have the power to prevent the construction of a nuclear power plant. One might reach a similar conclusion with regard to a shutdown of an operating plant, but no secure precedent exists. Were the state able to force a shutdown, however, it appears likely that the facility's owners would be entitled to compensation.

The second question raised in H.173 asked what authority the state has to protect the public safety, health and welfare when the Vermont Yankee nuclear facility is shut down. The state would continue to exercise its authority over aspects of the facility not including radiological health and safety. Included in this authority would be certain economic regulation of the facility, state control over environmental discharges, occupational safety, emergency preparedness, and authority over "low-level" wastes.

The General Assembly's third question was what financial exposure the state would have when the facility shuts down. Interpreting "state" to mean state government and the taxpayers (as opposed to Vermont utilities and ratepayers), we have concluded that if Vermont Yankee were to close as a result of either a federal regulatory agency ruling, an accident, or some other unspecified internal decision by its owners or management, then the state would not have any direct financial exposure other than lost tax revenues. Vermont utilities, however, would continue to be liable

for their share of plant capital and ongoing facility costs, as well as any new costs arising from the reason for the shutdown. What portion of these expenses would flow through to Vermont ratepayers would depend on the factual circumstances and subsequent regulatory decisions.

If a state action, however, caused a premature closing of the facility through eminent domain or other comparable action, then the state would likely be obligated to assume those costs and to compensate the owners of the facility. Other possible obligations to the state following a state taking and shutdown of Vermont Yankee, if that path were followed, would include ongoing facility costs until decommissioning, costs of compensating out-of-state ratepayers for replacement power, and any unfunded balance of the facility's decommissioning costs.

Alternative methods of establishing a condemnation payment to compensate Vermont Yankee's owners could be considered by the courts. The available guidance in the law appears to favor the establishment of compensation at the "book value" of the facility. In 1986, Vermont Yankee reported this figure to be $230 million. An alternative method would be a "capitalized value" of an expected earnings stream. In a regulated utility, the income earned is based on the undepreciated portion of its capital investment, leading again to the conclusion that compensation should be equal to book value.

The fourth question raised by the General Assembly concerned the adequacy of planning for replacement power and the ability to cover the costs of shutdown and decommissioning whenever the facility shuts down. Specific plans to address decommissioning the facility, including provisions for funding, have been made and appear to meet federal standards for adequacy. Approximately $11 million of the estimated $128 million required (in 1987) has been collected by Vermont Yankee and placed in a separate fund. The contract between Vermont Yankee and its owners appears to establish a clear obligation on the part of the owners to cover all costs associated with decommissioning except in the event of a taking of the facility by eminent domain or other similar proceeding, in which case future ratepayers could be exposed to significant unfunded portions of decommissioning costs.

Although no detailed replacement power plans exist for the event of a Vermont Yankee shutdown, there appear to be a number of alternative power sources available. This environment could change, however, and many difficult issues would confront the state in the event

of an early shutdown, including possible over-dependence on a few large suppliers, significant rate impacts, and environmental impacts associated with in-state sources of replacement power. In addition, planning for replacement power cannot be adequate without an understanding of both generation and transmission. A determination of whether mechanisms exist or are needed to ensure adequate power specifically for the event of an early shutdown of Vermont Yankee will depend on information supplied to the Department by the utilities in response to questions raised in this report.

The fifth question posed by the Legislature inquires as to the appropriate economic criterion for deciding whether the state should shut down Vermont Yankee. The Department believes that a social cost-benefit approach might yield an appropriate economic basis for such a decision. Based on its preliminary calculation of the costs and benefits of a state-initiated shutdown of Vermont Yankee, the Department's interim estimated cost to the state for such a shutdown has a present value equivalent of roughly $569 to $612 million in 1988 dollars. Other major elements of the costs and benefits of a shutdown that could not be quantified include reduced risk associated with a potential accident, litigation expenses and foregone benefits from sale of power from Vermont Yankee or sources used to replace it. A shutdown of Vermont Yankee would also impose certain costs and benefits to the strategic mix of power that ensures adequate power for the future at reasonable prices.

The bill's final question asked for an assessment of the effects of a shutdown and decommissioning upon Vermont ratepayers, and state and local revenues. The impacts on ratepayers will depend largely on the circumstances of the shutdown and the costs that are incorporated into the rates by the Public Service Board. Vermont relies on Vermont Yankee for up to a third of its power. Assuming a state taking with all major elements of costs borne by ratepayers, power rates to Vermont customers could increase by an average of roughly 10 percent. The distribution of these rate impacts could vary between utilities in the state and among customer classes. As noted in the report, a number of as yet unquantified factors could alter this estimate significantly.

The greatest impacts of a shutdown of the Vermont Yankee facility would probably be felt by the town of Vernon which relies on Vermont Yankee for about 88 percent of its tax revenue and has roughly 11 percent of its working residents employed by Vermont Yankee Nuclear

Corporation. Roughly 57 percent of the Corporation's 327 employees live in Vermont and, in 1986, Vermont Yankee paid about $3.2 million in taxes to the State of Vermont and approximately $2.5 million to Vernon and Brattleboro.

Open Issues

There were a number of issues raised in H.173 that have been left open for the final report in December, 1988. They have been addressed to varying degrees in this interim report, but will be expanded on in the final report with the completion of the research and further contributions from other state agencies and Vermont utilities. Major issues left largely untouched in this report include the effects of demand-side management and small power in reducing the burdens of replacement power costs; the effects of the recently proposed Hydro-Quebec Contract on the costs of replacement power; and the impacts of rate increases on the competitiveness of state business and industry within the state and associated impacts on employment and profits. Many other elements of the analysis will undergo careful review over the course of the year and the Department looks forward to the comments and suggestions of interested groups as we review our interim analysis and prepare a final report.

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1. INTRODUCTION

1.1 Legislative Mandate

The General Assembly initiated this study of the Vermont Yankee nuclear generating station by its passage of H.173 during the 1987 session.[1] The bill was introduced by Representatives Hockert, Batten, Lingelbach, McCormack and Potvin on January 30, 1987 and, after being amended, was approved upon voice vote by both houses May 1. Governor Madeleine Kunin signed the bill May 12.

The bill directed the Department of Public Service with assistance from other groups to study the state's authority and obligations in a closing of the Vermont Yankee nuclear plant. At the same time, lawmakers sought an assessment of the impacts associated with an early shutdown, including the cost of replacement power, decommissioning and changes in tax revenues. The impact on utilities and Vermont Yankee as well as state and local economies was also to be studied.

During legislative debate, it was recognized that the Vermont Yankee plant offered certain benefits to the state and its ratepayers. The plant is the single largest supplier or generator of electricity in Vermont, providing about one-third of the electricity consumed here. The total cost per kilowatt hour is presently in the mid-range of all of the state's electricity sources. Additionally, the plant generates tax revenues for local and state government and is a notable employer in the Windham County region.

Legislators recognized the plant might be closed due to technical problems, an accident or other reasons, but they specifically sought an opinion on whether the state has legal authority to cause a premature closing of the plant, given the complex web of federal and state laws and regulations governing nuclear operations.

Some legislators had concerns about the continued operation of the nuclear facility in the wake of accidents at Three Mile Island in Pennsylvania and Chernobyl in the Soviet Union. Another concern was the issue of nuclear waste disposal. Vermont Yankee is the largest producer in the state of high-level and low-level nuclear waste. The state now has under study a number of alternatives for disposal of low-level waste such as contaminated cleaning fluids, rubber gloves, and rags. Also, the federal government is searching for a high-level waste (consisting mostly of spent nuclear fuel) storage site to fulfill its legal responsibility, but may not have one ready for many years.

In fact, the Legislature realized that many significant issues required a public debate as the nuclear plant approached the mid-term of its licensed 35-year operating life. Other questions were: Would there be adequate replacement power if Vermont Yankee closed for any reason? What impact would a closing have on electric rates? Will there be enough money to decommission the plant? How long will decommissioning take and what method will be used? The answers to these questions and others promise to have significant influence on the electric industry as well as the health and welfare of Vermonters and other New England residents in decades to come.

1.2 Background

The concept of a nuclear power plant in Vermont was floated by a number of Vermont utilities in the mid-1960's not long after Governor Philip Hoff proposed the importation of electricity from the Churchill Falls hydroelectric project in Canada. In 1966, Vermont Yankee Nuclear Power Corporation was organized, and in 1967 it received a construction permit from the federal Atomic Energy Commission to build a plant in Vernon at

the southeastern corner of the state, bordering New Hampshire and Massachusetts. The proposed plant was sized at 540 MegaWatts compared to Vermont's total peak demand of 340 MegaWatts at the time. In 1966, 150 MegaWatts of Vermont's load was met by the State of Vermont with electricity purchased from the Power Authority of the State of New York (PASNY).

The plant is a General Electric Mark 1 boiling water reactor and cost $220 million to build in 1972. (In contrast, Connecticut's Millstone 3 nuclear plant was completed in 1986 at a total cost of $3.8 billion.) Vermont Yankee began operation in November, 1972, and its federal license is scheduled to expire in 2007. Recently, company officials and owners have discussed seeking an operating extension until 2012.

Fifty-five percent of the nuclear plant is owned by Vermont utilities and the balance is held by electric companies in other New England states. (See Appendix H for list of plant owners and their shares.) Vermont owners include: Central Vermont Public Service Corporation, Green Mountain Power Corporation, Burlington Electric Light Department, Vermont Electric Cooperative, Washington Electric Cooperative and Lyndonville Electric Department Seven other Vermont utilities purchase a total of 1.5% of Yankee's output from CVPS and GMP. They are five muricipal utilities: Morrisville, Northfield, Stowe, Hardwick and Orleans and two private companies: Allied and Rochester.

Vermont Yankee typically produces about one-third of the electricity consumed in Vermont each year, depending on its operating performance. During its 15-year operating history, it has, on average, generated electricity at 68.7% of net rated capacity. Despite a difficult period during its first two years, the unit has had a favorable "capacity factor" relative to nuclear plants of its type. When Vermont Yankee has

been unavailable, the state's utilities have had to to obtain "replacement energy" at market costs.

The plant has routinely stopped operation once a year for a period of 6-8 weeks to refuel and to perform scheduled repair and maintenance work. Vermont Yankee intends to lengthen the time between refueling outages to improve economy, effective with the cycle commencing October, 1987. Repairs at the plant, however, have proven costly: One significant project took place over a ten-year period -- from the mid-1970's to mid-1980's -- (during scheduled and unscheduled outages). It involved modifying the "torus" supports (part of the emergency cooling system) at a capital cost of about $14 million. Utilities and their ratepayers incurred additional costs for power to replace Yankee's during plant outages. Another repair resulted in a nine-and-a-half-month outage beginning in September, 1985, when cracked recirculation pipes were replaced at a capital cost of about $60 million. Expectation of this work prompted the state to purchase 150 MegaWatts from Hydro Quebec to assure a reliable supply of replacement energy. Between 1972 and 1985, the plant was shut down and taken "off line" 108 times: Twelve of the outages were for routine refueling and 96 outages were unplanned, caused by operational problems. The duration of outages has ranged from less than a day to several months.

The sponsoring utilities are responsible by contract to continue to pay the plant's capital costs and operating expenses even when it fails to operate. Those companies pass along these capital costs to customers along with the expected cost of replacement power purchased when Yankee is off line, a practice which has, in some cases, resulted in surcharges to most Vermont ratepayers. These surcharges are not reflected

in the average price per kWh Vermont Yankee has calculated. (See Chapter 6.)

1.3 Scope of Study

This study encompasses the impacts on the State of Vermont, its utilities, ratepayers and residents, associated with a shutdown of the nuclear plant. There clearly are effects on other states associated with a plant closing. A few miles or less from the plant are New Hampshire and Massachusetts, which would have concerns about the plant from the perspectives of safety, environment, employment and economics. Also, about 45% of Vermont Yankee's electricity is sold to utilities in other New England states, meaning out-of-state ratepayers have a stake in the plant's continued operation. However, impacts on Vermont are the focus of the study, except to identify potential compensation to out-of-state owners of Vermont Yankee in the event the state caused the plant to close.

If further studies of nuclear power plants in the region are contemplated, other New England states should consider participating in a coordinated study. There are eight commissioned nuclear generating plants in New England. The closing of any one of them has positive and negative implications for the entire region, not just the host state. For instance, Vermont utilities have ownership or interest in nuclear plants in four other New England states and an action or event closing any of them would have impacts here.

1.4 Study Overview

H.173 called for input from many sources, including Vermont utilities, some of whom supplied their projections of a plant closing's impact. Throughout their analyses, the utilities and Vermont Yankee looked at direct costs in considering the "economics" of

operating or closing the nuclear plant, i.e., only costs directly associated with the plant and with the supply of replacement power upon its closing. On these bases they have concluded that an early shutdown would be unjustifiably expensive.

The Department has chosen to take a somewhat broader view of the economic issue, recognizing that Yankee can not be viewed in isolation in matters such as state or regional power planning and health and environmental issues. In fact, any decision to close the plant or to continue its operation must examine a spectrum of economic and non-economic impacts. (See Tables 6-2 and 6-10, for example.) While the Department has not been able to quantify all the costs and benefits of a shutdown, it is important to at least consider those that are only qualitative.

What are the economic considerations? When deciding to build or to continue a plant's operation, regulators cannot decide based solely on the plant's ability to produce low-cost energy. The U.S. Supreme Court has noted that states may not be preempted on economic matters and that there seems to exist some state authority over such matters as economics and power planning issues, including the need for power, system reliability and diversity, and the environment. However, that decision relates only to the construction of a nuclear plant. No case has been decided relating to the closing of an existing nuclear plant. (See Chapter 2.)

Many power planners, for example, have concerns about relying on large, single unit generating sources, inherently requiring disproportionate increases in re[illegible] capacity.[2] In October, 1987, the New England Power Pool decided to increase electricity reserve requirements for utilities region-wide. This was done in part to reflect so-called "operational realities"

related to maintenance outages of large nuclear plants. During the summer electric peaks in 1987, nuclear plants in Connecticut, Maine, Vermont (for scheduled refueling) and Massachusetts were out of service. The winter of 1987-88 has already seen outages of a number of large nuclear plants in Connecticut and Massachusetts. Ultimately, electric consumers pay for the reliability risk associated with these generating sources through replacement power costs and increased reserve requirements, serving as an example that the direct cost of a plant's operation may not reflect its total costs to ratepayers.

The Department was required to make certain assumptions about the Vermont Yankee study due to the broad nature of the legislative questions. The Department assumed, for example, that references to the "state" in Questions 1, 2 and 3 meant the State of Vermont and its agencies and departments. The Department asks the Legislature to clarify these and direct further study as the interim report is discussed during the 1988 session.

The fundamental conclusions of the Department's interim analysis may be summarized as follows. Federal and state case law appear to indicate the possibility that a state effort to close an operating nuclear power plant may not be preempted, if the action is not taken on safety grounds. This possible reading is, however, an extrapolation into an area where there is no precedent and is, therefore, not secure. Also, any such attempt would face numerous further legal hurdles flowing from the Commerce and Takings Clauses of the U.S. Constitution, as well as the law of condemnation, making it exceptionally difficult to predict the outcome. Furthermore, were Vermont Yankee to shut down, whether through state action or otherwise, the economic analysis so far projects substantial immediate and long

term costs to Vermont which must be weighed against any benefits.

Regardless of the answer to the state authority question, Vermont Yankee is subject to some risk of a permanent or lengthy shutdown at any time for any of a wide variety of possible reasons. Vermont utilities do not, in fact, have a specific contingency plan for such an event. Neither do any of them have in place an integrated, long range plan identifying and evaluating options (such as would be available for use after a shutdown) as called for in the Department's proposed Twenty-Year Plan. Thus, it would seem that planning quality may be a matter of more concern to Vermont than the legal authority issue. Such planning cannot be effective without a thorough understanding of the resources likely to be available. But it is not enough to understand what the resources are; we must also see how they could be accessed. Transmission systems, especially those owned by VELCO, GMP and CV must also be considered. This interim report identifies a number of questions that should be answered by Vermont utilities. (See Section 5.4) To support orderly inclusion in the final report, their responses should be received by May 1, 1988.

Preparation of the interim report has been a major undertaking. The Department sent requests for information or assistance to approximately 38 groups, including Vermont electric distribution utilities, Vermont Yankee Nuclear Power Corporation, municipalities near the plant, state agencies, Vermont Electric Power Company (VELCO) and others. (Summaries of comments by these parties are found in Chapter 8.) Eight staff members from legal, engineering, planning and consumer divisions of the Department worked on the study. Five served as authors of the report. Cumulatively, department staff has devoted approximately eleven man

months to preparing the report. Recommendations for the final report are described in Chapter 9. Recommendations for resources for the final report, called for in H.173, will be forwarded under separate cover. Included in this report, as noted above, are various questions that will need to be answered for the final report.

Finally, it should be noted that this interim report, particularly as it relates to the state's legal authority to close Vermont Yankee prematurely, involves difficult and complex matters for which there are no specific legal precedents. Perhaps the only real certainty is that both Vermont Yankee owners and the nuclear industry in general will not be hesitant to spend substantial time and money to defend their interests, and that the resulting legal battles would be both long and expensive.

FOOTNOTES -- Chapter 1

1 "An act relating to the completion of a study assessing the shutdown of the Vermont Yankee Nuclear Facility," 1987 Vt. Acts 38.

2 Y. K. Henderson, et al., Planning for New England's Electricity Requirements, Fed. Reserve Bank of Boston, Nov., 1987, p. ii.

2. AUTHORITY OF THE STATE TO SHUT DOWN VERMONT YANKEE

"What authority does the state have to shut down the Vermont Yankee Nuclear facility?"

Analysis of the state's authority to order a shutdown of the Vermont Yankee facility involves consideration of federal law, state law, and the relationship between the two. Because no state government has taken the step of actually shutting down an operating nuclear facility, the courts have not had occasion to address the precise issues which would arise from such a shutdown or attempted shutdown. This absence of precedent makes predicting how a court would rule especially difficult (particularly as there is no specific shutdown legislation to analyze), and virtually assures that any shutdown effort would give rise to protracted and expensive litigation. Because of the interim nature of this report, this section attempts primarily to introduce and highlight some of the principal issues which would be likely to arise in shutdown legislation or litigation. It is expected that more detailed analyses will be developed by the Department and will be offered in the final report.

2.1 Federal Preemption

2.1.1 U.S. Supreme Court Case

There is no question but that Congress has made many aspects of nuclear power matters of federal regulation, and that the initial question which would be raised in shutdown legislation or litigation is whether the states have been left with sufficient residual authority to permit the shutdown of an existing nuclear plant. It is well settled that Congress may preempt state authority either by express terms of legislation, or by enactment of a scheme of federal regulation that is "so pervasive as to make reasonable the inference that Congress left no room for the states to supplement

it."[1] With respect to nuclear power, Congress has enacted a broad scheme which regulates "the radiological safety aspects involved in the construction and operation of a nuclear power plant."[2]

While the federal statutory scheme set forth in the Atomic Energy Act[3] and subsequent legislation may indicate a federal intent to preempt state regulation in the area of nuclear safety, a 1983 United States Supreme Court case suggests that the individual states retain a measure of control over non-safety related nuclear matters. The case, Pacific Gas and Electric Company v. State Energy Resources Conservation & Development Commission,[4] involved certain statutes passed by the California legislature in 1976. One of these statutes imposed a moratorium on the construction of nuclear plants until the State Energy Resources Conservation and Development Commission, a California state agency, "finds that there has been developed and that the United States through its authorized agency has approved and there exists a demonstrated technology or means for the disposal of high level nuclear waste."[5] The statute further defined "disposal" as "a method for the permanent and terminal disposition of high-level nuclear waste."[6] Certain California utilities challenged this statute, alleging, among other things, that it was preempted by the federal statutory scheme for the regulation of nuclear power.

Without dissent, the United States Supreme Court upheld the validity of the California statute. While indicating that "the Federal Government has occupied the entire field of nuclear safety concerns"[7] with certain minor exceptions, the court held that the California statute was based on economic considerations, and thus fell within the broad responsibilities traditionally held by the states in the field of public utility regulation. The court relied on a California

legislative report which indicated that the waste disposal problem was "largely economic or the result of poor planning, not safety related."[8] In rejecting the utilities' assertions that the statute was actually based on safety concerns, the court determined that it would be improper to look behind the avowed economic purpose of the statute. "It would be particularly pointless for us to engage in such inquiry here when it is clear that the states have been allowed to retain authority over the need for electrical generating facilities easily sufficient to permit a State so inclined to halt the construction of new nuclear plants by refusing on economic grounds to issue certificates of public convenience in individual proceedings," wrote Justice White for the Court.[9]

In a concurring opinion joined by Justice Stevens, Justice Blackmun stated his belief that the court's opinion did not concede enough authority to the individual states, and that a state could in fact use safety related concerns as a basis for prohibiting the construction of nuclear power plants. In his concurring opinion (which does not represent the full court's views), Justice Blackmun emphasized that "states traditionally have possessed the authority to choose which technologies to rely on in meeting their energy needs",[10] and that the judgment of the Nuclear Regulatory Commission that construction of plants may safely proceed does not mean that states must in fact permit utilities to build such plants. Summarizing his position, Justice Blackmun wrote:

> Congress has not required States to "go nuclear," in whole or in part. The Atomic Energy Act's twin goals were to promote the development of a technology and to ensure the safety of that technology. Although that Act reserves to the NRC decisions about how to build and operate nuclear plants, the Court reads too much into the Act in suggesting that

> it also limits the States' traditional power to decide what types of electric power to utilize. Congress simply has made the nuclear option available, and a State may decline that option for any reason. Rather than rest on the elusive test of legislative motive, therefore, I would conclude that the decision whether to build nuclear plants remains with the States. In my view, a ban on construction of nuclear power plants would be valid even if its authors were motivated by fear of a core meltdown or other nuclear catastrophe.[11]

The Department concludes that the majority decision lends support to state jurisdiction over non-safety related issues. Nevertheless, the Pacific Gas case relates only to a state's legal authority to preclude the construction of a nuclear plant. It must be stressed that no case has been decided relating to the closing of an existing nuclear plant. In a case governed by this ruling, it would seem that allowable economic and power planning considerations would not be limited, one-dimensional cost factors, but rather encompass both direct and indirect financial implications over the short and long term, including, but not limited to reliability, diversity of sources, environmental costs and energy costs.

Other recent cases lend support to the proposition that the primary function of the Nuclear Regulatory Commission involves safety matters. In Union of Concerned Scientists v. NRC,[12] decided in 1987, the Federal Court of Appeals for the District of Columbia circuit concluded that the Atomic Energy Act precludes the Nuclear Regulatory Commission from taking costs into account in determining and then enforcing a level of "adequate [safety] protection" in the operation of nuclear plants. As the court noted, "[n]ot a line in the legislative history accompanying the amendments suggests that such consideration would be appropriate."[13]

This understanding is reinforced by a reading of a 1984 federal Court of Appeals case involving the controversial Shoreham nuclear facility. In County of Suffolk v. Long Island Lighting Company[14], the federal Court of Appeals found, consistent with the Pacific Gas case, that concerns about the safety of the plant were preempted by federal law. With respect to economic concerns about the effect of cost overruns on rates, however, the Court did not find that federal preemption existed.[15] The Suffolk County case, like Pacific Gas, thus appears to recognize, to some extent, the states' right to control non-safety aspects of nuclear power.

2.1.2 Vermont State Law

Vermont, like most other states, has adopted statutes and rules which set forth a comprehensive scheme of utility regulation. In fully exercising what Justice Blackmun referred to as its "traditional police power over the manner in which [it] meets its energy needs,"[16] the Vermont Legislature has enacted Title 30 of the Vermont Statutes, which, among other things, creates a Public Service Board (Sec. 3) and Department of Public Service (Secs. 1,2), sets forth a comprehensive scheme of rate regulation (Secs. 225-230), imposes restrictions on abandonment of utility systems and transfer of utility assets (Secs. 109, 231-233), and requires that strict criteria be met prior to approval of the construction of new transmission or generation facilities (Sec. 248). Indeed, a review of the criteria which must be met under Section 248 (which became effective in 1969, after construction of Vermont Yankee began) shows the breadth of Vermont's regulatory scheme. Before a certificate of public good is issued under Section 248, the Board must make findings that the proposed new facility will confer an economic benefit on the state and its residents, and will not have undue

adverse effects on such things as the stability and reliability of the state's electrical system, the natural environment, historic sites, air and water purity, and human health and safety. Moreover, the Board must give due consideration to the recommendations of the regional and municipal planning commissions and municipal legislative bodies, and must determine that the need for electricity from the proposed facility could not be met in a more cost effective manner through conservation and demand side management measures. The legislature has imposed even stricter standards with respect to nuclear fission plants; the legislature must specifically determine, prior to the issuance of a certificate of public good, that construction of such a plant will promote the general welfare.[17] In this regard, the legislature has retained its oversight of nuclear plants, rather than delegate this responsibility to Vermont regulators.

2.1.3 Analysis

In view of the holding of the Pacific Gas case and the language of 30 V.S.A. Sec. 248, it appears that the State could refuse to permit the construction of additional nuclear power plants in Vermont, at least if it did so on economic or other non-safety related grounds. It is much less clear, however, how the courts would interpret the law if faced with a state decision to close an operating facility. It appears that two questions would immediately emerge. First, does the exclusive authority of the Nuclear Regulatory Commission over "the radiological safety aspects involved in the construction and operation of a nuclear plant"[18] conflict with a potential state determination that operation of a plant should be stopped? Second, how broad or narrow a reading of the "safety versus economic" distinctions should a state undertake in

considering whether to allow an existing plant to continue operation?

With respect to the both questions, the cases and statutes provide little guidance. However, the question of how a plant should operate (clearly left to NRC jurisdiction) may be different from the question of whether a plant should continue to operate at all, at least with respect to non-safety issues. It should again be noted that there is no case law considering this precise question, however, and that it is difficult to predict what a court would do when faced with it.

The second question is also a difficult one. While the Pacific Gas case undeniably creates a distinction between safety and economics, the two are intertwined in a practical sense. Perhaps all that can be said with any certainty is that the less a statute or its legislative history is based on safety, the more likely that statute would be upheld. Moreover, while courts will not generally "look behind" the stated legislative purpose of a statute,[19] any shutdown statute or action should be the product of careful study of economic considerations, and must not merely use an economic rationale as a pretext for dealing with safety concerns.

2.2 The Commerce Clause

Article I, section 8 clause 3 of the United States Constitution grants to the United States Congress the power "to regulate commerce among the several states." What this short phrase means has been the subject of innumerable judicial interpretations, although the Supreme Court long ago recognized that the Commerce Clause does leave some room for state regulation affecting interstate commerce, provided the subject is of local concern and is not one requiring national regulation.[20] Because Vermont Yankee "exports" some of its electricity to other states,[21] and because

these exports would be terminated by a state mandated shutdown of the plant, interstate commerce would be affected by the shutdown, and a Commerce Clause issue would almost certainly be raised in litigation.

While the courts have not had the opportunity to consider the Commerce Clause ramifications of the shutdown of an existing nuclear plant, there are numerous cases dealing with the relationships between the Commerce Clause, traditional state authority in the regulation of utilities, and the interstate sale of electricity. The gist of these cases is that the courts will perform a two part test in determining if a state statute, regulation or adjudication can survive a Commerce Clause challenge. First, the court will look to see if the challenged regulation constitutes "simple economic protectionism." If it does, it will usually be struck down without further analysis, as in the case of a New Hampshire Public Utilities Commission order which attempted to restrict the export of hydroelectric energy produced within New Hampshire.[22] If a measure does not amount to "simple economic protectionism," but rather visits its effects equally on local and interstate commerce, it is then subjected to a three part balancing test:

1) Does the statute regulate evenhandedly, with only incidental effects on interstate commerce; or, rather does it discriminate against interstate commerce on its face or in practical effect?

2) Does the statute serve a legitimate local purpose?

3) If the statute does serve a legitimate local purpose, could alternative means promote or serve the local purpose without discriminating against interstate commerce?[23]

It appears that legislation prematurely closing Vermont Yankee might survive the above preliminary

test. Such legislation would not constitute "simple economic protectionism" for Vermont, since the effects of shutdown would be shared by both instate and out-of-state purchasers of the plant's electricity. While meeting the second test might be more difficult, it appears that appropriate legislation would have a reasonable chance of surviving such a challenge, assuming such legislation could survive the other hurdles discussed in this report. As noted, a shutdown of the plant would appear to regulate evenhandedly and not discriminate against out-of-state purchasers, since all purchasers -- instate and out-of-state -- would lose the electricity generated by the facility.[24] A shutdown premised on legitimate economic grounds could conceivably serve a local purpose such as providing more reliable energy or providing lower rates over the long term if, for example, a premature closing would be cheaper than a rebuilding of the plant's containment system or some other major repair.[25] Moreover, if the economic concerns addressed by the legislation were directly related to the existence and continued operation of the Vermont Yankee facility, and could only be truly remedied by a shutdown, there would not appear to be an available alternative means of serving the local purpose without burdening or discriminating against interstate commerce. Under these circumstances, the criteria set out by the Supreme Court might be met, especially since "modern jurisprudence has usually, although not always, given more latitude to state regulation" than did an earlier approach used by the courts.[26]

2.3 The Contracts Clause

Article I, section 10, clause 1 of the United States Constitution precludes the states from enacting any law "impairing the Obligation of Contracts..."

Because Vermont Yankee has contracts to sell electricity, and because those contracts would undoubtedly be affected by a state mandated shutdown of the plant, it is possible that shutdown legislation or litigation would involve a claim by utilities that the Contracts Clause of the Constitution had been violated.

While any potential issue arising from shutdown legislation or litigation must be looked at very carefully, it appears that the Contract Clause issue might be less troublesome than the preemption and commerce clause issues discussed earlier. The Supreme Court has recognized that the prohibition contained in the Contracts Clause is not absolute, and that it must be read to accommodate the inherent police power of the state to safeguard the vital interests of its citizens.[27] Moreover, the fact that an industry has been heavily regulated in the past is relevant in determining the extent of impairment, since a person or company involved in a highly regulated industry may realistically expect further and changing regulation.[28] Given the principal of judicial deference "to legislative judgment as to the necessity and reasonableness of a particular measure"[29] with respect to issues of this type, carefully drafted legislation would have a reasonable chance of surviving a challenge under the Contract Clause.

2.4 Takings Clauses of Federal and State Constitutions

2.4.1 Standards For Takings

Assuming that legislation prematurely closing the Vermont Yankee facility could survive the challenges discussed above, the question would arise as to whether the plant's owners must be compensated as a result of the shutdown. While the cases pertaining to the Takings Clause of the U.S. Constitution (prohibiting the government's taking of private property without payment

of just compensation) are exceptionally difficult to interpret in a consistent fashion, it appears likely that enactment of shutdown legislation would lead to an obligation to pay Vermont Yankee's owners. Under general principles of constitutional law (both state and federal) a governmental "taking" of property, and the attendant requirement that compensation be paid to its owners, can arise in either actual or constructive fashion. An actual taking would occur through a legislative enactment specifically taking or condemning the facility[30] while a constructive taking would result from legislation or litigation which so pervasively disrupts the plant owners' property rights as to require that compensation must be made.[31] In either event, the plant's owners would have to be paid for their loss.

If the state were to seek to accomplish an actual taking of Vermont Yankee, it would likely do so by way of eminent domain. Under state and federal constitutional provisions, Vermont would have to show that the taking is necessary and that it is for a public use.[32] Because of federal preemption in the safety area as discussed earlier state concerns regarding the safety of the plant could not serve as a direct basis for establishing the necessity of the taking. Rather, what would apparently need to be established is that the specific site the facility is on is necessary to serve the intended alternative public use. Whether the future use of the site offered as the basis for a taking would in fact qualify as a "public" one would probably be the subject of litigation. The Vermont Supreme Court, in a case decided long ago, took a narrow view of what constitutes a public use, saying that "public use" and "public benefit" were not the same thing.[33] More recently, however, a court in another jurisdiction has said that "public use" and "public interest" could be

considered synonymous for eminent domain purposes.[34] The result of any potential litigation over the public use question will, of course, be largely dependent on the nature of the public use selected.

2.4.2 Need For Compensation

Under most circumstances, the owner of real or personal[35] property which is taken by the state (either in actual or constructive fashion) is entitled to just compensation for that property.[36] The principal exception to the rule that compensation must be paid arises when property is taken or affected pursuant to other, non-eminent domain aspects of the government's police power. Whereas eminent domain involves a taking of property because it is useful to the public, these other exercises of the police power involve regulation of use of property, or impairment of rights in property, on the ground that the free exercise of those rights is contrary to the public interest.[37] Examples include abatement of a nuisance,[38] destruction of an unlawful substance, forfeiture of property (such as an automobile) used in illegal transactions,.and destruction of property where necessary to avert imminent danger (such as the spreading of a fire).[39]

In the case of a state forced shutdown of Vermont Yankee, it appears that it would be difficult for the state to avoid payment of compensation to the plant's owners, since use of the police power to shut down the plant might well not pass muster with a court. A declaration that the plant was a nuisance would probably not be sufficient, since the health and safety concerns normally associated with a nuisance are in this case preempted by federal regulation, as noted earlier. The plant is not illegal in and of itself, and is not an instrumentality used in the commission of illegal acts.

A claim that a premature closing is necessary to prevent imminent danger, whether valid or not, also appears to be preempted by the federal regulatory scheme. Since these traditional police power functions cannot be used to justify a closing, it appears quite likely that compensation would have to be paid.[40] Questions as to the amount of that compensation are addressed in Chapters 4 and 6.

2.5 Indirect Shutdown Possibilities

As noted in the introduction to this section of the report, the analysis performed herein has attempted to address the ramifications of a legislative effort to close Vermont Yankee. If the entire picture is to be seen accurately, however, it must be recognized that there are other ways in which the state might work to bring about a shutdown if one is deemed appropriate.

2.5.1 Federal Congressional Action

The difficult federal preemption questions which have been noted in this report exist because of the complex relationship between the federal nuclear scheme and the traditional deference accorded the states in matters of utility regulation. Just as Congress was free to create the federal structure and federal statutes as they now exist, so it is free to change them, and to permit states to fully consider health and safety factors in making any and all decisions regarding nuclear power. Congress also may confer upon the states the ability that they would not otherwise enjoy to restrict the flow of interstate commerce,[41] and federal legislation permitting state mandated shutdowns of nuclear plants might well pass constitutional muster, particularly if it were conditioned on payment of compensation. The Vermont legislature could certainly work to promote passage of federal legislation of this

type if it desired to expand state control over nuclear plants. This would likely be a long and very difficult approach, given the federal government's historic role in promoting and overseeing nuclear power.

2.5.2 Traditional Utility Regulation

Under the provision of Title 30 of the Vermont statutes, the Public Service Board has broad regulatory power over the Vermont electric utilities which own a substantial portion of Vermont Yankee. When those utilities seek an adjustment in their rates, the cost of service data which they must supply includes costs and expenses associated with Vermont Yankee. The Public Service Board may deny recovery of any costs and expenses which have been imprudently or unreasonably incurred. Moreover, both the Public Service Board and the Department of Public Service enjoy broad authority

examine the books, papers, and records of utilities, and to investigate utility transactions which affect the interests of Vermonters.[42] Even if it is assumed that these state regulatory tools could not be used directly to bring about a shut down of the plant, they 1) give the state some opportunity to make informed judgments about the utilities' wisdom in continuing to incur nuclear-related costs and expenses, and 2) provide the types of checks and balances which may aid the utilities in making their own evaluations about whether the plant continues to be truly economic.

2.6 Conclusions

While absence of legal precedent makes it difficult to predict what the result of shutdown related legislation or litigation would be, carefully drafted legislation may have a reasonable chance of surviving challenges based on federal preemption and the Commerce and Contracts Clauses of the U.S. Constitution. If a

shutdown were enacted via a taking, it appears likely that the facility's owners would be entitled to compensation for the taking.

FOOTNOTES -- Chapter 2

1 Fidelity Federal Savings & Loan Ass'n v. DeLaCuesta, 458 U.S. 141, 153 (1982).

2 Pacific Gas and Electric Co. v. State Energy Resources Conservation and Development Commission, 461 U.S. 190, 206 (1983).

3 42 U.S.C. Sec. 2011 et seq.

4 461 U.S. 190 (1983).

5 Cal. Pub. Res. Code Ann. Sec. 25524.2 (West 1977 and Supp. 1983).

6 Cal. Pub. Res. Code Ann. Sec. 25524.2(a)(c).

7 461 U.S. at 212 (emphasis added).

8 Reassessment of Nuclear Energy in California: A Policy Analysis of Proposition 15 and its Alternatives, p. 18 (1976). This report is discussed at 461 U.S. 213-14.

9 461 U.S. at 216. It should be noted that Vermont Yankee did not receive a certificate of public good pursuant to 30 V.S.A. 248, since its construction preceded enactment of that statute. Vermont Yankee did receive a construction permit from the AEC in 1967.

10 Id. at 224.

11 Id. at 229.

12 824 F.2d 108 (1987).

13 Id. at 115.

14 728 F.2d 52 (2d Cir. 1984).

15 Id. at 60-61.

16 Pacific Gas, 461 U.S. at 225 (Blackmun, J., concurring).

17 30 V.S.A. Sec. 248(e).

18 Pacific Gas, 461 U.S. at 205.

19 Id. at 216.

20 Cooley v. Board of Wardens, 53 U.S. 299 (1851).

21 Electricity is a commodity subject to the Commerce Clause. See New England Power Co. v. New Hampshire, 455 U.S. 331 (1982).

22 Id.

23 Pike v. Bruce Church, Inc., 397 U.S. 137 (1970).

24 This assumes, of course, that the legislation is not drafted in such a way as to provide compensation or some other form of favoritism only to Vermont owners or purchasers.

25 These examples are offered for illustrative purposes only. Analysis of the economics of a shutdown is contained in later sections of this report.

26 See Middle South Energy, Inc. v. Arkansas Public Service Comm., 772 F.2d 404 (8th Cir. 1985), for an excellent analysis of tests to be applied in Commerce Clause cases.

27 Home Bldg. & Loan Assn. v. Blaisdell, 290 U.S. 398 (1934).

28 See Energy Reserves Group v. Kansas Power & Light, 459 U.S. 400, 412.

29 Id. at 413.

30 Vermont Hydroelectric Corp. v. Dunn, 95 Vt. 144 (1921).

31 Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419 (1982).

32 In re Petition of Town of Springfield, 143 Vt. 483 (1983).

33 Deerfield River Co. v. Wilmington Power and Paper Co., 83 Vt. 548 (1910).

34 Midkiff v. Tom, 471 F. Supp. 871 (D.C. Hawaii 1979).

35 It is clear that the Takings Clause covers both real and personal property. Haldeman v. Freeman, 558 F. Supp. 514 (D.C.D.C. 1983).

36 U.S. v. 320 Acres of Land, More or Less, in Monroe County, State of Fla., 605 F.2d 762 (4th Circ. 1979).

37 Franco-Italian Packing Co. v. United States, 128 F. Supp. 408 (Cd. Cl. 1955).

38 Eno v. City of Burlington, 125 Vt. 8 (1965)

39 United States v. One 1961 Cadillac Hardtop Automobile, 207 F. Supp. 693 (E.D. Tenn. S.D. 1962).

40 Like so many other aspects of this study, this question requires a degree of research and study which has not been possible up to this point. The compensation issue will be given greater study during preparation of the final report.

41 Lewis v. BT Investment Managers, 447 U.S. 27, 44 (1980).

42 30 V.S.A. Sec. 18.

3. AUTHORITY OF THE STATE TO PROTECT PUBLIC SAFETY

"What authority does the state have to protect the public safety, health and welfare when the Vermont Yankee nuclear facility is shut down?"

3.1 Background

Vermont's legal authority to protect the public safety, health and welfare upon shutdown of Vermont Yankee is found in Vermont and federal law. This chapter of the interim report surveys possible state statutory authority to protect the public. It does not and has not thoroughly analyzed preemption arguments with respect to each of the cited authorities. Recent and ongoing litigation concerning radiological emergency response plans for the Shoreham Nuclear plant on Long Island, N.Y. provides numerous illustrations of factual, political and legal responses to the amorphous nature of the relation between state and local authority to protect public safety and NRC jurisdiction over radiological safety.[1]

Under the U.S. Constitution, the states are reserved all powers not delegated to the federal government.[2] Among these powers is what is commonly referred to as a state's "police power." The exercise of this "police power" can most vividly be seen in the recent "exercise" by state officials during a simulated catastrophe at Vermont Yankee. On December 2, 1987, state and local officials mobilized to practice in a simulated nuclear emergency A state's police power, in essence, is its authority to protect the public safety, health and welfare.

In theory, to the extent reserved to it by the U.S. Constitution, the exercise of Vermont's police power is almost unlimited. In the Vermont Yankee and other contexts, that power may be limited by the effect of its exercise on other states.

In the Vermont Yankee context, important constraints on the state's police power are imposed by the federal government's exercise of its Commerce Clause power. The federal government, through passage of the Atomic Energy Act,[3] has to a large extent preempted the states' ability to regulate issues of radiological safety by giving exclusive jurisdiction over radiological safety aspects of nuclear plant operation and construction to the NRC.[4]

The scope of federal preemption of a state's efforts to regulate a nuclear plant after shutdown has not been litigated. At present only two things are clear. The state is not absolutely preempted from any conceivable exercise of its authority that might affect a nuclear plant.[5] There are areas of traditional state sovereignty affecting aspects of the plant that are not preempted.[6] For instance, the state and local communities have retained police power to protect persons and property off the Vermont Yankee site in an emergency.[7] On the other hand, the state does not have authority to regulate Vermont Yankee as it chooses. Resolution of these uncertainties will depend on the circumstances under which particular issues arise.

In addition to statutory authority the state would retain authority to protect public health, safety and welfare under common law remedies such as negligence. Indeed, the state would be free to award punitive damages against a utility if it were found liable in a tort case for causing a radiation injury. Such an award was argued by a utility as an impermissible attempt to regulate nuclear safety standards. However, the U.S. Supreme Court held that punitive damages as a means of causing potential defendants to exercise greater care was not preempted by the Atomic Energy Act.[8]

In exploring state authority, except as noted, it is assumed for purposes of this interim report that the measures taken under the following existing state statutes are not preempted.

3.2 Statutory Authority

The state's existing statutory authority to regulate Vermont Yankee derives from laws in several areas: public safety, emergency management, land use planning, air and water quality, utility and industrial regulation. Statutes which regulate generic industrial aspects of Vermont Yankee have not been detailed; examples of such statutes might include industrial equipment standards and certification, workers' compensation and unemployment insurance. The existing authority would survive a Vermont Yankee shutdown, except as otherwise noted. Examples of specific statutes include the following.

Vermont Water Pollution Control Act (10 V.S.A., Chapter 47)

The Vermont Water Pollution Control Act authorizes the Secretary of the Agency of Natural Resources to require water discharge permits. The Act applies to Vermont Yankee by defining "waste" to include "any substance or material, liquid, gaseous, solid or radioactive, including heated liquids, whether or not harmful or deleterious to waters."[9]

At present Vermont Yankee has a state waste water discharge permit for its discharges into the Connecticut River. After shutdown, were the plant to produce discharges into the Connecticut River, the state might be authorized to require a permit, so long as it did not regulate radiological aspects of discharge.[10]

Vermont Air Pollution Control Act (10 V.S.A., Chapter 23)

The Act authorizes the Agency of Natural Resources to prevent, abate and control air pollution. These regulations would apply after shutdown to the same extent as at present. The Federal Clean Air Act[11] specifically authorizes the states to regulate radioactive air pollutants from nuclear plants.

Act 250 (10 V.S.A., Chapter 151)

Act 250 authorizes the Environmental Board to regulate development. Act 250 would have possible application after shutdown to improvements or construction which would not affect radiological containment and which would not affect the plant as an electrical generation or transmission facility, since such facilities are governed by 30 V.S.A. Sec. 248. If non-utility development were to occur on the Vermont Yankee site after shutdown, Act 250 may apply.

Public Service Statutes (30 V.S.A., Chapters 1, 3, 5, 7)

These statutes provide the Public Service Board (Board) and the Department of Public Service (Department) general supervisory authority over public utilities including Vermont Yankee which would apply after shutdown, including:

* Financing arrangements of Vermont Yankee Nuclear Power Corporation, including issuance of securities or sales, mortgages or pledges of corporate property.[12]

* Vermont Yankee's manner of business operations, the condition and costs of maintenance and management.[13]

* A duty to report accidents resulting in loss of life or incapacitating injury.[14]

* Approval, including a finding of compliance with the state's electrical energy plan, prior to constructing any replacement electrical generation facility.[15]

* Approval of acquisition of control over another public service company or of consolidation or merger.[16]

Shutdown by eminent domain would transfer the ownership of Vermont Yankee plant to the state, even if the plant were not generating electricity. The present public service statutes do not address regulation of a state-owned electrical generating facility. The Vermont Yankee Nuclear Power Corporation would continue to exist subject to Board and Department regulation as a public service company.

If a shutdown were caused by state regulation, ownership would continue in Vermont Yankee Nuclear Power Corporation. Under these circumstances, Board and Department regulation over Vermont Yankee under the pertinent statutes would continue.

Vermont Occupational Health Act (18 V.S.A., Chapter 28)

The Act authorizes the state to regulate occupational health regarding all aspects of Vermont Yankee, including radiological. However, pursuant to funding arrangements governed by a memorandum of understanding between Federal OSHA and the NRC, the Vermont OSHA only inspects for safety issues arising from Vermont Yankee's operation as a large industrial plant. The present situation is likely to continue after shutdown so long as the plant remains a place of employment.

New England Compact On Radiological Health Protection (18 V.S.A., Chapter 31)

All six New England states are party to the New England Compact on Radiological Health Protection.

Members of the compact provide mutual assistance among the party states in radiation incidents.[17]

Should a radiation incident occur after shutdown, the compact plan provides for a method of response by the state. The compact also enables the state to request assistance in the form of personnel, equipment and facilities from other party states.[18]

Ionizing and Non-Ionizing Radiation (18 V.S.A., Chapter 32)

This statute designates the Department of Health as the state radiation control agency. The Act gives the Health Department responsibility to develop programs for the control of ionizing and non-ionizing radiation which are compatible with federal regulatory programs for by-product, source and special nuclear materials. To the extent state programs are compatible with federal regulation, the Health Department may control by licensing and registering sources of ionizing and non-ionizing radiation which are compatible with federal regulatory programs for by-product, source and special nuclear materials.[19] Chapter 32 is also important as the enabling legislation for Vermont to assume "agreement state" status with the federal government. Agreement status gives the state greatly enlarged powers and responsibilities over nuclear materials.[20] (See below for discussion of "agreement state" status.) Chapter 32 also grants the Health Department authority to declare existence of an emergency requiring immediate action for protection of health and safety.

Radiological Emergency Response Plan Fund (20 V.S.A. Chapters 42, 44)

The Act requires the Emergency Management Division of the Vermont Department of Public Safety, in cooperation with other state and local agencies, to

create a radiological emergency response plan to protect persons and property within the state who are threatened by their proximity to an operating nuclear reactor. The Act also requires payment of $250,000 to the State Treasury by Vermont Yankee to establish the Fund and contributions thereafter to maintain the fund level after expenses paid by the state in connection with state, municipal or county expenditures in providing personnel, operating costs and equipment necessary for implementing the state's radiological emergency response plan. Costs incurred by the state in its simulated emergency drills are reimbursed from this fund by Vermont Yankee.

Storage of Radioactive Material (10 V.S.A., Ch. 157)

This Vermont statute requires approval by the general assembly that a facility for deposit, storage, reprocessing or disposal of spent nuclear fuel elements or radioactive waste material will promote the general good of the state before such a facility may be built.[21] The statute exempts Vermont Yankee Nuclear Power Corporation[22], from approval of its temporary storage of spent nuclear fuel or other radioactive waste on its present site.

Vermont State Nuclear Advisory Panel (V-SNAP) (18 V.S.A. 1700-1702)

V-SNAP, as it is known, presently consists of the Commissioners of the Departments of Health and Public Service, the Secretary of Natural Resources, one member of the House of Representatives, one senator and two members of the public.[23] The panel has several advisory duties. It discusses issues relating to nuclear power and the presence of a nuclear plant in the state, impacts on state agencies, and changes in nuclear plant operation. It prepares technical data,

communicates with plant operators, and and acts as a liaison with the NRC.[24] After shutdown V-SNAP would likely continue with its advisory, communication and liaison duties.

Vermont Advisory Commission on Low-Level Radioactive Waste (10 V.S.A. 6510-6512)

This Commission was established to advise the governor and the legislature on matters relating to low-level radioactive waste (waste) and to develop a management plan for the waste generated in the state.[25] The Commission consists of 11 members from state agencies, the legislature, organizations holding licenses for the use of radioactive materials, one environmental organization, municipal government and the general public.

With public input, the Commission is charged with developing a management plan relating to generation, transportation and storage of waste. The plan among other matters advises on Vermont membership in a waste compact; plans if no facility will be able to accept waste generated in Vermont; and reviews the impacts of the federal mandate that Vermont take possession and ownership of Vermont generated waste.[26] The statute creates a waste management fund of $150,000 to staff and defray costs of developing the low-level waste management plan. The fund consists of fees assessed on low-level radioactive waste generated in Vermont.[27]

Waste Management Act (10 V.S.A., Chapter 159)

The Act's definitions of "harardous waste" excludes all special nuclear, source or by-product material as defined by 42 U.S.C. 2014. In general terms special nuclear, source or by-product material includes uranium or thorium, ores containing these materials or plutonium or isotope 233 or 235 enriched uranium or material made

radioactive in making or using the above listed materials.[28] If low-level radioactive wastes present a hazard to the health of persons or the environment, the state has various powers to order preventive, corrective, removal, abatement, cessation or restorative measures.[29] Examples of low-level radioactive waste which would be governed by the Act might include waste garments, tools and cleaning resins.

The Act authorizes the Commissioner of the Health Department to implement and enforce the waste management statutes, and rules and regulations of the hazardous waste management program concerning the generation, transportation, treatment, storage, and disposal of "low-level" radioactive wastes.[30]

In summary, under the state's present status, Vermont's authority to regulate would fall into two areas: first, the regulatory areas listed above; and second, indirect authority exercised through participation in NRC proceedings on licensing and decommissioning. The state would not be the ultimate decision maker in NRC proceedings.

3.3. Authority Under "Agreement" Status

Vermont law authorizes the governor to enter into agreements with the federal government "providing for discontinuance of certain of the federal government's responsibilities with respect to by-product, source and special nuclear materials (nuclear materials), and the assumption thereof by the state of Vermont."[31] Section 274(b) of the Atomic Energy Act[32] provides that states may enter into agreements with the NRC to assume state responsibility for low-level nuclear materials. An agreement entered into pursuant to these statutes would give the state authority to regulate health, safety and welfare issues arising from radiological wastes at the plant.

At anytime before or after shutdown, Vermont has two choices: The first would be to maintain current status as a non-agreement state. The second would be to enter into an agreement with the NRC to assume responsibility for by-product, source and special nuclear materials. If the state were to enter into such an agreement, under existing legislation the Department of Health would assume responsibility for licensing by-products, source, special nuclear materials or devices or equipment utilizing such materials.[33] The state would also have the right to enter Vermont Yankee to determine compliance with or violation of the governing statutes. However, areas of Vermont Yankee would remain under federal control and state inspection would depend on federal concurrence.

FOOTNOTES - Chapter 3

1 See, Long Island Lighting Company v. County of Suffolk, 628 F. Supp. 654 (1986), and cases cited therein.

2 U.S. Const. Amend. X.

3 42 U.S.C. Sec. 2011, et seq.

4 Id.

5 Pacific Gas & Electric Co. v. State Energy Resources Conservation and Development Commission, 461 U.S. 190 (1983).

6 Id.

7 See 18 V.S.A. Sec. 1655(b).

8 Silkwood v. Kerr-McGee Corp., 464 U.S. 238 (1984).

9 10 V.S.A. Sec. 1251(12).

10 Northern States Power Company v. Minnesota, 447 F.2d 1143, 1149 (1971), aff'd mem., 405 U.S. 1035 (1972).

11 42 U.S.C. Sec. 7422.

12 30 V.S.A. Ch. 3, 7.

13 30 V.S.A. Ch. 5.

14 30 V.S.A. Sec. 207.

15 30 V.S.A. Sec. 207 and 248.

16 30 V.S.A. Ch. 3, 7.

17 18 V.S.A. Sec. 1601(2).

18 18 V.S.A. Sec. 1604, 1601, and 1603.

19 18 V.S.A. Sec. 1652(c)(1).

20 See 18 V.S.A. Sec. 1653, 42 U.S.C. Sec. 2021(a), and Section 3.3.1 of this report.

21 10 V.S.A. Sec. 6501(a).

22 10 V.S.A. Sec. 6505.

23 18 V.S.A. Sec. 1700(a).

24 18 V.S.A. Sec. 1701.

25 10 V.S.A. Sec. 6510(a).

26 10 V.S.A. Sec. 6511.

27 10 V.S.A. Sec. 6512.

28 18 V.S.A. Sec. 1651(4)(8) and (9); 42 U.S.C.A. Sec. 2014.

29 10 V.S.A. Sec. 6610a.

30 10 V.S.A. Sec. 6608b.

31 18 V.S.A. Sec. 1653(a).

32 42 U.S.C. Sec. 2021(a)(1).

33 18 V.S.A. Sec. 1653(b)(1).

4. FINANCIAL EXPOSURE TO THE STATE OF VERMONT

"What financial exposure does the state have when Vermont Yankee shuts down?"

Several factors affect the financial exposure to the state, given a Vermont Yankee shutdown. The circumstances surrounding a shutdown (i.e., the method of shutdown) and the way in which "the state" is defined alter the financial impact on the state. What costs are considered, and how, affects the state's financial exposure. To whom those costs are allocated, be it to the government of the State of Vermont, Vermont's taxpayers, Vermont's ratepayers or all Vermont residents depends on the interpretation of the word "state."

This chapter discusses one likely scenario of a shutdown by state condemnation. Other plausible shutdown scenarios do exist such as a regulatory closing, a voluntary shutdown, or a shutdown by reason of accident or technological failure. For example, it has recently been reported that GPU Nuclear Corporation will be considering shutting down its Oyster Creek Nuclear Plant permanently due to its poor operating record and resulting low capacity factor.[1]

Financial exposure to the state upon shutdown of Vermont Yankee falls into several categories. This chapter discusses possible costs of compensation for condemnation of Vermont Yankee by eminent domain and costs for replacement power. Other potential impacts such as maintaining the facility, shutdown litigation, lost tax revenues, changed regulation and decommissioning are discussed in Chapters 6 and 7.

4.1 Compensation for Condemnation

Costs of condemnation derive from federal and Vermont constitutional requirements of "just compensation" for governmental takings of property.[2] Traditional eminent domain situations involve taking

land and buildings, not ongoing businesses; the most common example is highway condemnation. The traditional measure of just compensation, accordingly, has evolved along guidelines established for valuation of real estate, not valuation of an operating regulated utility plant such as a nuclear power facility. This unique circumstance creates an added layer of complexity in our analysis.

In arriving at the most likely measure of compensation, Vermont law offers no authoritative statements that define such measures of compensation. Regarding the problem of arriving at the elements of just compensation, the Vermont Supreme Court concluded that "[n]o exact formula is available."[3] The court continued by quoting Benjamin Cardozo, who said:

> No formula will be adequate unless its breadth of view and flexibility of adaptation are fitted and proportioned to the scheme and purpose of the inquest. The problem is one of justice between the individual proprietor on the one hand and on the other hand the sovereign, or representative of sovereign power.[4]

This chapter has examined three possible methods of valuing condemnation compensation:

1) replacement or reproduction cost;

2) foregone revenues or capitalized projected earnings and

3) original cost or net book value.

All three measures might possibly interact in a court or jury's calculus of determining what is "just compensation." However, legal precedent and economic reasoning provide bases for favoring original cost as the major determinant of value.

While the exact measure of compensation is inherently uncertain, opinions of the Vermont Supreme Court and orders of the Vermont Public Service Board, read with prevailing law in the majority of jurisdictions, do provide guidance for examining possible criteria for measuring compensation to a regulated utility.

4.1.1 Original Cost

For ratemaking purposes Vermont is an "original cost" jurisdiction.[5] What this means is that the proper rate base upon which a utility can earn a return is "historical or original cost plus capital improvements minus depreciation equals the net value of the property."[6] Applied to Vermont Yankee this cost measures $230 million as of 1986.[7] Original cost as a measure of condemnation compensation value has been widely accepted in long standing precedent from some jurisdictions.[8] Other states are guided by a combination of criteria, including replacement cost.

Original cost alone may not be the sole criterion of compensation.[9] The Vermont Supreme Court held it was error to use construction costs alone to value a road and sewer and water lines condemned by the City of Montpelier.[10] This decision, however, dealt with a sale of non-regulated utility components. An original cost award might be adjusted by adding the damage incurred to property remaining or by offsetting an increase to remaining property value by reason of the taking.[11]

Recent Vermont utility precedent on valuation on a non-ratemaking basis supports the conclusion that original cost would be the major, if not sole, criterion in determining compensation. The Public Service Company of New Hampshire and New Hampshire Electric Cooperative sold electric distribution facilities located in

Vermont.[12] The purchase price approved by the Vermont Public Service Board in 1983 was determined by the net book value of the facilities at date of closing or adjusted original cost.[13]

Interestingly, an earlier sale of the same facilities was rejected by the Board because of the Board's primary concern that the purchaser's offer of replacement cost, when depreciated, was an amount substantially in excess of book value.[14] The offer was based on the belief by the utility, rejected by the Board, that depreciated replacement cost should be used in computing a utility's rate base.[15]

With a single asset regulated utility, original cost would seem to be the most logical and equitable measure of compensation. Earnings by Vermont Yankee are tied to rate base, which is determined in part by the adjusted original cost of the plant. The Public Service Board has denied utility plant sales at greater than original cost.[16] The Vermont utility plant value has been based on its original cost for the purpose of both ratemaking and transfer of assets because original cost is the sole permitted rate basis upon which a Vermont utility may earn. In short, a utility's choices--to sell or to retain and make earnings, are both based, at least in Vermont, on the original cost of the plant. And, unlike unregulated businesses, the net book value of the plant not only equals adjusted original cost but also determines its revenue stream.

In holding that Vermont is an original cost jurisdiction the Vermont Supreme Court also rejected setting rates based on the value of shares issued.[17] Valuing a condemned public utility by looking at evidence of issuance of securities also has been held improper in other jurisdictions, because the price paid does not necessarily bear a relationship to the actual value of assets.[18] For the same reason assessed

valuation of property tax purposes is rejected as condemnation valuation.[19]

4.1.2 Other Criteria of Compensation

This section discusses other possible criteria which courts or regulatory commissions might use in determining just compensation.

In some jurisdictions, operating public utilities, when condemned, are valued with some consideration of evidence of income.[20] Consideration of evidence of income is generally confined, however, to past income.[21] For the most part evidence of prospective earnings is excluded as too speculative.[22] In a highway condemnation case the Vermont Supreme Court affirmed the trial court's conclusion that capitalization of projected income was too speculative to be the sole criterion of value.[23] In an original cost ratemaking jurisdiction, the foregone projected revenues of a regulated utility asset, when capitalized, are ideally equal to the net book value. Thus, the adjusted original cost and foregone revenues are the same. This lends additional support to a conclusion that original cost or net book value would likely be the basis for valuing Vermont Yankee's property if it were condemned.

Another factor in assessing compensation in other jurisdictions has been reproduction cost of the facilities.[24] However, nothing in Vermont condemnation or utility law indicates approval of reproduction cost as a measure of compensation. The reverse is indicated by judicial and regulatory approval of original cost valuation and rejection of replacement cost.[25]

Reproduction cost is a measure of compensation which has been used, together with other factors,[26] in

some other jurisdictions, and might very well be argued for by Vermont Yankee or its owners.

Two things must be noted before entertaining such arguments about use of reproduction cost. First, jurisdictions which approve its use may not be original cost jurisdictions. Second, use of reproduction cost in the Vermont Yankee context might result in excess benefits to the owners at the expense of ratepayers and taxpayers. One measure of reproduction cost might be the cost to build a coal powered generating facility of the same capacity as Vermont Yankee. This cost is estimated to be $1.15 billion (1988 $ present value).[27]

Replacement or reproduction cost for a new plant of the same generating capacity as Vermont Yankee would seem inappropriate in the context of this report's analysis of overall financial exposure to the state. First, this report considers replacement power cost as a specific financial exposure to the state. The cost of replacement power has been calculated by including both the cost of the energy needed and its capacity cost. To add the cost of building a replacement generating facility is to add an element of double counting. Similar problems are introduced by turning to a capitalization of foregone off-system sale profits as a measure of compensation. In the event of condemnation or rate treatment or when considering replacement power costs, regulatory or judicial analysis would have to make sure that the utility was not receiving the benefit of double counting or awarding benefits above what it would be entitled to earn under regulation.

4.2 Replacement Power Costs

Replacement power costs create financial exposure to Vermont ratepayers from any type of shutdown of Vermont Yankee. Replacement power costs are the difference between the cost of power to replace that

produced by Vermont Yankee and the projected price of Vermont Yankee power. Replacement power costs in the event of a 1988 shutdown are estimated to be approximately $1.338 billion which includes both Vermont and out-of-state shares. However, this would be offset against approximately $726 billion in savings in the cost of operating the plant, for a net of $612 million. The portion Vermont would be exposed to would depend on the reason for the shutdown. (All costs are 1988 present values. See footnote 1 of Chapter 6.)

4.3 Other Financial Exposures

For a discussion of other financial exposures to the state including loss of tax base, decommissioning costs, and costs of increased regulation, see Chapters 6 and 7. Litigation surrounding a shutdown for any reason might be protracted and extraordinarily expensive. On the other hand, litigable issues might all be negotiated and settled in advance of shutdown with no effect on the time of shutdown. Costs of litigation have not been estimated for this interim report.

4.4 Conclusions

The numerous variables and contingent costs envisioned by this question make it impossible to arrive at a simple bottom line figure of what it would cost the State to shut down Vermont Yankee. The foregoing has been an attempt to clarify the areas of uncertainty and to provide some guidance of the amount certain costs might be should they occur as a result of shutdown.

FOOTNOTES - Chapter 4

1 "GPU Nuclear May Close Oyster Creek if Performance Doesn't Improve", 9 Inside NRC No. 26, 1 (December 21, 1987)(McGraw-Hill).

2 U.S. Const. Amend. X.

3 Demers v. City of Montpelier, 120 Vt. 380, 387 (1958); see also, New England Power Company v. Town of Barnet, 134 Vt. 498, 506 (1976) (hereinafter cited as Barnet II).

4 Quoted in Demers, at 387.

5 See In re Towne Hill Water Company, 139 Vt. 72 (1980).

6 Id. , at 75.

7 Vermont Nuclear Power Corporation, Annual Report of Major Electric Utilities, Licensees and Others, FERC Form No.-1 (1986).

8 2 Orgel on Valuation Under Eminent Domain (2d ed. 1953) (hereinafter cited as Orgel), Sec. 209; 8 Nichols on Eminent Domain (2d ed. 1986) Sec. 14A.03, (hereinafter cited as Nichols).

9 See Demers at 390 - 391, Orgel at 85, 8 Nichols Sec. 14A.03, 5 Nichols Sec. 19.31 (1978); See also Barnet II at 503; New England Power Company v. Town of Barnet, 130 Vt. 407, 413 (1972) (hereinafter cited as Barnet I).

10 Demers, at 387.

11 Id., at 388.

12 Petition of Public Service Company of New Hampshire et al., Vermont Public Service Board, Docket No. 4705 (order, Mar. 18, 1983).

13 Id., at 3.

14 Petition of Public Service Company of New Hampshire et al., Vermont Public Service Board, Docket No. 4451, (Order August 20, 1981) 3.

15 Id., at 7.

16 Id.

17 In re Towne Hill Water Company, at 75.

18 5 Nichols Sec. 19.07; 2 Orgel Sec. 220.

19 5 Nichols Sec. 22.1; 2 Orgel Sec. 222.

20 8 Nichols Sec. 14A.04; 2 Orgel Sec. 218, Chap. XVII, XVIII (passim).

21 8 Nichols Sec. 14A.04; 2 Orgel Sec. 218.

22 8 Nichols Sec. 14A.04; 2 Orgel Sec. 218.

23 Record v. State Highway Board, 121 Vt. 230, 241-244 (1959).

24 2 Orgel Sec. 210; 8 Nichols Sec. 14A.03. For tax valuation purposes the Vermont Supreme Court has said that "[o]riginal cost less depreciation may be a method of arriving at fair market value if it reflects present costs. . .so that they will in effect become present reproduction costs." Barnet II at 505-506.

25 Petition of Public Service Company of New Hampshire et al, Vermont Public Service Board, Docket No. 4451 (order Aug. 20, 1981).

26 2 Orgel Sec. 210; 8 Nichols Sec. 14A.03.

27 Based on the cost of constructing a coal power plant in 1998. Costs were calculated based on construction cost estimates found in NEPLAN Generation Task Force Assumption Report and EPRI's 1986 Technical Assessment Guide discounted to 1988 using average cost of capital for Vermont Utilities.

5. ADEQUATE PLANNING FOR REPLACEMENT POWER, SHUTDOWN AND DECOMMISSIONING

"Is there adequate planning to provide for replacement power and to cover the cost of shutdown and decommissioning, whenever Vermont Yankee shuts down?"

There are a variety of alternative power resources today that could replace the loss of the Vermont Yankee facility given proper planning and lead time. Despite this, additional significant questions would need to be answered to determine whether there are adequate resources for the future or if additional contingency planning measures should be adopted by the utilities to help ensure adequate replacement power in the event of an early shutdown of the Vermont Yankee facility. It is clear that early planning for a shutdown of the facility would ensure available replacement power and reduce the burden of associated costs on ratepayers.

Current plans for decommissioning Vermont Yankee appear to address most major uncertainties surrounding the issue including funding. Probably the greatest concern under existing plans are that future ratepayers or taxpayers may be exposed to unfunded portions of decommissioning in the event of an early shutdown or to significant cost overruns following a normal operating life.

5.1 Replacement Power Planning

Because of the sweeping nature of this question, the Department assessed Vermont's adequacy of planning for replacement power by addressing the matter in three parts. First, do Vermont and its utilities have adequate mechanisms to plan for replacement power whenever Vermont Yankee shuts down? Second, have those mechanisms been utilized to prepare such plans? Third, regardless of the amount of planning that has been done, does Vermont have the supply-and demand-side options

necessary to yield an adequate power supply in the event that Vermont Yankee becomes temporarily or permanently unavailable?

5.1.1 Mechanisms

The Department is charged by statute with power planning responsibility for the state, and long term planning is one of its primary functions. The Twenty Year Plan, the main product of that effort, is a comprehensive planning document that projects the state's needs and analyzes Vermont's supply-and demand-side options in detail. Utility long range power planning capability is concentrated in Vermont's larger utilities, primarily Central Vermont Public Service and Green Mountain Power. Vermont's smaller utilities in general have much less planning capability, although Burlington Electric has begun developing its strategic planning capability. The Vermont Public Power Supply Authority assists in the long term planning of some municipal and cooperative utilities, although its greatest current impact is in short term planning, rate case preparation, and short-term power transactions. The Vermont Electric Power Company (VELCO) has transmission planning capabilities, recently expanded, that would play an important role.

The power planning capabilities of both the state and Vermont's distribution utilities have grown during the 1980's. These advances were forced largely by increased public attention stemming from past utility failures, and the emergence in 1981 of the Department as a body responsible for power planning.

There appear to be adequate mechanisms in place to plan for some, but not all aspects of replacement power in the event of a Vermont Yankee shutdown. Diversification of future sources and integration of demand-side management into planning are both essential

to sound planning. The most notable deficiencies in planning by Vermont utilities, primarily in the area of demand-side management (DSM) and its even-handed integration with supply planning, are discussed in the Twenty Year Plan.

One strength of Vermont's power planning capability is the experience of its utilities and the Department in acquiring Canadian energy, both electric and gas. Both Vermont's distribution utilities and the Department have negotiated substantial Canadian electricity purchases in the recent past. Recent negotiations have culminated in a five year purchase of firm power from Ontario Hydro, and a proposed long term contract with options to purchase large amounts of firm power from Hydro-Quebec. A process is presently taking place that may lead to increased future gas supplies for Vermont. Gas, as an economic energy source, provides the potential for significant direct energy, as well as fuel for future electric generation plants.

Also, Vermont utilities have demonstrated capability to construct instate generation, most recently the McNeil wood plant and several hydroelectric plants. However, Vermont's concern and awareness of environmental impacts raises questions regarding the prospect of constructing new instate generation.

5.1.2 Implementation.

While Vermont planners have adequate capability in some areas and on some levels for replacement power planning, very little such planning for an early Vermont Yankee closing has actually been done. Vermont's distribution utilities have not constructed a plan identifying precisely how the sources available to the state would be used to replace Vermont Yankee in the event of an unexpected closing. However, the Department has repeatedly expressed concern about the Vermont

utilities' heavy dependence on Vermont Yankee for their present and future power needs, and called for action to ameliorate that risk.[1]

It may be that a detailed contingency plan need not actually exist to deem Vermont's planning adequate. Rather, a suitable goal for replacement power planning might be to obtain a firm understanding of the potential, availability and limitations of each option available to Vermont, and to ensure that those options would be sufficient and flexible enough to replace Vermont Yankee in an economically and strategically acceptable way. However, based on the report submitted in response to H.173 by the utilities that own Vermont Yankee, the Department could not conclude that this lesser standard had been met. That report's consideration of the strengths and weaknesses and obstacles to implementation of the options it cited was cursory, and the list of options reviewed was short.

5.2 Power Supply and Demand-Side Management Options

5.2.1 Short Term Outlook

If Vermont Yankee were to become permanently unavailable in the near future, Vermont's utilities would face sharply higher energy costs for several years and would likely be forced to purchase short term capacity at premium prices. The time needed to construct new generation facilities, and lesser lead times to implement small power and DSM measures or acquire excess generating capacity from other utility systems, would limit Vermont's short-term ability to replace Vermont Yankee with instate sources. Before the commissioning of Phase II of the Quebec-NEPOOL Interconnection in 1991, the sum of Vermont's generation and its transmission ties to New York and Quebec may not be sufficient by themselves to meet the state's needs without Vermont Yankee. Capacity and energy sufficient

to meet Vermont's remaining needs could be obtained within New England, but the specific sources and the cost of that power cannot be identified at this time.

If planning for replacement power were to begin significantly in advance of a Vermont Yankee shutdown, the plant's capacity and energy could be replaced with a considerably more economic and sustainable set of options. First, a shutdown in the early to mid-1990's or later would allow the completion of a substantial amount of capacity that is currently being developed, primarily small power projects and Phase II of the Quebec-New England Interconnection. Second, some of Vermont's cheapest options are improvements in the areas of conservation and load management, as well as transmission and distribution line loss reductions. A lead time of even a few years would allow a significant improvement in the level of demand-side planning by Vermont utilities, and the implementation of many DSM measures by the time of the shutdown. Finally, that lead time would enable Vermont planners to assess the potential contribution and strategic value that could be obtained from new instate generation (including small power), plants constructed elsewhere in the region, and additional Canadian imports, and to procure appropriate amounts of each by the time they are needed.

5.2.2 Long Term Outlook

The Department expects cost-effective DSM measures to make a substantial contribution to Vermont's balance of electrical supply and demand in any foreseeable scenario of supply options and load growth. A shutdown of Vermont Yankee would greatly increase the state's need for both supply- and demand-side options. In fact, some projects might be made cost-effective by a closing of Vermont Yankee. To the extent that Vermont utilities pursue their most economic options, demand-side measures

will meet a substantial portion of Vermont's needs. However, a great improvement of Vermont utilities' demand-side planning capability will be needed to tap the full economic benefits of DSM.

The contribution of small power projects to Vermont's future supply mix will depend strongly on the prices that producers are offered. Those prices would reflect the state's increased needs in the event of a Vermont Yankee shutdown. A goal of the Public Service Board's current small power rulemaking proceeding regarding its Rule 4.100 is to develop an appropriate balance between the price and value of small power developed in Vermont, through a more efficient and responsive small power market. Small power's potential also depends on the number and size of potential projects. Most large projects under consideration today would be fueled by petroleum, natural gas, wood, or municipal waste. The Vermont Power Exchange has indicated that preliminary proposals for several hundred megawatts of small power production exist. However, the practicality and economic feasibility of such new proposals are untested.

Vermont's location, along with expected surpluses of hydroelectricity, coal generation, and gas supplies in Canada, combine to make the importation of Canadian energy a realistic long term option. The Vermont distribution utilities' recently proposed long term agreement with Hydro-Quebec, if approved, could be an important determinant of the cost and flexibility of replacement power if Vermont Yankee were to become unavailable.

Vermont's location also suggests the possibility of increasing access to out-of-state markets by adding transmission capacity. In particular, increased transfer capability to the west could enhance the feasibility of long term purchases from Ontario or New

York that would be limited with the present transmission system.

If needed, the most immediate form of new instate generating facilities would likely be gas turbine or diesel peaking plants. These units are designed for infrequent operation, have comparatively low construction costs, and take only about three years to build. They have limited fuel requirements, burn cleanly, and in general have modest environmental impact.

Plants designed for baseload operation would likely be more difficult to site than peaking units, because of their potential environmental impacts and need for a reliable fuel supply and delivery infrastructure. Among the most realistic options for new baseload utility generation in Vermont are one or more gas-fired combined cycle plants sized somewhat over 200 MW, wood-fired plants of between 20 and 60 MW, and coal-fired plants of various sizes.

While only a proposal, the construction of the Champlain Pipeline for natural gas could greatly improve the potential for gas-fired electrical generation in Vermont. Natural gas from the pipeline could conceivably be tapped at various locations in the state for fuel switching or to supply a gas-fired facility, and could serve as a catalyst for the development of gas-fired cogeneration projects by small power producers and Vermont industries.

5.3 Planning for Decommissioning

The issue of planning for the shutdown and decommissioning of Vermont Yankee has attracted considerable attention in the last 10 years. In the late 70's, there were numerous public discussions on the issues of funding decommissioning. Early in this decade the Vermont General Assembly considered legislation

enabling the state to establish a program for funding the shutdown and decommissioning of Vermont Yankee. Soon after, Vermont Yankee filed plans with FERC to establish an internally funded decommissioning plan.

Existing plans for funding the decommissioning of the Vermont Yankee facility were approved by FERC in 1983 and have since been adjusted. The current decommissioning plans include a technically feasible method for completing an immediate dismantlement and a long range funding program needed to pay for a scheduled shutdown in the year 2007.[2] All shutdown and decommissioning costs are to be borne by the purchasers of Vermont Yankee power.

5.3.1 Current Plans

Decommissioning of a nuclear power reactor is the process of taking it from service and disposing of remaining radioactive materials. For the process to be complete, the radioactive levels of materials remaining at the site must be brought to low enough levels to permit unrestricted access and use of the site.

The current plans for decommissioning the Vermont Yankee facility call for a complete dismantlement and removal of the facility immediately following the expiration of the operating license and shutdown in the year 2007. Current estimates of the time required to achieve complete dismantlement of the facility are approximately six years at a cost of approximately $531 million in the year 2007 ($128 million in 1987 dollars).[3]

Existing funding provisions call for cash received from the sponsors of the Vermont Yankee facility (the owners) to be deposited in a separate fund (escrow fund) controlled by a third party. Payments are made to this fund on a monthly basis. These decommissioning fund

payments increase costs at Vermont Yankee by roughly 4% (about $6 million per year in constant 1987 dollars).[4] Vermont Yankee reports that approximately $10.9 million was deposited in the fund as of September 30, 1987.

The fund collects interest from the purchase of high grade government securities and certificates of deposits. Every four years, starting in January, 1989, the payment plan is to be reviewed and revised to reflect any differences in the assumed and actual interest rates earned and inflation rate changes. This review is to be followed by a submission to FERC supporting any changes in the funding plan. Such filings may also include revised estimates of decommissioning costs. In the event the costs of decommissioning differ from those provided for in the fund, the difference would be covered by the sponsors and, presumably, their ratepayers.

Current power contracts between Vermont Yankee and its owners establish a clear obligation on the part of Vermont Yankee sponsors to cover all costs relating to the Vermont Yankee facility until decommissioning is complete, unless a state or federal government taking of the facility occurs.

5.3.2 Federal Regulations Providing for Adequate Planning and Safety

There are a number of federal regulations relating to the shutdown and decommissioning of a nuclear reactor. The NRC is also expanding its regulations to prescribe specific decommissioning methods and funding approaches needed for NRC approval. Current regulations specify only general requirements.

In general, current regulations require that applicants for operating licenses establish the financial capability to meet all obligations associated with a shutdown.

Listed below are the federal regulations and guidelines pertaining to federal regulation of decommissioning:

Part 10 CFR 50.54 -- Requires all operating licensees to take steps to obtain on-site property damage insurance to cover decontamination and cleanup following an accident.

Part 10 CFR 50.82 -- Requires licensees applying for termination of their operating license to develop procedures for disposal of radioactive materials and decontamination of materials and site.

Regulatory Guide 1.86 -- Provides guidance on how to satisfy the requirements of 10 CFR 50.82.

Part 10 CFR 51.5(b)(7) -- Provides that an environmental impact statement may be required prior to the decommissioning a nuclear facility.

5.3.3 Plans for Decommissioning Following Forced Shutdown

Were the state to force a shut down of Vermont Yankee through a taking, the state as owner would likely also assume responsibility for the decommissioning. As such it would also likely assume control of previously collected funds and responsibility for most or all future payments into the fund. A 1988 shutdown, then, would result in an additional obligation for the decommissioning fund of roughly $117 million dollars (in 1987 dollars).[5]

If the state were to force an early shutdown, the question remains whether the decommissioning could actually begin significantly earlier than the current scheduled shutdown date (after the scheduled end of Vermont Yankee's operating license in 2007). Decommissioning cannot be completed until all spent fuel has been removed and disposed of off-site. Current federal law (Nuclear Waste Policy Act of 1982) requires the federal government to start accepting spent nuclear

must retain that license until all radioactiv fuels, sources and components are removed from the site.

Four alternatives are considered acceptable by the NRC for retiring a facility. These are:

(1) Dismantlement (DECON) -- All radioactive components are removed from the site and the site is brought back to unrestricted use for other purposes.

(2) Mothballing (SAFSTOR) -- Mothballing consists of placing the facility in a state of protective storage until dismantlement can take place.

(3) Entombment (ENTOMB) -- Entombment consists of sealing all radioactive components behind a containment shield.

(4) Conversion -- Under the conversion option, the original source of steam generation is disconnected from the turbine and retired under one of the three option listed above. The remaining facility is then operated under a new nuclear or fossil fuel system.

DECON

Complete dismantlement of the Vermont Yankee facility will require all radioactive materials to be taken off-site soon after the facility schedules its shutdown. To date, there has been little experience in decommissioning a facility in this manner. Only one reactor of the same BWR type as Vermont Yankee has been completely dismantled: the Elk River facility in Minnesota. The Elk River facility was a small prototype reactor with only four years of total operating history before it was dismantled in 1974.[9]

The general advantages of the early dismantlement of the Vernon facility include the following:

(1) Early availability of property for alternative use -- Following the complete dismantlement, the owners of the Vernon site would be free to use it for some alternative function. Given

fuel for off-site disposal in 1998. The Department of Energy, however, has indicated that it does not expect to establish a permanent repository for the spent fuel until 2003. DOE has, however, proposed an amendment to its Mission Plan which would establish a facility to allow for interim storage of high level waste; such a facility could permit dismantlement as early as January 1998.[6] Considerable question remains, however, exactly when and how such storage can take place.

Alternatively, Vermont Yankee could start the decommissioning process much earlier by dismantling the facility around an on-site spent fuel storage facility.[7]

Other options for off-site disposal may exist, but may be viewed as unlikely. According to a Vermont Yankee report, the use of available storage capacity at other approved nuclear power plants, for example, is not a viable option. The only two plants with similar storage facilities in the northeast, Northeast Utilities' Millstone 1 and Boston Edison's Pilgrim 1, could only accept the spent fuel from Vermont Yankee at the expense of limiting their own storage capability.[8]

5.3.4 Options

The NRC Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactors," provides the methods and procedures considered acceptable by the NRC for termination of an operating license. Once a facility has decided to terminate its operating license it must apply for a possession-only (i.e., non-operating) license. Current regulations require plans for decommissioning be filed in conjunction with an application for a possession-only license. The advantage of the possession-only license is that it imposes reduced surveillance requirements. The licensee

the strategic location of the Vernon site and the infrastructure elements in place, options include placing a new generating plant on the same site.

In nominal dollars, early dismantlement may present the most expensive decommissioning plan; however, when one considers the lost opportunity for alternative uses of the site during a SAFSTOR or ENTOMB, early decommissioning may represent the most attractive option. The DECON option may also be most attractive from the standpoint of surrounding communities. Once the plant is no longer providing tax revenues and employment income to the Town of Vernon, it may be viewed as "an eyesore, a perceived hazard, or, at the least, an unproductive use of an otherwise useful site."[10]

(2) Safety -- Although the overall level of occupational radiation exposure will be higher and more personnel would be required to dismantle the facility than under a delayed dismantlement, at least two safety considerations favor a prompt dismantlement. First, the operations personnel who are most familiar with the facility would still be available to assist in the dismantlement. Second, immediate dismantlement would eliminate the risk of radiation leaks or exposure during the delay or safe storage period.

In general, DECON presents a greater safety hazard than the alternative options for decommissioning. Despite these hazards, the NRC reports that exposure can be kept reasonable under DECON.[11]

(3) Other considerations -- In the case of Vermont Yankee, the single asset nature of the company may favor an early decommissioning. Once the facility has closed and the decommissioning fund has matured, the company will no longer be generating any revenue, except on interest earned on the fund. As a long range proposition, this could create uncertainty over both the funding and the management oversight during any extended delays.

SAFSTOR

The SAFSTOR decommissioning option involves virtual isolation of the radioactive components of a facility until their radioactivity levels are lowered to enable less restrictive handling measures during decommissioning. Available cost data suggests that SAFSTOR may be safer and less expensive (ignoring alternative site uses) than DECON.

Cumulative constant dollar costs associated with a 100 year delayed dismantlement (of the Vermont Yankee facility) were lower than the costs of immediate dismantlement by approximately $20 million ($53 million vs. $73 million in 1981 dollars). Thirty year delayed dismantlement costs were higher than the immediate dismantlement option (at $85 million); however, a present value comparison yield[s] significantly lower costs (associated with either a 30 year SAFSTOR or ENTOMB than DECON).[12] The bulk of the costs under a SAFSTOR or ENTOMB option occur during the actual delay and dismantlement, 30 to 100 years after DECON.[13]

Although the potential for occupational exposure may increase during the delay before dismantlement (SAFSTOR), overall, SAFSTOR significantly lowers the risks of occupational exposure to unsafe radioactive materials by allowing the level of radioactivity to decay naturally. Even the occupational risks associated with transportation accidents would be significantly reduced in a SAFSTOR option over early dismantlement. An NRC report estimates that transportation casualties (injuries and fatalities) would be reduced by approximately 79% under SAFSTOR.[14]

ENTOMB

Total entombment of a facility involves the encasement of all radioactive materials behind a biological shield. The difference between the ENTOMB

and SAFSTOR options is the extent to which the radioactive components are secured behind a protective shield. Like SAFSTOR, entombment can eventually involve dismantlement, however the costs of that dismantlement would be increased by the extent of the barrier created to secure the radioactive materials. Under both the delayed SAFSTOR process and the ENTOMB process, continued security of the facility is required. However, the extent of the security is significantly reduced under the ENTOMB option.

The advantages of the ENTOMB option are its low initial and ongoing costs. Indefinite entombment has not been ruled out by the NRC, but, as a practical matter, is not generally viewed as a viable alternative. Indefinite entombment would render the site useless and require ongoing security for hundreds of years.[15] Entombment in conjunction with a delayed dismantlement, however, may be desirable from both a safety and a cost standpoint.

CONVERSION

Conversion of a boiling water reactor of the Vermont Yankee type is a less viable option than for other U.S. reactor types. The turbine in a BWR type reactor is exposed to radioactive steam and is contaminated. Both the source of steam and the turbines may have to be removed before another source of generation could be installed. On the other hand, cooling towers and some other non-contaminated structures could be reusable.

5.3.5 Issues

The selected method of decommissioning should be technically feasible, safe, cost effective, practical and address relevant uncertainties in costs and the timing of the plans.

SAFETY

Alternative methods for decommissioning Vermont Yankee present risks to both workers dismantling the facility and to the general public. Immediate dismantlement presents relatively high risks to the occupational workers and the general public. A delayed dismantlement of the Vermont Yankee facility presents significantly less health risk associated with occupational exposure.[16]

Table 5-1 shows the risks to the general public and occupational risks associated with the different decommissioning methods. These estimates were developed based on the conceptual decommissioning of a large (1155 MW) BWR reactor (more than twice the size of Vermont Yankee).

TABLE 5-1

SUMMARY SAFETY ANALYSIS FOR DECOMMISSIONING
A REFERENCE BWR

Safety Type / Concern Source	Units	DECON	ENTOMB	SAFSTOR 10 Yr	SAFSTOR 30 Yr	SAFSTOR 50 Yr	SAFSTOR 100 Yr
Public Safety							
Radiation Dose							
Decommissioning	mr*	0.05	0.04	<0.05	<0.05	<0.05	<0.05
Transportation	"	11	5.9	5.6	2.9	2.7	2.7
Continuing Care	"	--	neg.	neg.	neg.	neg.	neg.
Total	"	11.05	5.94	<5.65	<2.95	<2.75	<2.75
Occupational Safety							
Serious Injury							
Decommissioning	No.	6.7	6.5	9.6	9.6	9.6	9.6
Transportation	"	1.2	<0.8	1.5	1.5	1.5	1.5
Continuing Care	"	--	--	0.06	0.06	0.06	0.06
Total	"	7.9	<7.3	12.16	12.16	12.16	12.16
Fatalities							
Decommissioning	No.	0.038	<0.039	0.058	<0.058	0.058	0.058
Transportation	"	0.072	<0.047	<0.087	0.087	0.087	0.087
Continuing Care	"	--	--	>0.001	>0.001	>0.001	>0.001
Total	"	0.110	0.086	0.146	>0.146	>0.146	>0.146
Radiation Dose							
Decommissioning	mr	1845	1573	871	418	388	386
Transportation	"	120	56	60	30	28	28
Continuing Care	"	--	--	1.3	6.5	10.0	10.0
Total	"	1965	1629	932.3	454.5	426	424

*Man-rems [17]

The major sources of exposure and injury associated with the decommissioning of the facility occur during the actual dismantling operations. The most significant reductions in public and occupational exposure would come from a 30 year passive safe storage (SAFSTOR) with delayed dismantlement. After 30 years, there is little additional gain in exposure reduction.[19] Risk of serious injury or fatalities, however, is lower under the immediate dismantlement and entombment options.

In general, less than 10 work loss accidents are expected to result from the decommissioning under any plan.[20] Transportation occurring during the dismantlement creates the greatest potential risks to the general public. No fatalities were expected to result from decommissioning the reference BWR that was roughly twice the size of Vermont Yankee.

COSTS

Existing estimates of the actual decommissioning costs appear to favor delayed dismantlement. An NRC report shows the total constant dollar costs of immediate dismantlement of the Vermont Yankee facility to be approximately 8 to 25 percent higher than entombment of the facility.[21] Vermont Yankee's consultant estimated higher constant dollar costs associated with SAFSTOR and 30 year ENTOMB; however, a present value comparison of the alternatives yields lower costs associated with delayed dismantlement options.

In 1981, the Vermont Yankee Nuclear Power Corporation contracted a study to estimate the costs of decommissioning under alternative decommissioning options. Table 5-2 provides a summary of the cost estimates from the contractor's report.

TABLE 5-2

Decommissioning Costs

(Thousands of 1981 $)[22]

	DECON	SAFSTOR		ENTOMB	
Initial Costs	$72,772	$14,116		$17,103	
		30 Years	100 Years	30 Years	100 Years
Dormant Period Costs	--	12,510	41,700	2,550	8,500
Dismantlement	72,772	49,376	17,923	46,454	17,001
Total	$72,772	$95,003	$92,174	$85,134	$53,255

Actual dismantlement of Vermont Yankee after 50 to 100 years would be less costly than immediate dismantlement due to lower costs of handling contaminated components after 50 years, when the radioactivity levels of piping and components have decayed to unrestricted levels.[23]

UNCERTAINTIES

Uncertainties surround estimates of the costs, exposure risks and technologies associated with decommissioning Vermont Yankee. Although experience with dismantling a nuclear reactor is limited, the technologies employed in the cost estimates are available. The major uncertainties associated with the estimates of costs used in the fund are (1) accident, (2) cost overruns, (3) assumptions concerning inflation rates and interest earnings, (4) fulfillment of

obligations by utilities paying into Vermont Yankee's decommissioning fund, and (5) the early shutdown.

Accident

An NRC report estimates that the total costs of decommissioning following an accident increase the costs of normal decommissioning by about 33%.[24] This does not include the costs of actual clean-up which would be much higher. (See discussion in next Chapter.) On-site clean-up costs for the TMI facility were approximately $1 billion.

The NRC requires reactors to carry property damage insurance in the case of an accident at the site. Vermont Yankee currently carries $1.5 billion for on-site clean-up. The decommissioning fund itself and the continuing obligation of the owners would pay the balance of decommissioning costs associated with an early shutdown.

Cost Overruns

If the costs of decommissioning Vermont Yankee exceed estimates, the sponsors of the facility would be responsible for such costs under their existing contracts. Significant unanticipated overruns, however, could flow through to ratepayers, creating a burden on future ratepayers who would not be benefitting from the facility.

Funding Uncertainties: Inflation and Interest

The current funding provisions were established in 1983 and modified in 1985. They call for the fund to earn a real rate of return of 3% and assume 7% inflation on costs. The funding provisions and assumptions are reviewed every four years to determine whether these assumptions are inadequate or incorrect.

Vermont Yankee Nuclear Power Corporation amended its current payment schedule to incorporate adjustments due to the higher costs of disposing of low level waste (FERC Docket No. EL87-22-001). The costs of burying low level waste has recently increased from $14.34 per cubic foot to $60.08 per cubic foot.[25] Vermont Yankee proposed and had approved a plan for increasing the current payment schedule by 13.6% to accommodate the net effect of the additional costs.

Current estimates of the cost of final disposal of the facility (burial of low level wastes following the dismantlement of the facility) represent over 30 percent of the total costs of decommissioning. The ultimate costs associated with this component may represent the greatest source of uncertainty in estimating the future costs of decommissioning.

Default on Payments by Sponsors

Under current provisions, default on payments by one or more of the sponsor utilities could result in an added burden to other utility ratepayers and/or the taxpayers. Vermont Yankee reports that its sponsors and those of three other Yankee companies have initiated steps to organize a captive insurance company. The insurance company would insure the Yankee companies against a default by one of their purchasers.

This insurance company, after receipt of one year's advance premiums, would have sufficient assets to cover a default by a single small sponsor for approximately seven months -- a period which should permit either resolution of whatever payment delinquencies might arise in bankruptcy or permit a transfer of the defaulted power contract to a new purchaser.[26] Vermont Yankee expects the insurance fund to be established in early 1988.[27]

Early Shutdown

Unless a state taking of the Vermont Yankee facility occurs, it appears current sponsors of the Vernon facility would be liable for all costs associated with the shutdown and decommissioning of the facility, regardless of whether Vermont Yankee actually provides power. The ultimate burden of these costs would fall on the owners of Vermont Yankee, their ratepayers, or taxpayers.

5.4 Conclusions

Vermont utilities have adequate capability to plan for some aspects of replacement power in the event of a Vermont Yankee shutdown, while adequate planning capability has not been demonstrated in other areas. While specific contingency plans for replacing Vermont Yankee have not been constructed, it appears that such plans could be developed if a reasonable lead time were available. Adequate resources appear to be available to replace Vermont Yankee if necessary, although the acquisition of replacement power would be especially difficult and costly if the plant were closed unexpectedly. Even a planned shutdown would be costly, and that cost would have to be weighed against the benefits. However, the feasibility and cost of many options are uncertain. To ascertain the adequacy of Vermont's future options and to clearly identify the obstacles to satisfactory replacement power planning, the Department believes that the following questions need to be answered by Vermont utilities.

1. If Vermont Yankee were to become unavailable, what do Vermont's distribution utilities believe would be an appropriate proportion of replacement power to be met with small power development? Would they be able to acquire that amount within Vermont, either immediately or in the long term, and at what prices?

2. Do Vermont's distribution utilities have sufficient planning capability to identify and implement DSM initiatives? If not, what time and resources will be needed to develop that capability?

3. CVPS has recently suggested constructing a gas-fired combined cycle power plant in Rutland. Under what circumstances does CV or other utilities foresee the development of such a facility? What is the expected cost of power from such a plant, and what effects would it have on the Vermont transmission system?

4. While spent fuel remains on the Vermont Yankee site, what limitations would there be on the type and size of plant that could be constructed there?

5. What would be the appropriate size of, and likely cost and time frame needed to build, an additional converter or converters at Highgate or elsewhere on the Vermont-Canada border? Have studies been done to analyze the effects of increased imports over such a converter(s) on the Vermont regional and inter-regional transmission systems and those of interconnecting power pools? If not, what would be needed?

6. Have VELCO or Vermont's distribution utilities studied the feasibility, time frame, and cost of expanding Vermont's transfer capacity with New York, either through the construction of additional interties south of Lake Champlain or a transmission line under the lake? If so, VELCO and the utilities should identify the expected costs and time frames to construct such interties. If not, when could a study be completed?

7. Has the effect that losing Vermont Yankee would have on the adequacy of the state's transmission system been studied? Besides construction of a new facility on the Vermont Yankee site, what remedies might be appropriate?

The current plans for the funding and decommissioning of the Yankee facility appear to meet federal standards for "adequacy."[28] The Vermont

Yankee cost estimates and funding mechanisms address most of the major issues and uncertainties surrounding the issue of adequate funding for decommissioning. Probably the greatest concern with the existing planning provisions is that non-benefitting ratepayers and taxpayers are exposed to potentially significant cost overruns associated with decommissioning after a normal operating life or due to added or unfunded costs of decommissioning following an early shutdown.

FOOTNOTES -- Chapter 5

1 See Department of Public Service, Twenty Year Electric Plan, 1983. In fact, some amounts of Vermont Yankee power have been transferred to out-of-state utilities. Some Vermont distribution utilities have expressed concern at least for the current level of reliance on Vermont Yankee and the sudden increase in costs when the plant is out of service for lengthy periods.

2 According to the NRC, the technology is available to decommission a large nuclear power BWR reactor with present-day technology. "Further development of special equipment such as the plasma-arc torch, the arc saw, and sophisticated remote-handling equipment could lead to reductions in both cost and occupational exposure." Experience with the large BWR type reactor is, however, limited. See discussion in Appendix on experience with decommissioning. From Technology, Safety and Costs of Decommissioning Reference Light Water Reactors Following Postulated Accidents (Washington, D.C.: U.S. Nuclear Regulatory Commission, November 1982), NUREV/CR-0672, p. 2-17.

3 The estimates reported were based on disposal costs at the South Carolina Barnwell facility of approximately $60 per cubic foot per figures reported by Vermont Yankee in a 1987 FERC filing, Docket No. EL87-22-001.

4 Letter from William J. Daley, Vermont Yankee, to Vermont Department of Public Service (November 6, 1987).

5 One hundred twenty-eight million less the approximately $11 million already collected.

6 Office of Civilian Radioactive Waste Management, Draft Mission Plan Amendment, U.S. Department of Energy, DOE/RW-0128.

7 Cost data supplied by the U.S. Department of Energy suggest that a separate dry storage facility could be used at Vermont Yankee for a cost of less than $20 million. This assumes spent fuel costs of approximately $60,000 per concrete cask and approximately 5 spent fuel casings per cask (for BWR reactor); the total cost of establishing an on-site spent fuel storage capability (for its approximate 1500 fuel assemblies) separate from the facility would be approximately $18 million. Telephone

conversation with Chris Kouts, Office of Civilian Radioactive Waste Management, Washington, D.C., U.S. Department of Energy, November 22, 1987.

8 Vermont Yankee, Vermont Yankee Spent Fuel Storage Rack Replacement Report, April 1986, p. 5.

9 Accountants for the Public Interest, An Analysis of Decommissioning and Premature Shutdown Costs of Nuclear Power Plants, New York, New York, August 1980, p. 10.

10 NRC, Technology, Safety, and Costs, p. 4-13.

11 "...studies indicate that occupational doses from decommissioning light water power reactors would be about 400 man-rem per year ... This is generally less than current annual doses at operating reactors." NRC, Decommissioning Criteria for Nuclear Facilities, op.cit., p. 5604.

12 Nuclear Energy Services, Inc., "Decommissioning Study of the Vermont Yankee Nuclear Power Station in Vernon, Vermont," FERC D. No. 81A0842., September 2, 1981.

13 The $531 million raised for DECON on 2007 would more than cover a 30 year delayed dismantlement as long as interest earnings on the decommissioning fund exceeded the rate of change in decommissioning costs (inflation) by more than 0.51%.

14 Technology, Safety and Costs of Decommissioning Reference Light Water Reactor, op.cit., p. 11-28 and 11-29.

15 Anderson, Aquila, Rodbourne, Decommissioning Commercial Nuclear Power Plants, Center for Urban and Regional Affairs, (Minneapolis, Minnesota, 1980), Pub. No. 80-6, p. 70.

16 Pacific Northwest Laboratory, Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station, (Washington, D.C.: U.S. Nuclear Regulatory Commission, June 1980), NUREG/CR-0672-Volume I, p. 14.3.

17 Man-rems -- Average radiation exposure to the average U.S. roughly 0.1 to 0.2 man-rems per year. The first detectable physiological impacts on humans are recognized at about 50 man-rems and an exposure dose to about 400 man-rems is a lethal dose to approximately 50% of humans.

18 Negligible.

19 "Based on the half-life of the critical/abundant nuclide, the reduction of occupational doses beyond about 30 years would be marginally significant although a significant volume reduction in contaminated waste would result from 50 years in safe storage. It appears that DECON or 30 to 50 year SAFSTOR are reasonable options for decommissioning a light water power reactors." Nuclear Regulatory Commission, Decommissioning Criteria for Nuclear Facilities, Federal Register, Vol. 50, No. 28 p. 5604.

20 NRC, Technology, Safety, and Costs of Decommissioning a Reference Boiling Water Reactor Power Station, p. 2-16.

21 The entombment costs do not include the cost of continued care estimated to be $40,000 per year or the cost of any subsequent dismantlement.

22 Nuclear Energy Services, Inc., Decommissioning Study of the Vermont Yankee Nuclear Power Station in Vernon, Vermont, FERC 70 D. No. 81A0842 (December 1981).

23 Ibid.

24 Technology, Safety and Costs of Decommissioning Reference Light Water Reactors Following Postulated Accidents, (Washington, D.C.: U.S. Nuclear Regulatory Agency, November 1982), NUREG/CR-0672, p. 17-2.

25 Vermont Yankee Nuclear power Corporation, Testimony of William J. Daley, Docket No. EL87-22-0001, p. 3.

26 Vermont Yankee Nuclear Power Corporation, "An Analysis of H.173: The Vermont Yankee Shutdown Study," October 1987.

27 Phone conversation with William Daley, Vermont Yankee, December 3, 1987.

28 NRC, "Decommissioning Criteria for Nuclear Facilities," op.cit., p. 5600.

6. ECONOMIC CRITERIA

"By what economic criteria should the state decide whether to shut down Vermont Yankee?"

This section addresses many of the relevant economic concerns associated with continued operation of the Vermont Yankee facility, plus the issue of appropriate economic criteria for evaluating a Vermont Yankee shutdown.

From its preliminary analysis of the economic issues, the Department projects that a state shutdown of the facility at the end of 1987 would cost the state approximately $569 to $612 million depending on the reason for shutdown. This figure reflects a savings of $726 million in Vermont Yankee expenses, partially offsetting the following costs. Instate replacement power costs alone would be $714 million, assuming an immediate, permanent shutdown. Total replacement power costs are projected at $1.338 billion. Approximately $32 million would be lost in tax revenues from out-of-state sources. The costs of compensating owners based on book value would be roughly $230 million. Unless otherwise specified, all costs and benefits presented in this chapter are provided in present value 1988 dollars.[1]

While there are costs associated with an early shutdown, there are also benefits. The major ones are the reduced accident risks to the public associated with a shutdown of the facility and the potential avoided costs of continuing to produce power at Vermont Yankee including potential retrofits and future expenses. Based on expense projections supplied to the Department by Vermont Yankee and assuming a definitive and expeditious state shutdown and condemnation payment, the present value of avoided costs are estimated to be $403 million.

The Department believes a cost-benefit approach may provide an appropriate economic framework for evaluating the issue of a Vermont Yankee shutdown. Under such an approach, the relevant question is whether the benefits exceed the costs, after taking into account all relevant costs and benefits. Other economic concerns relevant to the issue of a shutdown include short term cost impacts, and the distributional burdens of costs. In this chapter we present a discussion of the costs and benefits of a shutdown and in the following chapter we discuss the impacts. All costs presented in this chapter reflect a shutdown due to a state taking including a condemnation payment to the owners or other similar event as described above.

6.1 Cost-Benefit Analysis vs. Economic Impact

A social cost-benefit analysis provides a framework for comparing the economic costs and benefits[2] associated with public policy alternatives. The costs and benefits measured would differ from the measurement of broader impacts. Impact analysis reflects transitional economic considerations (i.e., short term impacts like temporary unemployment) and distributional concerns associated with burdens of costs, benefits and economic transfers[3] (i.e., where the costs of a particular action surface). A discussion of impacts is provided in Chapter 7.

6.2 Cost-Benefit Analysis

The cost-benefit approach attempts to quantify all relevant tangible costs and benefits to evaluate economic concerns presented by public policy decisions. Intangibles (such as the strategic value of Vermont Yankee to the state's energy portfolio) are relevant, but are not included in this interim report's estimates of costs and benefits due to problems associated with

quantifying their significance. Nor does the Department expect to be able to do so for the final report. A resolution of these issues may ultimately depend on answering such questions, however.

A strict application of a pure social cost-benefit approach to the issue of closing Vermont Yankee might fail to capture concerns associated with the flow of funds into and out of the state. A social cost-benefit approach, modified to reflect the local nature of the issue, would appear to provide an appropriate economic framework for analyzing the issue of a Vermont Yankee shutdown. The relevant costs and benefits might include, (1) real costs [e.g., replacement power costs] borne by Vermont ratepayers, taxpayers or stockholders, (2) transfer costs flowing out-of-state [e.g., compensation to out-of-state owners of the Vermont Yankee facility], and (3) transfer payments or foregone transfer payments flowing into Vermont [e.g., Vermont tax revenues associated with Vermont Yankee and currently being paid by out-of-state ratepayers]. Such flows may reflect simple income transfers, not economic gains or losses from the broader standpoint of society. They do reflect, however, differences in the total wealth of the state and, so, are included in this analysis.

Despite its potential usefulness in analyzing appropriate policy based on economic concerns, the cost-benefit approach may also present subjective, inadvertent or inherent sources of bias and error. These problems are discussed below:

(1) Quantification and Potential Bias

A cost-benefit approach permits an objective basis for discussion and analysis of issues dealing with potentially volatile concerns over jobs, health and environment. There is, however, a potential for an inherent bias associated with this approach as it relates to

issues affecting environmental and human health risks. The benefits of avoiding environmental damage and/or risks to human health are often difficult to quantify; therefore, estimates of the benefit-cost ratio would tend to be understated, creating an asymmetric analysis. These difficulties are typically greater for low probability events.

(2) Distributional and Short Term Impacts

Again, even if all costs and benefits could be quantified, the distribution of impacts are not factored into the cost-benefit framework. The underlying impacts of such distributional considerations can be reduced through strategies to mitigate and/or redistribute such impacts.

(3) Uncertainty in Estimates

Uncertainty surrounds any estimates of costs or benefits. In the case of the analysis of a Vermont Yankee shutdown, however, the uncertainties are a particular problem in one special regard. Estimates of accident risk are based on an approach, first developed in the mid-1970s, called probabilistic risk assessment (PRA). PRA has been applied to Vermont Yankee and other nuclear facilities to estimate the risks of a containment failure and radiation release. Uncertainty in these estimates result from both the conservative nature of the approach and concern that it fails to capture all relevant sources of accident risk. Table 6-1 summarizes the PRA approach and its associated uncertainties.

Table 6-1

PROBABILISTIC RISK ANALYSIS[4]
Areas of Uncertainty

* Data on equipment failure and human error[5]
* Handling dependant failures
* Modeling all possible failures
* Understanding the chemical/physical behavior of radioactive materials

* Modeling the response of containment safety systems

* Weather conditions at the time of the accident

* Modeling dispersion of radioactive materials in various weather conditions

* Emergency response to the accident

* Understanding the relationship between dose and health effects

* Consideration of all externally initiated events (e.g., airplane accident)

In general, a cost-benefit approach provides a good basis for choosing appropriate policy based on economic considerations. Uncertainties over cost estimates and problems with quantifying their relevance compromise attempts to place dollar signs on all relevant costs and benefits. Certain elements of the decision calculus are better presented without attempting to quantify them. However, dollar values placed on some of the driving elements of the costs and benefits are available and are presented in the following sections.

6.3 Costs and Benefits of a Vermont Yankee Shutdown

The discussion of the costs and benefits proceeds in three parts: First, the major cost and benefit elements relevant to the issue of a Vermont Yankee shutdown are summarized in Table 6-2. Second, the driving cost and benefit elements and the uncertainties surrounding the available plant expense projections and benefit calculations as discussed. Finally, preliminary estimates of costs and potential savings of shutting down the Vermont Yankee facility are provided. The replacement power cost calculations presented in the summary section are based on an independent evaluation of their costs by the Department. The plant expense data used for purposes of calculating residual and

avoided plant expenses in the summary rely solely on the expense projection data supplied to the Department by Vermont Yankee (and assume a condemnation of the facility by the state).

Table 6-2 provides a list of the relevant costs and benefits associated with a Vermont Yankee shutdown.

Table 6-2

ECONOMIC COSTS AND BENEFITS
OF A VERMONT YANKEE SHUTDOWN

Economic Costs

* Replacement power costs (to Vermont, possibly including replacment power costs to out-of-state ratepayers).

* The strategic and/or portfolio value of the facility to ratepayers as protection from potential supply disruptions or energy price fluctuations.

* Costs associated with risks to the environment and public health associated with replacement power sources.

* Costs of additional demand-side management and conservation.

* Foregone benefits from off-system sales from Vermont Yankee or sources used to replace it.

Economic Transfers (Costs)

* Compensation to out-of-state owners from ratepayers or taxpayers.

* Tax revenue losses (from out-of-state owners and ratepayers).

* Out-of-state share of the carrying costs of the facility otherwise paid by out-of-state purchasers of Vermont Yankee power.

Benefits

* Avoided cost of future capital additions at Vermont Yankee.

* Avoided costs of additional spent fuel disposal and low-level waste disposal.

* Avoided cost of paying Vermont Yankee's share of accident costs at <u>other</u> nuclear plants under the Price-Anderson Act.

* Avoided cost of paying Vermont Yankee's share of NRC program costs.

* Other avoided ongoing fixed and variable costs associated with Vermont Yankee power production.

* Avoided costs associated with risks of nuclear accident.

  -- Personal health and injury
  -- Property damage
  -- Replacement power
  -- Clean-up and other on-site costs

* Avoided costs of government oversight (e.g., environmental monitoring, emergency preparedness).

* Avoided "worry costs," or stress to local communities potentially affected by an accident.

* Avoided exposure to ratepayers of a sudden loss of Vermont Yankee power due to unexpected events.

* Reduced environmental discharge effects (e.g., thermal discharges).

Secondary impacts, such as impacts to the attractiveness of Vermont, competitiveness of Vermont industry, profits, and employment income are inappropriate to include in the framework of a social cost-benefit analysis.[6] Exclusion of these second order impacts, however, becomes more difficult as one narrows the geographic scope to the state and local communities.[7]

The costs of litigation might also be viewed as a cost associated with a decision by the state to shut down the Vermont Yankee facility. These costs are not

included in a cost-benefit analysis because they rely largely on speculative assumptions over the legal responses of the utilities involved.[8] In addition, it could also be argued that a state action to force a shutdown of the facility may reduce the potential costs of litigation that would follow liability claims associated with an accident, as well as continued litigation involving expansion of the high-level waste storage, license extension, rule changes, and so on.

6.3.1 Benefits Assessment

Major economic benefits of a Vermont Yankee shutdown to the state would include (1) the reduced risks of an accident and (2) avoided operating costs (i.e., capital expenditures, waste disposal costs, and other operating costs that could be avoided through an early shutdown of the facility). Potential for performance degradation as the plant ages would also be relevant, but has not been quantified.

ACCIDENT COSTS AND RISK REDUCTION

Accident risk reduction would represent an economic benefit to Vermont from closing the Vermont Yankee facility.

In July of 1986, the General Accounting Office (GAO) released a report to the U.S. Senate estimating the costs of a nuclear accident at each of the 117 nuclear facilities in the United States that were either operating or under construction in 1982.[9] The purpose of these estimates was to assess the financial consequences of a nuclear reactor accident for purposes of establishing liability limits on Amendments to the Price-Anderson Act.[10]

Included are the estimates of (1) early health effects, (2) latent health effects, and (3) property damage (including economic losses and land

contamination). Not addressed are the added on-site costs of shutdown and decommissioning and the indirect economic losses.

The GAO estimated the costs of average off-site liability at Vermont Yankee to be approximately $1.2 billion in 1986.[11] Under severe weather conditions (judged by GAO to be 100 to 1000 times less likely to occur nationally), the costs could be 10 times that amount. Not addressed in their estimates were on-site clean-up and damage costs and indirect economic losses.[12]

Although the GAO estimates represent the most up-to-date and probably most authoritative estimates of off-site consequences to date, there are concerns over the estimates.

Concerns over the GAO estimates include the following:

* No severe or catastrophic accident has ever occurred in the U.S. Therefore, there is no actual experience on which to draw.

* The GAO relied largely on the estimates of outcomes and probabilities developed through the use of PRA. As stated earlier, there are uncertainties associated with every stage of PRA.

On-site damage estimates should also include the costs of clean up and decommissioning that are incremental to the costs that would otherwise be incurred by the facility at the end of the operating life of the facility. An NRC sponsored study estimates the costs of immediate dismantlement after an accident to increase over the normal costs of decommissioning by roughly 33%. Depending on the severity of an accident, 1981 estimates of clean up costs for a large BWR (roughly twice the size of the Vermont Yankee facility) range from $128 million to $421 million (roughly $156 to $512 in 1987 dollars).[13]

Other on-site costs not included in those estimates include (1) replacement power costs (Vermont and out-of-state), (2) capital costs of carrying unused capital assets, and (3) the costs of any lawsuits filed by shareholders.[14]

Actual clean up costs could be much more expensive. The March 28, 1979 Three Mile Island, Unit 2 (TMI-2) accident cleanup was estimated to cost approximately $1 billion in 1981.[15] Off site liabilities due to losses in property values and economic losses associated with testing and evacuation measures to date were estimated to be $41 million. The only health effect damage claims were associated with the risk of future cancers rather than actual injuries.[16]

Not all costs associated with this accident risk, however, are covered by liability insurance. Current Price-Anderson Act limits of off-site liability are $665 million, well below the GAO estimate of even an <u>average</u> accident consequence at the Vermont Yankee facility.[17]

Even if coverage is extended to the proposed $7.3 billion limits under new federal legislation, the public still faces the risk of uncompensated losses due to either extensive property damage or economic losses beyond the scope of those covered by Price-Anderson legislation.

RISKS OF CORE MELTDOWN OR RADIATION RELEASE

There have been roughly 35 attempts using PRA to estimate the risk of a serious accident at a nuclear power plant in the U.S. Typically, the risk of a core meltdown has been found to be less than 1 in 10,000 per plant per year and the risk of fatality (to local residents) less than 1 in 1 million per plant per year. GAO estimates that there is a "12 percent chance that an

accident involving melting at the reactor core will occur in the next 20 years."[18]

The Vermont Yankee containment study estimated that the probability of core meltdown for the Vermont Yankee plant is about 1 in 33,333. According to Vermont Yankee's study, the probability of a large release following a containment failure was about one in 500,000.[19] Again, these estimates are based on the application of a limited probabilistic risk analysis conducted by Vermont Yankee; there are significant uncertainties associated with the use of PRA for purposes of measuring accident risk. Moreover, the estimates of accident risk at the Vermont Yankee facility failed to incorporate some externally induced accidents.[20]

AVOIDED OPERATING COSTS FROM A SHUTDOWN OF VERMONT YANKEE

In addition to the risk reduction benefits are the avoided costs of continued operation for Vermont Yankee and consequently for ratepayers that rely on Vermont Yankee power. Continued operation costs include (1) added capital expansion and/or retrofits necessary to assure safe and efficient operation until its operations are ended; (2) waste disposal for additional spent fuel and any low-level wastes generated between now and the end of its operating life, and (3) other ongoing fixed and variable costs (e.g., incremental labor and fuel costs) to keep the facility operating and providing power.

AVOIDED CAPITAL EXPENDITURES

Recent capital additions have increased the costs of Vermont Yankee power significantly in the last few years and have raised some concerns about the future costs of providing that power. Since 1972, Vermont

Yankee has routinely expanded the capital base of the facility with new capital projects. Some of the major capital additions include recirculation pipe replacement, torus and other modifications resulting from the short and long term Mark 1 programs.

Approximately 78% of capital additions at Vermont Yankee have come in the second half of its operating life, after the TMI-2 accident. Appendix E provides a summary chart showing significant outages and capital cost projects associated with those outages. The most significant outage was due to the recent pipe replacement, which extended for a period of 9 months from September, 1985, to July, 1986. Vermont Yankee estimates the capital cost of that project alone to be $60 million, not including the cost of replacement power.

Table 6-3 shows the list of capital cost additions made from 1972 to the present. Again, the most significant capital costs additions occurred in the 1985-1986 period for projects dealing largely with the pipe retrofit. Table 6-4 reflects Vermont Yankee projections of future capital additions. Capital additions are projected by Yankee to continue at a rate of roughly 2.5 to 3.0 percent per year until 2003, near the end of its operating life.

Between 1972 and 1987, capital additions to the historical capital base increased at a rate of roughly 4.7%. If these trends continue, we can expect a future capital addition of approximately $515 million over its remaining life (roughly $175 million in present value 1988 dollars).

Between 1972 and 1980, capital additions were experienced by Vermont Yankee at a lower rate of approximately 2.4% of the gross plant and retirements. This rate reflects the much lower level of additions prior to the TMI-2 accident (which led to many

Table 6-3

VERMONT YANKEE NUCLEAR POWER CORPORATION
HISTORICAL CAPITAL ADDITIONS
(Millions of Nominal $)

YEARS	GROSS UTILITY PLANT	RETIREMENTS	CAPITAL EXPENDITURES	CAPITAL EXP/ (GROSS PLANT & RET.) (Percent)
1986	335,057	167	25,396	8.2%
1985	309,828	3,445	37,435	13.6
1984	275,839	282	12,696	4.8
1983	263,425	382	16,815	6.8
1982	246,911	87	8,674	3.6
1981	238,404	742	10,198	4.5
1980	228,948	409	15,021	7.0
1979	214,336	676	5,020	2.4
1978	209,991	653	4,389	2.1
1977	206,255	129	3,018	1.5
1976	203,366	556	7,432	3.8
1975	196,490	622	3,878	2.0
1974	193,234	0	1,723	0.9
1973	191,511	0	8,098	4.4
1972	183,413			
Average (1972-1986)				4.7%

Reference: Provided to the Department in letter from William J. Daley, Vermont Yankee (November 6, 1987).

Table 6-4

VERMONT YANKEE NUCLEAR POWER CORPORATION
PROJECTED CAPITAL ADDITIONS
(Millions of Nominal $)

YEARS	GROSS UTILITY PLANT	CAPITAL EXPENDITURES	CAPITAL EXP/ GROSS PLANT (Percent)
2007		0	
2006	545,253	2,846	0.5%
2005	542,407	6,278	1.2
2004	536,129	8,479	1.6
2003	527,650	10,025	1.9
2002	517,625	15,[illegible]59	3.0
2001	502,466	14,332	2.9
2000	488,134	13,550	2.9
1999	474,584	12,811	2.8
1998	461,773	12,112	2.7
1997	449,661	11,451	2.6
1996	438,210	10,827	2.5
1995	427.383	10,236	2.5
1994	417,147	9,678	2.4
1993	407,469	9,150	2.3
1992	398,319	9,809	2.5
1991	388,510	9,2[illegible]	2.5
1990	379,236	10,012	2.7
1988	369,224	14,354	4.0
1987	354,870	19,813	5.9%
Total (1988-2007)		202,759	

Reference: Provided to the Department in a facsimile from William J. Daley (December 3, 1987).

industry-wide reactor modification programs). If Vermont Yankee continues to add to its historic capital base at only this lower rate, it would add approximately $171 million in future capital additions (approximately $72 million in present value 1987 dollars).

Table 6-5 provides a comparison of alternative capital addition projections. All figures are reported in present value 1988 dollars. The Department estimates of capital additions assume a rate of capital addition that diminishes near the end of the facility operating life in about 2004.

Table 6-5

PROJECTED CAPITAL ADDITIONS
PRESENT VALUE
(Thousands of 19[illegible] $)

Vermont Yankee Projections	Department Projections[21] 2.4%	4.7%
$85,810	$72,425	$175,489

WASTE DISPOSAL COSTS FOR SPENT FUEL

Current federal law requires all owners of nuclear power reactors to pay for the ultimate disposal of spent nuclear fuel. The fees assessed consist of a one-time fee for waste generated prior to April 7, 1983 and ongoing fees for subsequent power generation. The current payments required are 1 mill (one-thousandth of one dollar) per kWh of output.[22]

If no adjustments are made to the payment requirements by DOE and Vermont Yankee produces at the projected rate of roughly 3.7 million MW hours annually, then Vermont Yankee can expect to pay a total additional $74 million for its spent fuel disposal (a 1988 present value of roughly $29.6 million). The DOE currently estimates that 1.0 mill per kWh fee will

produce sufficient revenues to cover the life-cycle costs of civilian radioactive waste, nuclear electric generation and interest rate forecasts.[23]

In 1986, Vermont Yankee owed DOE approximately $2.1 million for the costs of spent fuel disposal based on a 2,058,426 MWH production for the year.

LOW-LEVEL WASTE DISPOSAL

The costs of low-level waste disposal for Vermont Yankee may represent one of the more significant sources of uncertainty in projecting the costs of both continued operations and decommissioning of the facility. Vermont Yankee produces approximately 94% of the total state low-level radioactive waste and over 99.7% of the waste measured by radiation concentration. It also produces 100% of the class B and C waste with the higher concentration of long lived radionuclides.[24] Appendix D presents statewide historical data on low-level waste generated within the state for the last several years.

In 1986, Vermont Yankee spent over $581,000 on low-level waste disposal, and over $473,000 in 1987 through October.[25] Between 1984 and 1987, disposal rates have increased approximately 319%.[26]

The current low-level waste disposal costs reflect the costs of burying waste at the South Carolina Barnwell facility, which will no longer be available for waste disposal beyond 1992.[27] Failure to establish a plan for siting a low-level waste site well before that time will create significant uncertainties over disposal costs. Between January 1, 1988, and January 1, 1992, the state faces several standard and penalty surcharges associated with disposal siting.

Instate disposal of the waste is currently being considered by the Advisory Commission on Low-level Radioactive Waste as a long term disposal alternative to an out-of-state compact for disposal. The 1988

deadlines for establishing an approved siting plan may not be met. Tables 6-6 and 6-7 show the costs of low-level waste disposal assuming existing disposal rates and new federal surcharges.

If a disposal site is unavailable for a time (either due to denied access to the Barnwell facility or failure to establish a receiving site by 1993, when the Barnwell facility closes), Vermont Yankee has several years of storage capacity on site.

The estimated cost of instate disposal of Vermont Yankee low-level waste from 1994 through 2013 is roughly $189 million.[33] Total costs of low-level waste disposal from 1988 through 2013 are projected to be roughly $200 million. The Department estimated the incremental costs of disposal associated with Vermont Yankee continued operation of Vermont Yankee to be approximately $59-88 million (in constant 1988 dollars), over and above the estimated $156 million to dispose of low-level waste during decommissioning. This increment would represent a total potential present value savings of roughly $18-30 million.

LOW-LEVEL WASTE ASSOCIATED WITH DECOMMISSIONING

Vermont Yankee's original consultant report on decommissioning incorporated a volume of low-level waste disposal of roughly 730,000 cubic feet.[34] The annual low-level waste generated at the facility represents just over 1-2% of the low-level waste disposal capacity that will be needed when the facility is finally dismantled (roughly 22-29% of the cumulative future low-level waste disposal needs over the facility's remaining life).[35]

The greatest costs associated with the low-level waste coming from the Vermont Yankee facility will come at the end of its operating life. At a cost of roughly $60 per cubic foot as provided for under 1987 revisions

Table 6-6

ESTIMATES OF LOW-LEVEL WASTE DISPOSAL COSTS[28,29]
NO PENALTY SURCHARGES
(1988 $)

	Dry Active Waste ($/cu.ft.)[30]	Resins ($/cu.ft.)	Quantity (est.) (cu.ft.)	$/Yr[31] (000)
1987	$ 61.93	$126.09	10,000 - 15,000	$ 853 - 1,280
1988	71.93	136.09	"	953 - 1,380
1990	91.93	$156.09	"	1,053 - 1,480
1993+	$198-214		"	2,140 - 2,970
Total (1988-2013)				$193,777 - 195,920

Table 6-7

ESTIMATES OF LOW-LEVEL WASTE DISPOSAL COSTS[32]
WITH PENALTY SURCHARGES
(1988 $)

	Dry Active Waste ($/cu.ft.)	Resins ($/cu.ft.)	Quantity (est.) (cu.ft.)	$/Yr ($000)
1987	$ 61.93	$126.09	10,000 - 15,000	
1988			"	$1,353 - 2,030
(1/1/88)	91.93	156.09		
(7/1/88)	131.93	196.09		
1989	"	"	"	1,553 - 2,330
1992	171.93	$236.09	"	1,953 - 2,930
1993+	$198-214			2,140 - 2,970
Total (1988-2013)				$196,685 - 200,670

Note: Data based on information supplied from various sources including Tom Bennet of Vermont Yankee and Laurence Becker of the Agency of Natural Resources.

to the decommissioning schedule, the low-level waste (or burial) costs of dismantlement will be roughly $44 million (roughly 34% of total estimated costs of decommissioning). If the rates increase to $214 per cubic foot, the burial costs of Vermont Yankee would increase to over $156 million, more than tripling existing schedule provisions of approximately $44 million in 1987 dollars.[36]

Low-level waste disposal associated with decommissioning will occur whether the facility is shut down early or after the completion of its operating license in 2007. An early shutdown could only potentially reduce the disposal burden of incremental waste generated between the time of the early shutdown and a projected shutdown date in 2007.[37]

AVOIDED ONGOING FIXED AND VARIABLE COSTS

A shutdown of the Vermont Yankee facility would significantly reduce the ongoing costs at the facility. Many costs, however, such as the sunk capital costs and obligatory maintenance costs, could not be avoided by an early shutdown. Table 6-8 represents the Vermont Yankee estimates of projected ongoing costs assuming normal operations through 2007, and assuming a shutdown by the state in 1987 with an associated condemnation payment made to the owners.

Table 6-8

VERMONT YANKEE ESTIMATES
OPERATING EXPENSES

(Millions of Dollars)

Expenses	2007 Shutdown (Nominal $)	1987 Shutdown (Nominal $)	Costs Difference (Nominal $)	Present Value Difference (1988 $)
Total Direct	$1,918	$263	$1,655	$499
Yankee Nuclear Service Div.	277	64	213	64
Total Variable	466	29	437	170
Total Fixed	994	259	735	256
Total Capacity	3,655	615	3,039	988
Fuel	700	16	684	246
Total Operating	4,355	632	3,723	1,234

Note: Calculated from data supplied by Vermont Yankee in letters dated November 6, 1987 and November 19, 1987. (See Appendix F.)

GOVERNMENT PROGRAMS AND SERVICES

The closing of Vermont Yankee would also alter requirements for certain public services, monitoring and oversight of the facility. The overall level of savings to state and local governments associated with the shutdown of the facility are unclear. Most state agencies that monitor or provide some regulatory oversight of the facility indicate that there would be little overall reduction in their program costs if Vermont Yankee were shutdown; in the short term, some monitoring and administrative requirements would significantly increase in conjunction with program

requirements related to shutdown and decommissioning the facility.

The Department estimates that a shutdown of the Yankee facility would ultimately reduce the need for some personnel. Estimated savings to the state are approximately $72,000 per year, plus somewhat less than $1,000 per year for air monitoring and water permit related expenses.

6.3.2 Costs Assessment

REPLACEMENT POWER

The total costs of a Vermont Yankee shutdown would include both the replacement power costs and losses due to its strategic value to Vermont ratepayers as a buffer or source of protection against volatile prices for fossil fuels. It also represents a source of instate power, free from geographic and/or political intrusions, subject only to state and federal jurisdictions.

The incremental costs of replacement power to Vermont ratepayers were estimated to be $2.25 billion cumulative nominal dollars, $1.26 billion in constant 1988 dollars and $714 million on a present value basis. The added costs of replacement power for instate and out-of-state ratepayers combined were estimated to be roughly $4.22 billion in cumulative nominal dollars, $2.36 billion in constant 1988 dollars and $1.338 billion in present value 1988 dollars. These costs do not include the other offsetting avoided operating costs at the Vermont Yankee facility from an early shutdown, nor the foregone benefits of resales of power used to replace Vermont Yankee. The methodology used in establishing these estimates are discussed in Appendix B. Additional discussion of replacement power costs are included in the next Chapter under "Rate Impacts."

COMPENSATION

As discussed in Chapter 4, various levels of compensation may be required of the state if the state forces a shutdown of the facility. Compensation to the owners of Vermont Yankee does not represent a real economic cost of a shutdown; rather, it represents a transfer payment from taxpayers and/or ratepayers to the owners to compensate them for the unrecovered capital investment (sunk costs).

Compensation based on the book value of the facility would be approximately $230 million. As discussed in Chapter 4, the replacement cost of a comparably sized coal fueled generating plant would be approximately $1.15 billion (1988 $).

TAX REVENUES

In 1986, Vermont Yankee paid approximately $5.7 million in taxes to the state and local communities for their services. The majority of these taxes were property taxes (roughly $4.4 million). The out-of-state portion of these revenues are equal to roughly $2.6 million. Present value loss of out-of-state taxes flowing into the state are about $32 million.

6.4 Summary of Costs and Benefits

Table 6-9 presents the derivation of the effective costs to the State of Vermont following an early shutdown forced or unforced of the Vermont Yankee facility. The net costs or financial exposure to the state from a forced shutdown of the Vermont Yankee facility by the state is estimated to be a 1988 present value equivalent of approximately $569 - $612 million. If a shutdown occurred due to some other reason the net costs to the state would be about $350 million.[38] These estimates do not include the costs or avoided costs associated with litigation, an accident, impacts

an Vermont's power portfolio or foregone benefits of off-system sales of Vermont Yankee power or other sources. The estimate of $350 million relies largely on expense data provided by Vermont Yankee and assumes the owners are compensated for their investment in the facility in proportion to their share of the purchases.

The top third of Table 6-9 shows the present value estimates of net costs assuming shutdown of the Vermont Yankee facility in 2007. The middle portion of Table 6-9 shows the costs to Vermont of the Vermont Yankee facility in the event of a 1988 shutdown. The bottom third of the table shows the Department's estimates of the difference of these costs.

Table 6-10 summarizes the costs and benefits to the state of a forced shutdown of the Vermont Yankee facility assuming a state taking followed by a condemnation payment. The table presents the incremental (differential) costs and benefits of a forced shutdown. The right-most column lists major unquantified elements of the analysis not incorporated in the dollar estimates of costs and benefits. Quantified estimates of the costs and benefits are given in nominal dollar, constant dollar and present value dollar terms. (All costs referred to in the discussion below are in present value dollars. See footnote 1 to this chapter.)

6.4.1 Replacement Power

The Department's preliminary estimate of the cost of replacement power following a shutdown is approximately $714 million for instate ratepayers and $1.338 billion for both instate and out-of-state ratepayers before offsetting savings in Vermont Yankee costs. These power costs reflect the increased energy and capacity costs less the avoided costs of Vermont

TABLE 6-9

NET COST TO VERMONT OF A VERMONT YANKEE SHUTDOWN
(Millions of 1988 Present Value Dollars)

Quantified	FORCED SHUTDOWN		UNFORCED SHUTDOWN*	
COSTS				
VY IN	**Instate**	**Out-of-State**	**Instate**	**Out-of-State**
Replacement Power	0	0	0	0
Plant Capital	122	108	122	108
Carrying Costs	135	118	135	118
Other Avoidable Costs	403	323	403	323
Out-of-state Tax Revenues	-32	32	-32	32
	628	581	628	581
VY OUT				
Replacement Power	714	624	714	624
Plant Capital	230	0	122	108
Carrying Costs	253	0	135	118
Other Avoidable Costs	0	0	0	0
Out-of-state Tax Revenues	0	0	0	0
	1197	624	971	850
CHANGE IN COSTS				
Replacement Power	714	624	714	584
Plant Capital	108	-108	0	0
Carrying Costs	118	-118	0	0
Other Avoidable Costs	-403	-323	-403	-323
Out-of-state Tax Revenues	32	-32	32	-32
	569	43	343	229
EXPOSURE TO VERMONT	569-612		343	0

Note: *Assumes expense projections based on Vermont Yankee data presented to the Department with condemnation payment to the owners of Vermont Yankee by the state. Also assumes that owner investment in plant capital is paid by ratepayers.

TABLE 6-10

SUMMARY COSTS AND BENEFITS TO VERMONT
OF A FORCED SHUTDOWN
(Millions of 1988 Present Value Dollars)

	Quantified		Unquantified
COSTS	**Instate**	**Out-of-state**	
Replacement Power	714	624	o Portfolio/Strategic Value
Plant Capital	108	-108	--Protection Against Volatile Fuel Prices
Carrying Costs	118	-118	--Protection Against Supply Disruptions
Lost Out-of-state Tax Revenues	32	-32	o Environmental Impacts of Replacement Power Sources
Totals	972	366	o Added DSM and Conservation Costs
			o Forgone benefits from off-system sales from Vermont Yankee or sources used to replace it.
BENEFITS/AVOIDED COSTS			
Other Avoided Operating Costs	403	323	o Portfolio/Strategic Value
Totals	403	323	--Diversification of Power Supply
			o Avoided Risk of Catastrophic Accident
			--Associated Risk to Health
			--Risk to Property Damage
			--Stress ("Worry Costs")
NET COSTS OVER BENEFITS	<69	43	o Avoided Cost of Government Oversight & Services
Total Financial Exposure to Vermont	569 - 612		

Yankee fuel. Not included in this figure is the potential for other avoided costs at Vermont Yankee.

6.4.2 Condemnation

As discussed in prior Chapters, the Department believes a condemnation payment would be based on the net book value of the facility of roughly $230 million. This equals the undepreciated portion of the plant capital account. Vermonters currently pay for approximately 53% of shareholder investments as they are expensed over time. Consequently, Vermonters are already obligated to repay the majority of shareholder investment. A shutdown of the facility with condemnation would likely obligate the state to pick up as a new obligation the out-of-state share of Vermont Yankee investment of roughly $108 million.

6.4.3 Taxes

The loss of Vermont Yankee would also result in lost tax revenues to the state from out-of-state purchasers of Vermont Yankee power. Based on data presented by Vermont Yankee, the Department estimates that roughly $66 million would flow to the state from this source; roughly 53%, or approximately $34 million comes from instate ratepayers and approximately $32 million comes from outside the state.

6.4.4 Carrying Costs of the Facility

Even after a shutdown of the Vermont Yankee, ratepayers will face certain ongoing costs at the facility associated with ongoing maintenance and operations until the spent fuel can be shipped off site and the plant decommissioned. The Vermont share of these costs are already borne by Vermont ratepayers in their rates under normal operations. A state taking of the facility would likely obligate the state to assume

responsibility for 100% of the carrying costs associated, including the share now covered by out-of-state power purchasers. Our estimates indicate that the additional costs associated with the out-of-state share of these ongoing costs are $714 million.

6.4.5 Costs Avoided In A Shutdown

The costs that would be avoided in the budget of Vermont Yankee after a shutdown represent approximately an 85% reduction in projected operating costs. These include reduced salaries, maintenance, capital additions, fuel expense, waste disposal, and the like. The Department estimates the costs incurred in a shutdown to be approximately $569 to $612 million.

6.4.6 Unquantified Elements Of Costs And Benefits

Other major costs and benefits that were not quantified are presented to the right of Table 6-10. The major costs not incorporated in the calculations include litigation expense and the strategic value of the facility in offering protection from supply disruptions from other sources and protection from volatile fossil fuel prices, offset by uncertainties in plant operation. Off system sales of Vermont Yankee power or of the sources assumed to be used in replacing Vermont Yankee also represent a significant cost of a shutdown that could not be quantified well enough to be incorporated in these interim calculations.

The major benefits not quantified are the risks of a nuclear accident at the plant and the benefit of developing a less centralized power supply portfolio as new replacement power sources come on line.

The Department's estimates of the costs and benefits suggest that the cost would be approximately

$569 to $6?? million (1988 present value), net of avoided cost to shut down the Vermont Yankee facility. However, the balance of these estimates are unce.tain as major elements of the analysis have not been quantified.

6.5 Conclusions

There are uncertainties associated with almost every element of the cost and benefit estimates included in the analysis. The issues involved require technical analysis of many complex issues, and major uncertainties are inherent in any attempt to accurately appraise the concerns that are relevant to the analysis. The Department believes that specific assumptions, calculations and even the approach should undergo careful review during preparation of the final report. We caution, however, that "precise" estimates of many of the costs and benefits of a shutdown may never be available.

From our review of the economic issues, and, specifically, the estimates of costs and benefits, we have concluded that the issue of a shutdown of the Vermont Yankee facility may deserve further study. Based on the information supplied to the Department, our estimates of calculated quantifiable costs would exceed the quantifiable benefits to Vermont of a shutdown. The Department believes, however, that the uncertainty in these estimates is sufficiently great that a more precise evaluation of relevant cost and benefits could alter the balance of that assessment.

FOOTNOTES -- Chapter 6

1 Present value estimates of costs are one of several ways in which costs are presented in this document. Other ways of presenting cost information include "cumulative constant dollars" and "cumulative nominal dollars." Nominal dollar estimates are simply the actual projected costs. Constant dollar estimates have had a deduction made to remove the effects of projected inflation. A present value estimate is made from the projected costs by computing the effective lump sum payment that would have to be placed in an account bearing interest at the utility's cost of capital today in order to just cover the principal and interest needed to meet projected costs.

2 An "economic" cost reflects its value in some alternative use, an "opportunity cost." Costs and benefits in this sense reflect real changes to the efficient allocation of resources.

3 "...if we take national viewpoint in choosing among proposed investments...we should attempt to...choose those investments to which people attach a value in excess of incremental cost. The ensuing redistribution of wealth and revaluation of assets are 'intangible' considerations which are relevant to final decisions. But these pecuniary external effects should not be totaled and incorporated into cost-gain estimates whose purpose is to show which investments are most efficient given that distribution of wealth." per Roland N. McKean, Efficiency in Government Through Systems Analysis, ORSA No. 3, (John Wiley & Sons, 1958: New York), p. 149-150. For other discussions of the cost-benefit approach and discussions of the field of welfare economics, see E.J. Mishan, Cost-Benefit Analysis, (New York: Praeger Publishers,); or Tibor Scitovsky, Welfare and Competition (Chicago, IL: Richard D. Irwin, Inc., 1951).

4 U.S. General Accounting Office, Nuclear Regulation: Financial Consequences of a Nuclear Power Plant Accident, GAO/RCED-86-193BR, (July 1986), p.10.

5 Human error may include not only an inappropriate response to problems, but also procedurally correct responses to events in the face of inadequate or incomplete information, P.R. Davis and M. L. Corradini, A Review of the Vermont Yankee Containment Safety Study, October 31, 1986, p. 1-5.

6 "... Successive Payments are undeniably gains to the recipients, and it is easy to slip into regarding them as net gains to the nation. But the result is a strange sort of multiple-counting.... [F]rom the standpoint of economic efficiency, they should not be recognized." per McKean, op. cit., p. 158.

7 To the extent that profits and employment are lost at Vermont Yankee, we would expect losses of wealth and income to the community surrounding the facility. Property owners suffer from lower property values and employees suffer some income losses during periods of unemployment. One might expect the replacement power sources to create jobs and higher salaries, and contribute to higher property values in other areas of the state. Unless one knows with certainty that replacement power and/or jobs created for added DSM will replace Vermont Yankee power instate, then it is difficult to exclude these "cost impacts" from the benefit/cost ratio. This is particularly a problem when one views the employment and profit losses to state industry which may face such losses in the face of higher electric rates which compromise their competitiveness in out-of-state markets.

8 Although the state should recognize that it may face a substantial legal burden associated with a State action to shut down Vermont Yankee, we have not included such cost elements into the cost and benefit factors to consider. To include such costs would suggest that the state has obligated such a legal burden as a result of actions to force the shutdown of the facility; although Vermont Yankee could be expected to mount a substantial legal defense to protect its assets, it is still the perrogative of the owners to actually initiate this. Also many shutdown scenarios do not include any state action as a trigger.

9 General Accounting Offices, op. cit.

10 The costs measured include costs associated with health effects and property damages. The property damages represent 76-90 percent of total estimates of accident consequences, per GAO, op.cit., p.25.

11 The cost figures shown represent the costs of off-site liability. The range in estimates for different factors vary from $67 million at the Big Rock Point (Michigan) facility to approximately $15.3 billion at Indian Point 3 (New York) (in 1986 dollars). The variance in these estimates is due

largely to population density surrounding the facility, per GAO, op.cit., p. 25.

12 The costs included in these estimates include latent health effects (10-40 years after exposure to radioactive materials), per GAO, op.cit. p. 20.

13 Murphy and Holter, Technology, Safety and Costs of Decommissioning Reference Light Water Reactors Following Postulated Accidents, NUREG/CR-2601, p. 17-2.

14 GAO, op.cit., p. 23.

15 Murphy and Holter, op. cit.

16 GAO, op. cit., p. 7.

17 The Price-Anderson Act sets limits on public liability associated with a single accident of $665 million. If total damages at a facility exceed the private coverage of $160, then Vermont Yankee would pay its share of the excess up to a maximum of $5 million per accident and $10 million per year, per P.R. Davis and M. L. Corradini, op.cit., p. 1-3.

18 GAO, op. cit. p. 25.

19 Only a meltdown with a coincident break of the containment structure could cause significant off-site damage. Vermont Yankee Containment Study, (September 2, 1986).

20 See PRD Consulting, A Review of the Vermont Yankee Containment Safety Study, (October 31, 1986).

21 Assumes capital additions at the indicated annual percentage of gross utility plant from 1988 through 2003. The capital additions for 2004 through 2007 were assumed to be 75%, 50%, 35% and 0% of those amounts, respectively. Capital additions for 1987 were estimated at $15 million.

22 These fees were established under the Nuclear Waste Policy Act of 1982. Vermont Yankee is obligated to pay DOE approximately $39 million for spent fuel discharged prior to April 7, 1983. This fee has been collected from the utility's sponsors and is due to DOE no later than its first delivery of nuclear fuel. FERC Form No. 1.

23 Office of Civilian Radioactive Waste Management, Nuclear Waste Fund Adequacy: An Assessment, U.S.

Department of Energy, DOE/RW-0020 (June 1987), p. 2.

24 Memorandum to the Advisory Commission on Low-Level Radioactive Waste, from Laurence Becker, Vermont Agency of Environmental Conservation, November 6, 1987.

25 Memorandum from William J. Daley, Vermont Yankee to DPS, November 13, 1987.

26 Based on increases of $14.34 per cubic foot to $60.08 per cubic foot. Testimony of William J. Daley before FERC, Docket No. EL87-22-001.

27 Access to the Barnwell facility could be denied before 1993 (as early as January 1, 1990) if Vermont has not produced a siting plan, by either providing an in-state site or a compact with other states for the long range low-level waste disposal.

28 Assumes instate disposal of low-level waste at a earth-mounded concrete bunker and immediate dismantlement of the Vermont Yankee facility following shutdown in 2007. These estimates are based on the DOE low-level disposal model, and assumes 850-882 thousand cubic feet of additional low-level waste generated at Vermont Yankee over its remaining operating life.

29 These estimates do not account for all of the significant uncertainties surrounding the range of costs associated with the disposal of low-level waste from 1993 to the completion of decommissioning. Uncertainties exist because the total volume of waste is uncertain, the site location is unspecified, and eventual plans for the ultimate decommissioning may change.

30 Assumes roughly 36.5 percent of low-level waste is from resins and 63.5 from dry active waste.

31 Includes $10/cu. ft. federal surcharge as of 7/1/86, $20/cu.ft. as of 1/1/87, and $40/cu.ft. as of 1/1/90. Penalty surcharges include an additional $10/cu.ft. as of 7/1/86 (on top of standard surcharge), an additional $20/cu.ft. as of 1/1/88, an additional $60/cu.ft. as of 7/1/88 and an additional $80/cu.ft. for 1992.

32 Based on an average cost/cu.ft. of $198-$214 as estimated assuming a 20 year operating life of a facility disposing of approximately 882 to 955 thousand cubic feet of waste (including approxi-

mately 730,000 cubic feet associated with decommissioning).

33 Includes decommissioning costs of approximately $156 million.

34 Testimony of William J. Daley, Vermont Yankee to FERC, Docket No. EL87-22-001, p. 5.

35 Based on annual disposal needs of roughly 10 to 15 thousand cubic feet per year.

36 Revisions to the cost estimates assuming a cost of roughly $214/cu.ft. would increase the current [illegible]ts of decommissioning (plus contingencies) from approximately $128 million to about $229 million in 1987 dollars.

37 The incremental burden of low-level waste generated between the time of the early shutdown and the projected shutdown in 2007 would result in some waste reductions. It is unclear that the need for low-level waste disposal for Vermont Yankee would be totally eliminated unless the actual decommissioning process can start early. See discussion in Chapter 1 on early decommissioning following an early shutdown.

38 The cost numbers presented for the case of an unforced shutdown are based largely on expense projections provided by Vermont Yankee for the case of a shutdown of the facility by the state assuming compensation to the owners for the loss of their investment. These projections assume the owners of Vermont Yankee are compensated for their loss of the facility, but, in the case of an unforced shutdown, the cost of compensation is borne by in and out-of-state ratepayers or taxpayers in proportion to the ownership share of the facility.

7. IMPACTS

"What will be the effects of shutdown and decommissioning upon Vermont ratepayers, the revenues of the state, the town of Vernon, and surrounding communities?"

In this Chapter, we discuss the impacts of a Vermont Yankee shutdown on electric rates for Vermonters and tax revenues, as well as other impacts associated with the shutdown on employment and income.

A shutdown of Vermont Yankee could increase electric costs statewide and reduce tax revenues to Vernon, Brattleboro and the state. Roughly 89% of the state's ratepayers currently rely on Vermont Yankee for up to a third of their electricity. Assuming they bear the burden of replacement power costs, condemnation payments and ongoing operating costs, rates could increase by approximately 10 percent. As pointed out elsewhere, however, some utilities such as Central Vermont Public Service, which rely heavily on Vermont Yankee, could see higher increases. Moreover, the increases may be distributed unevenly between customer classes. These effects could be moderated by regulatory decisions on how to phase in any rate increases.

The town of Vernon would be heavily impacted by a Vermont Yankee shutdown. Vernon currently relies on Vermont Yankee for approximately 88% of its total revenue base and spending.

An early shutdown of the Vermont Yankee facility would also create temporary unemployment and, potentially, some long term job losses in the state; the communities surrounding the facility would likely experience the greatest impacts. Approximately 11% of the town of Vernon is directly employed by the Yankee facility.

As discussed in Chapter 4, there are uncertainties in the cost and associated financial exposure to Vermont

taxpayers, ratepayers and stockholders following a shutdown of Vermont Yankee. Depending on the legal and factual circumstances leading to a Vermont Yankee shutdown, ratepayers may pay all or some portion of replacement power and carrying costs of the facility after a shutdown.

A state taking of Vermont Yankee could present financial exposure to taxpayers from a variety of costs and revenue losses including: (1) the costs of compensating Vermont Yankee owners [both in and outside the state] for a plant taking; (2) the costs of "compensating" ratepayers for replacement power costs; (3) the carrying costs of the facility (4); the uncollected balance associated with the decommissioning of the facility; and (5) the loss of out-of-state tax revenues currently flowing into the state as a result of out-of-state power purchases from the Yankee facility.

7.1 Rate Impacts

The potential costs and savings to Vermont of an early shutdown of Vermont Yankee that have been quantified consist of the cost to replace Vermont's share of the plant's long term output, a reduction of capital additions and costs at the facility, a loss of state tax revenues paid by the plant's out-of-state owners, a compensation payment to plant owners in the event of a state-imposed shutdown, and compensation to out-of-state ratepayers for their increased cost of power. Because of legal and factual uncertainties discussed above, it is not known which of those costs would be born by Vermont electric ratepayers.

The Department estimates that the cost to Vermont utilities to replace Vermont Yankee's power through 2007 would have a 1988 present value of $714 million. The distribution of projected replacement power costs over

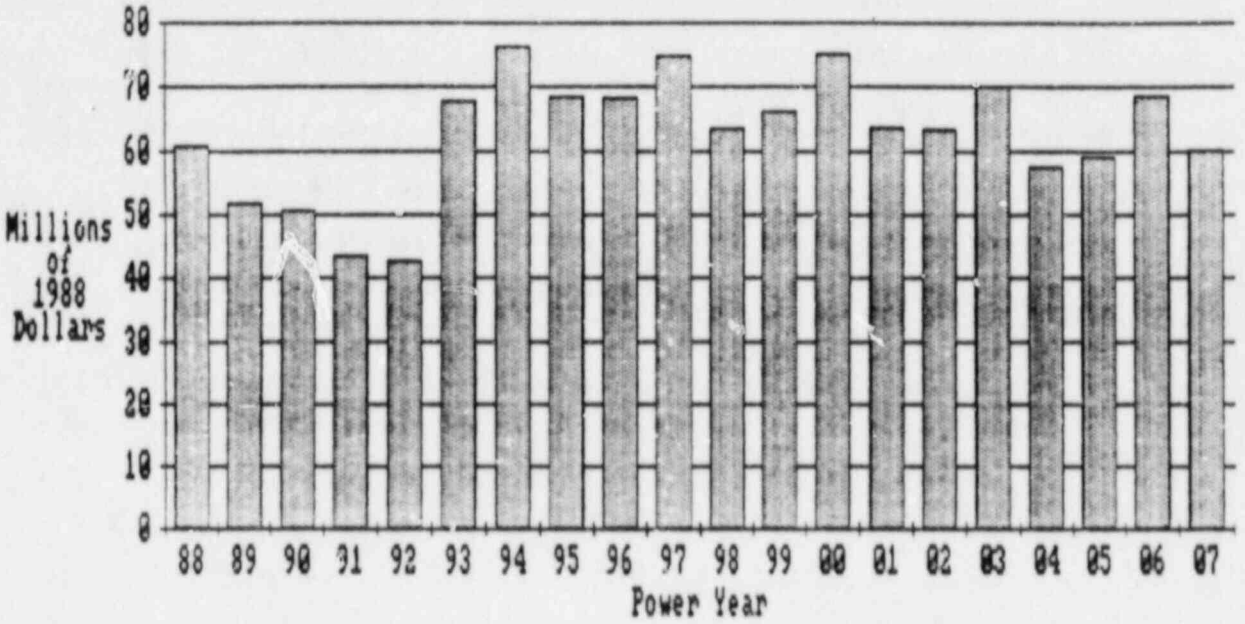
time is presented in Figure 7-1, and their derivation is discussed in detail in Appendix B.

Vermont ratepayers presently pay about 55% of the annual costs associated with Vermont Yankee. Based on plant expense projections by Vermont Yankee, Vermont's share of future non-fuel costs is projected to be about $660 million in present value terms. If Vermont ratepayers were to bear the cost of replacement power and be relieved of all costs associated with the maintenance and decommissioning of Vermont Yankee, the net impact would be a present value increase in retail electrical rate burden of $54 million. The Department estimates that this would translate to roughly a 1% long term increase in average Vermont retail rates.

Plant costs at Vermont Yankee after a state-imposed shutdown would likely be much lower than those of continued operation. Presuming a separate condemnation payment to plant owners, Vermont Yankee has estimated that total continued costs of plant maintenance and decommissioning through 2007 in the event of a shutdown in 1988 would be about $253 million in present value terms. If Vermont ratepayers were to bear that cost plus the net cost of replacing Vermont's share of Vermont Yankee power, the cost of an early Vermont Yankee shutdown would rise to about $307 million in present value terms. This is estimated to be an increase of about 5% in average Vermont retail rates.

The Department believes that the present value of a condemnation payment to compensate Vermont Yankee owners for the loss of their asset and future income would be the plant's approximate net book value of $230 million. (See Chapter 4.) It is uncertain if electric ratepayers would bear this cost, and how the payment of such compensation would be made over time. However, the estimated cost of replacement power for Vermont, the full estimated continuing cost of the facility, and a

FIGURE 7-1
Cost To Replace Vermont Share of Vermont Yankee Power, 1988-2007



THIS CHART ONLY INCLUDES:

* Projected capacity and energy costs for Vermont purchases

THIS CHART DOES NOT INCLUDE:

* Cost of replacement power to out-of-state owners
* Savings from reduced operating expenses and avoided capital additions at Vermont Yankee
* Decommissioning costs
* Possible compensation to Vermont Yankee owners

condemnation payment of the plant's book value sum to a present value of $537 million. If borne entirely by ratepayers, this would represent roughly a 9% long term increase in average Vermont retail rates.

Presuming replacement power for Vermont Yankee's out-of-state purchasers were obtained at the average price faced by Vermont utilities, its long term cost is estimated to be $624 million in present value terms. If the out-of-state purchasers were compensated for their share of the plant's value and relieved of all costs of maintaining and decommissioning the facility, they would avoid estimated present value costs of about $581 million, for a net cost of $43 million. If this cost were borne by instate ratepayers in addition to the costs of instate replacement power, maintenance and decommissioning costs, and compensation of all plant owners, the present value cost of $581 million would increase Vermont's long term average rates by about 10%. (The difference between this figure and the $612 million cost given in Chapter 6 is the $32 million tax revenues lost in a forced shutdown.)

Because rate impacts of an early shutdown of Vermont Yankee would not be evenly born by the state's ratepayers, the average retail rate changes described above are a highly simplified description of a shutdown's possible rate effects. The extent to which the direct purchasers of Vermont Yankee would bear a proportionately larger share of Vermont's total cost, and the extent to which non-purchasing utilities would suffer or benefit from a shutdown, are not clear. Another important effect of an early shutdown would be the distribution of rate increases among customer classes, and the potential for one class to be inordinately burdened. The distribution of costs and benefits among utilities and customer classes are important to an understanding of how Vermont would be

affected by ar early shutdown of Vermont Yankee, and may warrant further examination.

Rates would also be affected beneficially by optimization of short-term purchases and sales, by demand-side measures; and they could also be negatively affected by elimination of profits from off-system sales of power from Vermont Yankee or from other sources used to meet Vermont load as a result of a Vermont Yankee shutdown. It was not possible to quantify these impacts for this interim report although we suspect they are sizable.

7.2 Employment and Income Impacts

Closing Vermont Yankee would result in potential short and long term job and income losses. The potential short term job losses include the direct loss of jobs to Vermont Yankee employees and vendors that provide services to the facility.

The longer range impacts on jobs in Vermont are far less certain. The impacts of a Vermont Yankee shutdown on employment and income will depend on (1) where the replacement power is generated (i.e., instate vs. out-of-state) and (2) the magnitude of electric rate increases and the resulting potentia. secondary job losses from changes in the competitive position of Vermont industries.

In the longer term, these employment losses would be offset by new jobs created as the state expands demand-side management measures and new sources of replacement power are created. Nuclear power, in general, is not a labor intensive source of power. The employment associated with replacement power sources could be significant.

DIRECT EMPLOYMENT IMPACTS

Vermont Yankee reported 327 full, part-time and temporary employees at the facility in 1986.[1] Nineteen of these were part-time and temporary workers. One hundred eighty-six or approximately 57%, of these employees are residents of Vermont.[2] A shutdown of Vermont Yankee would eventually result in lost jobs for most of the Yankee operation and utility staff.

Table 7-1 provides a list of the state of residence of Vermont Yankee employees. Not all of these jobs, however, will be lost following a shutdown of the facility. Employment in the Vernon area could actually swell in the short run as the facility prepared for either a storage or early dismantlement. The employment figures presented in Table 7-1 reflect direct employment losses once the actual decommissioning process has been completed.

TABLE 7-1

VERMONT YANKEE NUCLEAR POWER CORPORATION
EMPLOYEE RESIDENCES
SUMMARY BY STATE
(1986)

No. Employees	Percent	Income ($ Million)	Percent	State of Residence
186	57	$7.7	59	Vermont
70	21	2.6	20	Mass.
66	20	2.5	19	N. H.
4	1	0.2	2	Other[3]
326	100	$13.0	100	

Reference: Facsimile provided to the Department from Tom Bennet, Vermont Yankee (November 13, 1987).

Only four towns within the state had more than 10 employees that work for Vermont Yankee in 1987: Brattleboro with 70, Vernon with 60, West Brattleboro with 16 and Putney with 12. Table 7-2 provides a list of the town residences of Yankee employees who are residents of the State of Vermont.

TABLE 7-2

VERMONT YANKEE NUCLEAR POWER CORPORATION
VERMONT RESIDENCES
SUMMARY BY TOWN
(1986)

	Number	Income	City/Town
	86	$3,505,065	Brattleboro & W. Brattleboro
	9	422,379	Newfane
	12	405,018	Putney
	60	2,609,889	Vernon
	19	758,719	Other
Total	186	$7,701,070	

Reference: Facsimile provided to the Department by Tom Bennet, Vermont Yankee (November 13, 1987). Income data to the Department from William J. Daley, Vermont Yankee (November 6, 1987)..

Vermont Yankee paid approximately $6.7 million to instate vendors serving the Yankee facility.[4] Since most of the vendors that supply the Vermont Yankee facility are based outside Vermont, instate employment losses would depend on the extent of their instate hiring and are expected to be moderate.

LOCAL EMPLOYMENT IMPACTS

The communities of Brattleboro and Vernon would be hardest hit by the loss of the Vermont Yankee facility. Once the Vermont Yankee facility has been shut down and decommissioning completed, approximately 146 jobs could be lost by residents of those two communities as a direct result of the shutdown. In addition to direct employment losses, these communities could face additional job losses associated with service industries that support Vermont Yankee and their employees.

Vernon

A shutdown of the Vermont Yankee facility would eventually result in approximately 60 direct job losses to Vernon residents, equivalent to approximately $2.6 million dollars in annual employee income. Vermont Yankee provides a substantial portion of the overall employment base of Vernon. The total number of Vernon residents employed inside or outside the state was 536 in 1980.[5] Most of the Vernon labor force is reported to work in the town of Brattleboro (approximately 44%). The Vernon community could face an approximate 11.2 (60/536) percent reduction in jobs as a direct result of a shutdown.[6]

Brattleboro

Vermont Yankee employs approximately 86 residents of Brattleboro and West Brattleboro, with a total estimated income of about $3.5 million. The Department of Employment and Training reported total employment in the Brattleboro area to be 15,600 in September 1987. The closing of the Vernon facility may result in direct job losses to the Brattleboro area of roughly 86 workers; potentially increasing the current unemployment rate for Brattleboro about half of one percent.

OTHER INCOME AND SECONDARY EMPLOYMENT IMPACTS

Vendor Services and Stockholder Dividends

In addition to the potential loss of employment income, Vermont residents also face some potential losses in income from vendor services and stockholder dividends. Fifty-five percent of Vermont Yankee is owned by instate distribution utilities. Vermont Yankee paid approximately $6.7 million in vendor services instate and approximately $4.9 million in stockholder dividends.

The long run net impacts of a shutdown on Vermont Yankee stockholders and vendors are less certain. If a state taking of the facility occurs, and the stockholders (the owners of Vermont Yankee including the instate and out-of-state utilities) are duly compensated, then they are also free to either reinvest to earn dividends from other investments or to simply pass through the returned investment to stockholders to cover all costs of debt service and their investment.

The vendor services supplied by instate suppliers will likely be replaced by other vendor services supplied to new sources of replacement power, if they are instate.

Other Secondary Impacts

Secondary employment losses (both inside and outside the state) may result from rate increases. Rate increases may compromise the competitive positions of instate industries, leading to increased costs of producing Vermont goods, price increases and lost product demand for Vermont manufactured goods. Estimating these impacts is difficult, requiring speculative assumptions over variables such as demand elasticities (i.e., estimates of demand response to a change in price) of various industry goods and the use of regional input-output tables. Such impacts could

create a burden on the state economy, having the greatest impacts to industries that rely heavily on electricity and sell in competitive out-of-state or national markets. One response to this might be a movement towards industrial cogeneration, conservation and demand-side management.

Aside from the direct income and employment losses to the local economy from a shutdown of the Vermont Yankee facility and lost business to its vendors, other secondary impacts will be experienced by the local economy as merchants experience lower demand for consumer goods like food and clothing. These changes in demand create further "ripple effects" to the local employment and income base of the local economy. Although these ripple effects are recognized, establishing an appropriate multiplier to capture these effects is an area requiring further research.

7.3 Tax and General Fund Impacts

A shutdown of the Vermont Yankee facility will create some losses in state and local sources of tax revenues. However, it is important to remember that a majority of the Vermont Yankee taxes are ultimately paid by Vermonters in any case. Some government services will be eliminated at both the state and local levels; however, the costs of those services are uncertain. In the shorter term, a shutdown of the facility could actually create a demand for greater state and local government involvement with the shutdown and decommissioning of the facility.

7.3.1 Tax Revenues

Vermont Yankee pays taxes to both state and local governments. For the 1986 tax year, the Department of Taxes reported total roughly $3.5 million in ta revenues collected from the Yankee facility.[7] Vermont

Yankee reports local government property taxes for the 1986 tax year to be $2.3 million to the Town of Vernon and $182,000 to the City of Brattleboro.

The state and local taxes paid by Vermont Yankee in 1986 were roughly $5.7 million. Roughly 45%, or $2.6 million, comes through the power purchases by out-of-state buyers. Vermont Yankee projects payments to the state and local governments by Vermont Yankee from 1988 through the end of its operating license in 2007 to be roughly $217 million. Table 7-3 provides a summary of the taxes paid in 1986 and projected payments by Vermont Yankee for the 1988 to 2007 time period.

The roughly $3.2 million in state taxes paid by Vermont Yankee for 1986 represents less than 1 percent of the total state general revenue fund collection for FY 1987 of $446.9 million.

Figures reported for the Town of Vernon show that property tax revenues collected from the facility represents 88 percent of its total revenue base. Approximately $2.60 million was collected by Vernon from Vermont Yankee for the 87/88 tax year; approximately $2.95 million was assessed and billed through all revenue sources.[8] Roughly $1.8 million of the town spending goes to school spending and $1.1 million for other general requirements including roads.

School statistics for the 1984-85 school year show the average spending per pupil (approximately $4,251 and $3,972 for elementary and secondary education respectively) were significantly above the state average of $2,996.[9]

Vernon currently enjoys one of the lowest property tax rates within the state. The loss of Vermont Yankee would place a significant burden on local residents likely requiring a phase-down of existing program spending and requiring that the balance of continued

program spending be funded with increased local tax rates.

The City of Brattleboro estimates approximately $235,700 was collected from Vermont Yankee for taxes on land, property and buildings within the city. The total tax revenue base for Brattleboro was approximately $11.1 million, roughly 2% of which comes from Vermont Yankee.[10]

Table 7-3

VERMONT YANKEE TAX PAYMENTS TO VERMONT
($ Thousands)

	1986			Totals (1988-2007)		
	State	Local	Annual	Nominal	Const. 1988 $	Present Value $
Property	1,935	2,519	4,454	168,885	93,463	51,591
Income Corporate			-0-		-0-	-0-
Employee Withhold	644		644	24,413	13,514	7,460
Sales/Use	562		562	21,326	11,793	6,510
Unemployment	52		52	1,978	1,091	602
Totals	3,194	2,519	5,712	216,602	119,861	66,163

Reference: Vermont Yankee Nuclear Power Corporation, An Analysis of H.173; The Vermont Yankee Shutdown Study, October, 1987. Constant dollar and present value estimates were calculated by the Department of Public Service.

7.3.2 New Obligations

One of the principal burdens of a forced shutdown of the Vermont Yankee facility by the state or taxpayers may be a new obligation to compensate current Vermont Yankee owners for loss of their investment. Payment to owners, if required, could come out of the state's general revenue fund or through the existing rate structure. Compensation to Vermont Yankee owners based

on the net book value of the facility would add roughly $230 million in new tax obligations.

7.3.3 Government Programs

The closing of the Vermont Yankee facility would also reduce requirements for certain public services, monitoring and oversight of the facility. The savings to state and local governments associated with the shutdown of the facility is unclear. Most state agencies that monitor or provide some regulatory oversight of the facility indicated that they would experience overall reduction in their program costs if Vermont Yankee were shut down.

State programs that monitor or otherwise provide services that are only necessary because the Vermont Yankee facility exists include the following:

* Department of Health -- Air monitoring
* Agency of Natural Resources -- Water pollution permits -- less than $1000/yr
* Department of Public Safety -- Emergency Response Management -- $71,642/yr
* City of Brattleboro and Town of Vernon -- Schools, roads, water and sewer services
* State Emergency Management Fund -- $2 million

In addition to the programs listed above, the state engages in extensive annual emergency preparedness exercises that involve the Governor, various state, local officials and Vermont Yankee staff.

7.3.4 Net Burden on Taxpayers

The net burden to taxpayers of closing Vermont Yankee includes the net effect of out-of-state revenue losses, new obligations to taxpayers less government programs and/or funding requirements no longer needed

after a shutdown. The immediate impacts of the loss of Vermont Yankee include the loss of roughly $5.7 million in tax revenues, of which 45%, or roughly $2.6 million, are collected from out-of-state purchasers of the power. The Vermont Electric Energy tax paid by Vermont Yankee to the state is peculiar to Vermont Yankee power facility; instate sources of replacement power will unlikely fully compensate the state for the loss of Vermont Yankee as a funding mechanism.

New obligations to taxpayers would be approximately $230 million if the condemnation payment to Vermont Yankee owners is based on net book value and comes from the state general revenue fund. Table 7-4 shows the estimated range of the economic impact of a shutdown on state and local tax bases.

Table 7-4

NET IMPACT OF A SHUTDOWN ON VERMONT STATE AND LOCAL TAX BASE
($ Millions)

	Total	Out-of-state Share
New Obligations	$230	$108
Lost Revenues	$ 66	$ 32
Govt. Programs	Various	
Net Total	$296	$140

7.4 Secondary Impacts on Employment, Income and Competitiveness

Not included in the discussion above were the potential impacts to jobs, profits, taxes and income impacts due to the second order effect of higher electric rates on Vermont industry; especially instate industries that rely heavily on electricity and compete in out-of-state markets. The shutdown of the Vermont Yankee facility would increase electric rates and,

consequently, the costs of production in many industries. For industries in competitive markets, the higher rates could result in losses of employment, income, and profits to the communities that serve these industries.

7.5. Other Impacts

Other potential impacts of a Vermont Yankee shutdown include such effects as changes to property values in the Vernon area, transportation risk reduction resulting from as decreased overall need to transport radioactive material, decreased demand for municipal services, road maintenance and repair, any local impacts on the cost of living and local land use. Further discussions of these and other impacts will be included in the Department's final report.

FOOTNOTES -- Chapter 7

1 Vermont Yankee Nuclear Power Corporation, "Annual Report of Major Electric Utilities, Licensees and Others," FERC Form No. 1 (December 31, 1986).

2 Facsimile to DPS from Tom Bennet, Vermont Yankee (November 13, 1987).

3 Towns with less than three employees working at Vermont Yankee including Bellows Falls, Bennington, Chester, East Dover, Guilford, Halifax, Jamaica, Perkinsville, Rutland, Saxtons River, Springfield, West Dummerston, West Townsend, Williamsville. Wilmington, Fairfax, Montpelier, and Middlebury.

4 Vermont Yankee Nuclear Power Corporation, An Analysis of H.173: The Vermont Yankee Shutdown Study, October, 1987.

5 Vernon, Town of Vernon, Town Plan, June 5, 1986.

6 Applying the estimate of 60 Vermont Yankee employees to the overall employment base of Vernon residents for 1980.

7 Memorandum from Earle E. Fennessey, Department of Taxes to Christopher Owen, Department of Public Service, September 10, 1987.

8 Phone conversation with Christine Howe, Vernon Town Treasurer, November 17, 1987.

9 Vermont Department of Education, 1984-1985 Financial Statistics; Vermont School Systems (1985-1986).

10 Phone conversation with David Sickle, City of Brattleboro, November 20, 1987.

8. SUMMARY OF OTHER STUDIES, COMMENTS AND RESPONSES

The Department of Public Service solicited comments for this study from 38 groups, including 24 instate electric distribution utilities, the plant's operating company, state agencies, municipal governments and others. Many responded with detailed written comments and offered their perspective concerning a shutdown of Vermont Yankee. The comments and studies are available for inspection at the Department's offices and are summarized below.

8.1 Utility Responses

8.1.1 Electric Utilities Study

Nine electric utilities, which purchase most of the Vermont Yankee power consumed in this state, jointly prepared a report, which they released at an October news conference. Investor-owned utilities participating in the joint effort were Central Vermont Public Service Corporation and Green Mountain Power Corporation. Six municipal utilities and a cooperative were also represented: Burlington, Hardwick, Lyndonville, Morrisville, Northfield, Stowe and Washington Electric Cooperative.

The utilities asserted a premature shutdown would be unjustifiably expensive. They estimated the cost of replacement power from the date of an early closing until 2007 would be significant as set forth below in Table 8-1.

Table 8-1

COST OF REPLACEMENT POWER
ACCORDING TO UTILITY PROJECTIONS
($ Billions)

Yankee Closing Date	Replacement Power Costs
1987	$3.19
1997	$2.73

The companies also projected savings in replacement power costs of $2.58 billion if the nuclear plant extends operation from 2007 to 2012.

The utilities said the nuclear plant supplies Vermont with low-cost power when it is operating. Whether or not the plant operates, the companies said they are obligated by contract to pay the nuclear plant's "mortgage."

Although state agencies have certain regulatory powers (e.g. safety, environmental and rate regulatory powers) related to the plant, the utilities claim those agencies lack authority to cause a shutdown. Moreover, according to the utility report if the Vermont Legislature passed a law authorizing a shutdown, it would likely be superseded by the federal Atomic Energy Act of 1954 and other federal laws.

The utilities recognize that the State of Vermont, however, does retain its traditional right to regulate utilities, including Vermont Yankee, in such areas as economic matters and plant siting. The utilities contend that if state action caused the plant to be closed on economic or other, non-preempted grounds it would amount to a state condemnation of the property, requiring the state to compensate plant owners for loss of the property. The utilities also cite Vermont Yankee's claim that a state condemnation would result in loss of tax revenues and that the cost of compensation to plant owners would be $1.44 billion.

On the issue of replacement power, the utilities said they have been studying the matter in recent years because of uncertainty over the continued supply of power from New York and the Merrimack, N.H. coal plant. Probable sources of replacement power are additional purchases from Ontario, Quebec and New York. Other sources might be a coal- or natural gas-fired plant in

Vermont or New England and new small power producers. Conservation and demand management initiatives also figure into the picture, they added.

The utilities are presently contributing to a Yankee decommissioning fund at an annual rate of $3.2 million. The companies are concerned about the decommissioning fund, noting that large rate increases might be needed if the cost of decommissioning is not covered by the annual contributions toward decommissioning. The companies also noted that the decommissioning fund is a matter requiring monitoring by the state and Vermont utilities purchasing Yankee power.

The companies said a premature shutdown of the plant could cause electric rates to increase. In the case of CVPS and GMP, it was estimated rates would increase 33 percent and 25 percent respectively. Moreover, state and local governments would lose tax revenues now paid by the nuclear plant. The benefit of jobs, and the so-called "multiplier effect" of those incomes in the regional economy, would also be lost.

Based on their conclusions, the utilities recommended the final part of this two-part study, due to be delivered to the Legislature in 1988, not be undertaken.

8.1.2 Vermont Yankee Nuclear Power Corporation Study

Vermont Yankee Nuclear Power Corporation concluded in its legal analysis that, under the Atomic Energy Act and by Supreme Court decisions, only the federal government has the authority to shut down the plant. Additionally, it asserts the state lacks authority to cause a plant shutdown on economic grounds. However, it concluded the state might cause a closing if it could demonstrate a necessary public use for the Vernon site and thereby invoke its power of eminent domain. Were this to happen, the operator claims the state would be

obligated to pay Vermont Yankee Nuclear Power Corporation the fair market value of the plant, an amount it estimates at $1.4 billion for a 1988 shutdown and $1.65 billion for a 1998 shutdown. In reaching these figures, Vermont Yankee derived its estimate of the fair market value by projecting the revenues that could be earned by selling the plant's long-term output to other utilities in the region. Additionally, the state would inherit the responsibility of operating and decommissioning the plant with attendant costs, according to the plant operator.

A premature shutdown of the plant would cost as much as $5 billion, or $9,000 per Vermont resident, if replacement power costs, lost tax revenues, jobs and the multiplier effect are added together, Yankee asserted in its report.

The company pointed out that the nuclear plant provides Vermont ratepayers with protection against higher oil prices, and that it does not pose the uncertainty associated with other energy sources, such as small power projects or foreign energy supplies.

8.1.3 Vermont Electric Power Company (VELCO)

VELCO, a provider of transmission services to Vermont utilities, carries electricity from the Vernon plant to the Vermont distribution utilities buying the power. The company said if Vermont Yankee was closed and another power plant built in its place, no alteration in transmission systems would be needed. Similarly, no changes are needed if power replacing Vermont Yankee entered the VELCO system in Vernon. However, if alternate supplies were acquired from Canada or New York, significant upgrading of transmission facilities would be needed, according to VELCO. The cost of improvements to the transmission system are borne by electric companies, and, ultimately, by

Appendix J

Glossary

APPENDIX J - GLOSSARY

AVOIDED COST	The total cost of energy and capacity that would otherwise be incurred if a given action were not taken.
BASE LOAD	The minimum load over a given period
CAPABILITY RESPONSIBILITY	The capacity a utility must have to meet its peak load plus a reserve margin. The reserve requirement is a function of size, number, and location of units in a power system.
CAPACITY FACTOR	The ratio of the average load on a machine or equipment during a specified time period to the capacity rating of the machine or equipment.
COGENERATION	The combined production of electricity and useful thermal energy.
COMBINED CYCLE	A combination of a steam turbine and a gas turbine in a generating plant, with the gas turbine exhaust producing steam for the steam turbine.
COST OF SERVICE	A pricing concept used to design electric rate schedules. This concept attempts to align utility cost curves with utility revenue curves for the various classes of usage and customers served.
CONSTANT DOLLARS	Dollars that have had an adjustment made to remove the effects of projected inflation.
CUMULATIVE NOMINAL DOLLARS	Total actual projected costs.
DEMAND	The rate at which electric energy is delivered or used expressed in Watts, Volt-Amperes or other unit, at a given instant or averaged over any designated period.
DEMAND-SIDE MANAGEMENT (DSM)	Control of energy and capacity costs by modifying or controlling amount or timing of use rather than supply. Includes programs that influence customer use as well as

	programs that increase the efficiency of transmission and distribution systems.
DISPATCHING	The operating control of an integrated electric system involving assignment of load to specific generators or other sources for the most reliable and economical supply; control of high-voltage lines and equipment; and scheduling of energy transactions with connecting electric utilities.
DISTRIBUTION	Delivering electric energy from the transmission or bulk power system to consumers; also that portion of utility plant used for that purpose, or expenses relating to that plant.
EMINENT DOMAIN	The right of a government to appropriate private property for public use, usually with compensation to the owner.
FERC	Federal Energy Regulatory Commission
HIGH-LEVEL NUCLEAR WASTE	Spent fuel from nuclear reactors and the wastes directly produced in the reprocessing of spent fuel.
IONIZATION	The process of exciting an atom to a higher energy state than its ground stall energy level.
IONIZING RADIATION	Gamma rays and x-rays, alpha and beta particles, high speed electrons, neutrons, protons, and other nuclear particles of sufficient energy to cause ionization of atoms of as particular materials.
KILOWATT (kW)	1,000 Watts.
KILOWATTHOUR (kWh)	The basic unit of electric energy equal to one kiloWatt of power supplied to or taken from an electric circuit, steadily, for one hour, i.e., 1,000 W x 1 hour = 1 kWh.

LIFE-CYCLE COST	The total cost of owning and operating a system, supply or demand, over its expected life.
LOAD FACTOR	The ratio of the average load in kW supplied during a period to the peak load in that period.
LOSS-OF-LOAD PROBABILITY	The probability that the system load will exceed available generating capacity.
LOW-LEVEL NUCLEAR WASTE	Waste garments, equipment, tools, cleaning resins and similar irradiated materials.
MARGINAL COST	Cost to produce one more unit.
MEGAWATT (MW)	1,000 kiloWatts.
MELTDOWN	A buildup of heat in the core caused by insufficient cooling which causes the fuel to melt.
MILL	One-thousandth of one dollar ($.001).
NUCLEAR FISSION	Power plants based on the principle of fission -- the splitting or breaking apart of a heavy atom into two new atoms. When a heavy atom, such as uranium is split, large amounts of energy and one or more nuetrons are released.
OSHA	Occupational Safety and Health Administration.
PRESENT VALUE	An estimate made from projected costs by computing the effective lump sum payment that would have to be placed in an account bearing interest at a utility's cost of capital today in order to just cover the principle and interest needed to meet projected costs.
PRODUCTION COST	The variable cost of generation, including fuel, operating labor, maintenance labor and materials.

RADIONUCLIDES	A species of radioactive atom characterized by the constitution of its nucleas.
RATE BASE	The value established by a regulatory authority, upon which a utility is entitled to earn a return. Generally, this represents the amount of property used and useful in public service and may be based on the following values or combinations thereof: fair value, prudent investment, reproduction cost, or original cost; and may include working capital, materials and supplies, and various deductions such as depreciation.
RATE OF RETURN	The ratio of allowed net income to a specified rate base.
RELIABILITY	Probability that a component or system will function as planned in a given environment for a certain period.
RESERVE MARGIN (Capability Margin, Reserves)	The difference between net system capability and system peak load; the margin of capability available for scheduled maintenance, emergency outages, and unforeseen loads.
REVENUE REQUIREMENT	The revenue level necessary to achieve a specified rate of return and recover all authorized expenses.
SHUTDOWN	Permanently ceasing electric power production.
TRANSMISSION	Transporting electricity in bulk from the sources of supply to other principal parts of the system or to other utility systems, also that portion of utility plant used for transmission.
WATT	The electrical unit of power, equal to one Ampere flowing continuously across a potential of one Volt. One horse-power equals about 746 Watts.

ratepayers to the extent that expenditures for those improvements are shown to be useful.

8.2 Town of Vernon Response

The Town of Vernon, through its Board of Selectmen, submitted a December 7, 1987 letter outlining its concerns over an early closing of the nuclear plant. The Selectmen said an early closing would be "devastating" for the local employment market and for municipal tax revenues, since Yankee pays most of the town's taxes. One drawback of the Yankee plant is increased traffic on local roads, particularly when contractors arrive for refueling outages. The town acknowledged risk of an accident at the plant and noted emergency planning exists for nuclear and non-nuclear incidents. It also said that time is needed to plan for the eventual loss of the Yankee tax revenues, and that such planning efforts would be compromised by an early plant closing.

8.3 State Agencies

8.3.1 Department Of Health.

Vermont law (18 VSA Sec. 1652 (b), and (d) and Sec. 1654) grants authority to the Department of Health in matters related to radioactivity and protecting the public health and welfare as well as the transportation of radioactive materials. The department is also allowed to enter private property for purposes of inspection. (In the case of Vermont Yankee, concurrence by the federal government is needed for state inspection.) In discharging its duties, the department employs the equivalent of 1.8 persons for tasks such as radiation surveillance, investigating field incidents, emergency response programs and transportation. The department deals with other users of radioactive materials, notably medical facilities. Because other

users exist, the department said it did not anticipate any significant changes in its regulatory role or operating budget if the generating plant were closed. A dismantlement of the plant, whenever it occurs, might result in a temporary doubling or tripling of current manpower to handle added surveillance and emergency preparedness work, the Health Department said.

8.3.2 Public Safety Department, Division of Emergency Management

The Division of Emergency Management administers federal and state laws and regulations regarding "radiological emergencies." The Division has developed detailed plans on a town-by-town basis for protection of residents and for evacuation routes in communities near two nuclear generating facilities -- the Vernon plant and the Rowe, Mass., plant, situated near the Vermont border. The Division has the equivalent of 1.5 persons to fulfill state and local emergency preparedness needs. An annual payment by Vermont Yankee is required in the amount of $250,000 to defray emergency planning expenses, a contribution that would cease if the plant closed, the Division said. The Division sees a responsibility to oversee emergency planning even after a closing as long as radioactive material remains on the Vernon grounds.

9. CONCLUSIONS

9.1 Open Issues

The study of Vermont's only nuclear power plant has raised many complex issues. The Department has endeavored to identify all major issues, and has discussed those issues in differing degrees of detail. However, a number of issues are candidates for further investigation. Among them are the following topics.

9.1.1 Expanded Legal Research

Important questions regarding federal preemption, the Commerce Clause of the U. S. Constitution and the potential need to pay compensation to the plant's owners would likely arise during the debate over shutdown legislation and any ensuing litigation. In view of the difficulty of these questions, and the challenge of applying existing law to a new situation, the Department recommends that any conclusive legislative or regulatory consideration of shutdown action be preceded by more exhaustive research than time and resources have permitted to date in this study. The Department will, of course, continue to expand upon and update its legal research during preparation of the final report.

9.1.2 Decommissioning

The current plan to fund decommissioning carries certain risks for ratepayers or taxpayers. Further review of this issue is needed to determine whether legislative action or state participation in a proceeding before the Nuclear Regulatory Commission could provide the public with greater protection in this regard.

9.1.3 Economic Impacts

The potential impacts of a Vermont Yankee closing on the Vermont economy regarding tax revenues, electric

rates and the job market have been reviewed in the study. The impacts discussed in this report generally reflect only the primary impacts of shutdown to the state and local communities near the facility. The potential second order impacts have been briefly discussed, yet deserve further study. Higher electric rates that may follow a plant shutdown could create an additional cost to state industry which could compromise the competitiveness of state industries that rely heavily on electricity.

9.1.4 Regional Impacts

About 45 percent of Yankee's output is exported to companies and their ratepayers in other states. Also, Yankee's operation raises environmental and safety issues in Vermont and elsewhere because of its proximity to other states. An analysis of regional impacts would be needed to identify all relevant concerns associated with a Yankee closing.

9.1.5 Small Power and DSM

Small power production is one part of the mix of power which would replace Vermont Yankee, but many variables about small power remain to be decided and analyzed. Expanded demand-side management potential is likewise a large, but relatively uncharted territory. Ideally, they could reduce the cost of replacement power more than anticipated, but more study is needed to define the potential.

9.1.6 Rate Impacts

The Department has made general estimates about rate impacts, but a more precise estimate, possibly by region or utility territory, would be warranted if this issue is studied further.

9.1.7 Price-Induced Conservation

Spontaneous initiatives for demand-side management and energy efficiency would follow any increase in electric rates caused by a Yankee closing. Any rate increase would also trigger lower demand, reducing the cost impact for replacement power. These influences on the replacement power picture warrant more detailed study. Any effect would be to lower the estimated impacts.

9.1.8 Hydro-Quebec Contract

The Department was completing this interim report at the same time that a number of Vermont utilities were proposing a contract to import up to 500 MegaWatts of Hydro-Quebec power over the next 30 years. This potential source would be an important factor in determining the cost of replacing Yankee's power and needs closer examination.

9.1.9 Vermont Yankee Submissions

Vermont Yankee provided substantial assistance in the Department's review of issues raised by the legislation. However, certain elements of their costs and expense projections deserve greater scrutiny for the final report. The Yankee projections of capital costs, plant capacity factor and fuel costs, for example, appear to reflect optimistic assumptions for future plant operation at the plant. These questions deserve close scrutiny.

9.1.10 Low-Level Waste Costs

There are substantial uncertainties associated with long-term, in-state disposal costs of low-level waste as they have been developed for, and used in, this report. Further review of inherent uncertainties surrounding

estimates of in-state low-level disposal costs may be warranted.

9.1.11 Cost-Benefit Analysis

Further review of cost streams and related analytic assumptions underlying the cost/benefit analysis presented in this report will be necessary for the final report. The effects of lost off-system sales is an area particularly in need of study.

9.1.12 A Planned Shutdown

This interim report quantifies the effects of an immediate shutdown of Vermont Yankee in 1988. Given a lead time of several years, Vermont utilities could potentially acquire a more economic and strategically desirable mix of replacement power sources than would be possible in the event of an immediate shutdown. A delayed closing also would permit more comprehensive planning for the method and costs of decommissioning the facility and optimizing capital additions and operating expenses to the plant's limited operating life.

The Department believes that the costs and benefits of a Vermont Yankee shutdown cannot be adequately weighed without an assessment of the effects of a delayed shutdown and plans to address those effects in its final report.

9.2 Interim Conclusions

While further study of the issues noted above is essential before firm conclusions can be reached, certain preliminary conclusions can be stated with respect to the questions posed by legislature.

9.2.1 Authority of the State to Shut Down Vermont Yankee

Because the U. S. Supreme Court has recognized that states retain significant control over those aspects of nuclear energy not related to radiological safety, thoughtful legislation or regulatory action not based on radiological safety concerns would appear to have a reasonable potential for surviving a challenge based on federal preemption. It also appears that such legislation might survive challenges under the Contracts and Commerce clauses of the U. S. Constitution. Analysis of the law pertaining to takings suggests that the facility's owners would be entitled to compensation if the plant were prematurely closed through state action.

9.2.2 Authority of the State to Protect Public Safety, Health and Welfare When Vermont Yankee Is Shut Down

Upon shutdown, the state would continue to exercise the authority it has always had over areas not related to radiological health and safety. The State would continue to maintain control over occupational safety, emergency preparedness, and environmental discharges. The State could work to influence the NRC in matters related to decommissioning, and may increase its responsibilities at any time by becoming an "agreement state" as provided by federal law.

9.2.3 Financial Exposure to the State of Vermont

If the state were required to pay compensation to Vermont Yankee's owners as a result of a state taking of the plant, compensation would most likely be based upon the "original cost" method. In this context, this means that the net value of the plant would be determined by

taking the historical or original cost of the facility, adding the cost of capital improvements, and subtracting depreciation. When this formula is applied to Vermont Yankee, it yields a 1986 figure of $230 million. Replacement power costs also create substantial financial exposure to ratepayers discussed below.

9.2.4 Adequate Planning for Replacement Power, Shutdown and Decommissioning

To date, the Vermont distribution utilities have not devised a plan indicating how the power sources available to the state would be used to replace Vermont Yankee if the plant shut down. Moreover, it does not appear that the advantages and limitations of options available under such circumstances have been comprehensively studied.

If Vermont Yankee were to permanently close in the near future, the utilities would likely need to purchase short term capacity at premium prices for the next several years. If planning were to commence well in advance of a shutdown measure, replacement power could be secured on more favorable terms, and there would be a greater opportunity for the implementation of demand side management measures. In the long term, numerous opportunities for meeting Vermont's electricity needs on favorable terms may exist; these opportunities, not accounted for in this interim study, include expansion of demand side management efforts, development of small power projects and development of additional transmission capacity in order to increase access to out-of-state markets. Lead time for planning and to take the best advantage of market opportunities would be critical.

The future decommissioning of Vermont Yankee is being funded by payments from the facility's owners into a escrow account. Current plans for decommissioning

involve a complete dismantlement of the plant after 2007 (when the operating license expires), at an estimated cost of $531 million at that time. Various alternative methods of retiring a facility are considered acceptable by the NRC; these include mothballing, entombment dismantlement, and conversion to another type of system. Each of these methods has advantages and disadvantages, and numerous uncertainties surround estimates of the costs, and exposure risks of the decommissioning alternatives.

9.2.5 Criteria for Deciding Whether the State Should Shut Down Vermont Yankee

Based on analysis and expense projections supplied by Vermont Yankee, the Department's preliminary estimate of the net cost of a shutdown (including condemnation payment to the owners) is an equivalent present value of about $569 to $612 million. A cost benefit analysis may provide a reasonable framework for evaluating the appropriateness of a shutdown, although it must be recognized that a cost benefit approach may present subjective, inadvertent or inherent sources of bias or error.

Major benefits of a shutdown include the reduced risks of accident and the avoiding of plant operating costs. These operating costs include capital additions. An early shutdown would also lessen the costs of waste disposal.

9.2.6 Effects of Shutdown on Vermont Ratepayers, the Revenues of the State, the Town of Vernon and the Surrounding Communities

Roughly 89% of Vermont ratepayers rely on Vermont Yankee for over a third of their electric energy. The Department's preliminary estimates is that if these ratepayers were to bear the burden of replacement power

costs, condemnation payments and continuing maintenance and decommissioning, rates could increase by 10 percent, not including the effect of various items that could not be quantified for this interim report.

Vernon, which relies on Vermont Yankee for about 88% of its total revenue base and spending, would be heavily affected by a shutdown of the plant. Approximately 11% of the town's working residents are employed there.

Of the 327 employees of Vermont Yankee, 186, or 57%, reside in Vermont; these employees have a combined income of $7.7 million. Brattleboro and West Brattleboro combined have 76 Yankee employees, and Vernon has 60. Payments to instate vendors by Vermont Yankee totaled $6.7 million in a recent year. The plant paid about $3.5 million in Vermont taxes during 1986, $2.6 million to Vernon during the 1987/88 tax year, and $235,700 to Brattleboro.

A shutdown of Vermont Yankee would reduce certain expenses related to state oversight and monitoring of the facility, including expenses relating to the State Emergency Management Fund ($2 million).

Appendix A

H.173

NO. 38. AN ACT RELATING TO THE COMPLETION OF A STUDY ASSESSING THE SHUTDOWN OF THE VERMONT YANKEE NUCLEAR FACILITY.

(H.173)

It is hereby enacted by the General Assembly of the State of Vermont:

Sec. 1. VERMONT YANKEE NUCLEAR FACILITY; SHUTDOWN; ASSESSMENT

(a) The general assembly finds that a publicly conducted comprehensive assessment of the impact of a Vermont Yankee nuclear facility shutdown is necessary. The general assembly hereby directs the department of public service, with the assistance of the nuclear advisory panel, and with the participation of all appropriate agencies of state government, under the direction of the governor, and in consultation with representatives of the Town of Vernon and Vermont Yankee officials, to cause such assessment to be undertaken, and to report interim findings thereon to the general assembly on or before December 15, 1987, and a final report on or before December 16, 1988. The interim report shall include recommendations with respect to the resources necessary to complete the final report.

(b) The assessment shall address, but not be limited to, the following questions:

(1) What authority does the state have to shut down the Vermont Yankee nuclear facility?

(2) What authority does the state have to protect the public safety, health and welfare when the Vermont Yankee nuclear facility is shut down?

(3) What financial exposure does the state have when Vermont Yankee shuts down?

(4) Is there adequate planning to provide for replacement power and to cover the costs of shutdown and decommissioning, whenever Vermont Yankee shuts down?

(5) By what economic criteria should the state decide whether to shut down Vermont Yankee?

(6) What will be the effects of shutdown and decommissioning upon Vermont ratepayers, the revenues of the state, the town of Vernon, and surrounding communities?

Sec. 2. EFFECTIVE DATE

This act shall take effect from passage.

Approved: May 12, 1987

Appendix B

Methodology and Calculated
Rate Impacts

APPENDIX B

REPLACEMENT POWER COSTS: METHODOLOGY, ASSUMPTIONS, AND DISCUSSION

1. Methodology and Assumptions

The goal of the analysis was to provide an estimate of the cost to replace Vermont's share of Vermont Yankee power in the event that the plant were to become permanently unavailable. It was performed on a statewide basis, examining the resources, needs, and future options of the state's distribution utilities in aggregate.

1.1 Approach

The costs to Vermont utilities for replacement of Vermont Yankee power were estimated by comparing the projected revenues required to meet the state's electrical needs with the plant operating through power year 2007 to those required if the plant were unavailable beginning in power year 1988. Present and expected components of the state's mix were compared with projected Vermont capacity requirements, to determine the need for additional generating capacity in each case. A set of generation sources was chosen to represent the cost of supply options likely to be available to Vermont. A consistent method of economic decision-making was then used to simulate the selection of future generation additions from among those options in each case.

1.2 Existing and Committed Sources

The capacities of present and projected sources that were modeled in all cases are summarized in Table B-1. Notable assumptions regarding their pricing and availability include the following (all years are power years, ending Oct. 31).

VERMONT YANKEE

* Forced outage rate based on the plant's mature operating history.
* Maintenance schedule as projected by Vermont Yankee.

NYPA

* Current Niagara allocation available throughout the study.

* Availability based on Vt. PSB Docket 5177 assumptions.

ONTARIO HYDRO

* Capacity on the Lake Champlain submarine cable (PV-20) made available by decreasing NYPA deliveries is assumed filled by firm Ontario power through 1992. (Post-1992 assumptions are given below.)

HIGHGATE

* Current contracts modeled through 1990.

* Last 50 MW modeled same as 150 MW portion 1991-1995.

* Energy price of all 200 MW modeled at HQ/CMP plus 4% after 1995.

SMALL POWER

* Statewide total of VPX and direct purchases increasing to 110 MW by 1993, as in Vt. PSB Docket 5248.

MERRIMACK

* Available through 1998.

NEPOOL PHASE I AND II

* The present Phase I and II regional contracts provide savings share revenues, and partial capability credits from 1991 to their expirations. They provide no direct energy for consumption in Vermont.

1.3 Energy Costs

Statewide energy costs were calculated using the Department's Sysgen production simulation model. Starting values of fuel prices were based on August, 1987, NEPEX dispatch prices. Fuel price escalations were based on the Department filing in Vt. PSB Docket 5177. The Nepool Weighted Average Fossil Fuel index was estimated based on Docket 5177 fuel escalation rates and NEPLAN projection of New England fossil generation.

1.4 Future Needs

The state's future electrical needs were projected as in the Department's Conservation Case load forecast. (See the Department's Twenty Year Electric Plan, Public Review Draft, Sec. II.4) This forecast was augmented by system power and all-requirements sales of CVPS and GMP to out-of-state utilities. The NEPOOL reserve requirement was modeled at 24% throughout the study.

1.5 Replacement Power Options and Costs.

CANADIAN OPTIONS

Vermont's ownership shares of the NEPOOL Phase I and II projects were assumed convertible to long term firm purchases from Hydro-Quebec. Capacity and energy prices of long term firm power were modeled 4% above Block 2 of Hydro-Quebec's February, 1987, letter of intent with Central Maine Power (HQ/CMP). The contractual structure of long term purchases from Hydro-Quebec were based on that agreement, including constant nominal fixed charges based on the first year of purchase. First year fixed contract costs were inflated by coal construction cost escalations projected in NEPLAN's 1986 Generation Task Force Assumptions (GTF). Constraints on energy deliveries were modeled by a 15% forced outage rate.

PV-20

The PV-20 interconnection was modeled as available from 1993 forward to transmit long term firm purchases, with the maximum firm capacity of PV-20 modeled as 175 MW. HQ/CMP agreement plus 4% was used as a proxy price for imports from Ontario, Quebec or New York, and transmission charges of $5/MWH ($1988) were applied to the dispatch price of purchases over PV-20.

MARKET GENERATION

The cost of peaking capacity was ramped from the current market price to the cost of newly constructed gas turbines by 1993, which is similar to but revised from Department assumptions in Vt. PSB Docket 5248. The market price thereafter reflects a combination of new and mid-1990's vintage units. Gas-fired combined cycle capacity was modeled available from 1992 forward, with coal-fired capacity available from 1998 forward. Prices of combined cycle and coal capacity were modeled to reflect the carrying cost of newly constructed units. Overnight construction cost estimates of all three plant types are based on the 1986 NEPLAN GTF and Electric Power Research Institute's 1986 Technical Analysis Guide

(EPRI TAG). Real construction cost escalations were taken from NEPLAN GTF. AFUDC estimates were based on the 1986 NEPLAN GTF capital expenditure schedules and Vermont utilities' average cost of capital from the Department filing in Vt. PSB Docket 5177. Annual carrying charges were estimated using the 1986 EPRI TAG approach and Vermont utility weighted cost of capital.

1.6 Generation Expansion Methodology

The development of the state's future power supply portfolio was simulated using the same method of economic decision making in each scenario. Baseload and intermediate capacity additions were optimized by adding 25 MW blocks of capacity to the mix, until carrying costs of the additions outweighed the own-load energy cost savings they provided. Only permanent baseload and intermediate additions were modeled, based on their future impact on revenue requirements. Short term sales and purchases were not considered. Further annual capability deficiencies were assumed to be met by purchases of market turbine capacity.

1.7 Retail Rate Impacts.

The replacement power analysis above yielded estimates of the increased revenue required to meet statewide needs in each Vermont Yankee shutdown case. To estimate the impact on Vermont retail rates as a whole, the revenue impacts of replacement power costs were then divided by statewide revenue requirements assuming continued Vermont Yankee operation. The latter were projected based on the forecast of Vermont retail rates in Nepool's April, 1987, Load Forecast. The distribution of rate impacts among customer classes was not estimated.

2.0 Discussion of Analysis

2.1 Distribution of Costs.

The costs to Vermont utilities to replace Vermont Yankee were estimated in aggregate, with total costs calculated and generation expansion decisions made on a statewide basis. In reality, those decisions would be made and costs incurred by individual utilities.

Most Vermont customers are served by utilities that are direct purchasers of Vermont Yankee power. The power supplies of those utilities would clearly be more directly affected by an early plant shutdown than those of non-purchasers. However, non-purchasers could be affected by changes in the price or availability of system power from present Vermont Yankee purchasers,

particularly CVPS and GMP. Non-purchasing utilities with surpluses could also obtain some benefit from a shutdown if instate purchasers turn to other Vermont utilities to purchase replacement energy and capacity.

Given the uncertainties in the potential interactions between instate and regional utilities in the event of a Vermont Yankee shutdown, it would be difficult to quantify how much of Vermont's replacement power cost would be borne by the direct purchasers, or what benefits could be gained by non-purchasers. It is clear that the ability, if any, of non-purchasing utilities' ratepayers to profit from Vermont's increased supply needs would come at the expense of other Vermont ratepayers.

2.2 Profits from Resales

This replacement power analysis was performed on an "own-load" basis, and was designed to estimate an optimized cost of serving Vermont's needs in each case. The cost of an early shutdown of Vermont Yankee would also include the loss of present and potential profits from the sale of power in excess of those needs.

Vermont utilities presently sell a substantial amount of surplus energy, both from Vermont Yankee and other sources, to New England utilities. This analysis did not quantify the effective cost to Vermont of lost revenues from such sales in the event of a Vermont Yankee shutdown.

A similar and potentially greater cost of a shutdown could be decreased opportunities for Vermont to benefit from New England's need for economic baseload power. To the extent that power from Quebec or Ontario would be used to replace Vermont Yankee in Vermont's power supply, the state would lose the potential to sell imports at a profit to other utilities. This also was not included, other than to reduce savings shares revenue from the existing Phase II contract.

2.3 Replacement Options.

SMALL POWER

The analysis in this preliminary report does not estimate the savings that could be achieved by the acquisition of small power at prices below competing supply options. These savings could be large in the case of an early Vermont Yankee shutdown. A recent solicitation for small power production in Maine was met with several hundred MegaWatts of project proposals at prices below the utility's long term avoided cost.

DEMAND SIDE MANAGEMENT (DSM).

The estimate of replacement power costs in this study was based on the Department's Conservation Case forecast of Vermont's annual peak load and energy requirements. The forecast incorporates the effects of DSM measures that are both cost-effective and marketable, and is the Department's attempt to quantify a conservative, achievable target for utility efforts to modify load growth in Vermont. An early shutdown of Vermont Yankee would certainly increase the capacity and energy needs of Vermont's utilities, and could raise the electric rates faced by their customers. These effects would increase the attractiveness of DSM measures to both utilities and consumers.

In addition, this analysis did not quantify how short and long term consumption would be affected by changes in electric rates. The steps taken by customers to reduce consumption in the face of higher rates could significantly reduce the need for new generation, even in the absence of formal DSM initiatives by utilities. To obtain a better understanding of how Vermont Yankee power would be replaced, an improved understanding of the price response of electrical consumers will be needed.

QUEBEC

If Vermont Yankee were closed early, the ability to obtain additional Hydro-Quebec power would become more valuable to Vermont. Late in the preparation of this study, a number of Vermont utilities signed an agreement with Hydro-Quebec containing options to increase imports up to 500 MW of long term power. Because imports from Quebec are accessible and can be a direct source of replacement power and an option against which other potential sources will compete, the contract would be one of the more important factors in assessing Vermont's replacement options.

The proposed contract would be important to the state's degree of flexibility in replacing Vermont Yankee. It would dictate the size and timing of long term Quebec imports available to Vermont. The total cost of power from the contract would directly influence both the cost of replacement power and Vermont's ability to profit from sales of Quebec power to out-of-state utilities. It will be necessary for power planners to carefully study the implications of the proposed contract regarding the availability and cost of power to replace Vermont Yankee in the event of an early shutdown.

PRICE OF IMPORTS OVER PV-20

Vermont presently benefits from the import of inexpensive firm power from Ontario, over the PV-20 interconnection with New York. The value of this and the state's other interconnections would increase in the event of a Vermont Yankee shutdown. This report's analysis of replacement power costs modeled the availability of long term imports over PV-20 at a price comparable to that of imports from Quebec, and did not quantify the potential benefits of less expensive imports from Ontario or New York. While the actual amounts and prices of long term power that will be available from the west are uncertain, long term purchases over PV-20 at prices below those of competing options would help mitigate the cost of replacing Vermont Yankee power.

SHORT TERM PURCHASES

In the short term, the bulk of the impact from the loss of Vermont Yankee would be from higher energy costs rather than from the cost to replace capacity. While this analysis quantified only the contributions of long term replacement power sources, an important determinant of the short term cost of replacement power would be the ability of Vermont's utilities to purchase moderately priced energy from existing units in the region. Short term purchases are made routinely in the course of their normal business, but would be especially valuable in the event of a shutdown, enabling Vermont to minimize its use of expensive energy from peaking units. Such moderately priced energy purchases may be associated with system power, unit entitlements, or other short term transactions. While New England's short term capacity reserves would be affected by a loss of Vermont Yankee, it is likely that Vermont would still be able to substantially reduce its energy costs during many hours of the year, through short term purchases of energy or capacity.

TRANSMISSION

Neither this analysis nor that of Vermont Yankee's instate purchasers accounted for the potential costs of alterations to Vermont's transmission system that might be required to accommodate replacement power in the event of an early Vermont Yankee shutdown. VELCO has indicated that the necessary changes, if any, would depend strongly on the extent to which replacement power sources come from the north or west, and whether another generating facility is constructed at or near the present Vermont Yankee site.

Secondly, the potential costs and benefits of increasing Vermont's interconnection transmission capacity with other systems has not been analyzed. Each of these could be substantial and would require study in the event of an early shutdown.

2.4 Conclusion

The extent to which economical DSM initiatives and small power production can be developed in Vermont could have a great effect on the cost to replace Vermont Yankee power in the event of an early shutdown. That cost will also depend strongly on the long term price of imported power available from Canada and New England. The Department believes that this report's analysis is a reasonable preliminary estimate of the cost Vermont utilities would face to replace Vermont Yankee's power. Further study of the supply and demand uncertainties outlined above will provide a better understanding of the sources Vermont would likely rely on to replace Vermont Yankee, and the steps that will be necessary to minimize the magnitude of Vermont's exposure to replacement costs.

Appendix C

History of Nuclear Reactor
Decommissionings

Information on Past Nuclear

Reactor Decommissionings

Facility Name and Location	Reactor Type	Power Rating(a)	Type of Decommissioning	Year Decommissioned
HRE-1 (Homogeneous Reactor Experiment), Oak Ridge, TN	Fluid-fuel	1 MWt	Dismantled	1954
HRE-2 (Homogeneous Reactor Experiment), Oak Ridge, TN	Fluid-fuel	1 MWt	Dismantled	1954
ARE (Aircraft Reactor Experiment), Oak Ridge, TN	Fluid-fuel	1 MWt	Dismantled	1955
PM-2A (Portable Medium Power Plant), Greenland	PWR	10 MWt	Dismantled	1964
Hanford Production Reactors, Richland, WA	Graphite moderated, water cooled	-	Custodial Safe Storage (Layaway), 4-Standby, 4-Retired	1965-1971
CVTR (Carolina Virginia Tube Reactor), Parr, SC	Pressure tube, heavy water cooled and moderated	65 MWt	Passive Safe Storage (mothballed)	1968(d)
Hallam Nuclear Power Facility, Hallam NB	Graphite moderated, sodium cooled	256 MWt	Entombed	1969
Piqua Nuclear Power Facility, Piqua, OH	Organic cooled and moderated	45 MWt	Entombed	1969
BONUS (Boiling Nuclear Superheater Power Station, Rincon, PR	BWR with nuclear superheating	50 MWt	Entombed	1970
Walter Reed Research Reactor, Washington, DC	Al Model L-54, homogeneous fuel	50 kWt	Dismantled	1971
Pathfinder, Sioux Falls, SD	BWR with nuclear superheating	190 MWt	Passive Safe Storage (mothballed) with steam plant conversion	1972
B&W, Lynchburg, VA	Pool	6 MWt	Partially Dismantled	1972
EBR-1 (Experimental Fast Breeder Reactor), Scottsville, ID	Liquid metal cooled	-	Deactivated, decontaminated, converted for public access	1973
Saxton Nuclear Experimental Facility, Saxton, PA	PWR	23 MWt	Passive Safe Storage (mothballed)	1972
SEFOR (Southwest Experimental Fast Oxide Reactor), Strickler, AR	Sodium cooled, fast	20 MWt	Passive Safe Storage (mothballed)	1973
Elk River Reactor, Elk River, MN	BWR with fossil superheating	58 MWt	Dismantled with steam plant conversion	1974

Facility Name and Location	Reactor Type	Power Rating	Type of Decommissioning	Year Decommissioned
ASTR (Aerospace Test Reactor), U.S. Air Force, NARF, Ft. Worth, TX	-	10 MWt	Dismantled	1974
GTR (Ground Test Reactor), U.S. Air Force, NARF, Ft. Worth, TX	-	10 MWt	Dismantled	1974
RTA (Reactivity Test Assembly), U.S. Air Force, NARF, Ft. Worth, TX	-	1 MWt	Dismantled	1974
FERMI 1, Monroe Co. MI	Sodium cooled, fast	200 MWt	Passive Safe Storage (mothballed) with steam plant conversion	1975
PM-3A (Portable Medium Power Plant), Antarctica	PWR	9 MWt	Dismantled	1977
MTR (Hanford Test Reactor), Richland, WA	Graphite moderated	Zero Power	Dismantled	1977
IRL (Industrial Reactor Laboratories Inc. Research Reactor), Plainsboro, NJ	Pool	5 MWt	Partially dismantled	1977
GE EVESR, Alameda Co., CA	BWR with nuclear superheating	17 MWt	Passive Safe Storage (mothballed)	-
NASA Plumbrook, Sandusky, OH	Light water	100 KWt	Passive Safe Storage (mothballed)	-
Peach Bottom 1, York Co., PA	Gas cooled, graphite moderated	115 MWt	Passive Safe Storage (mothballed)	-
VBWR (Vallecitos Boiling Water Reactor), Alameda Co., CA	BWR	50 MWt	Passive Safe Storage (mothballed) with steam plant conversion	-
Westinghouse Test Reactor, Waltz Mills, PA	Tank	60 MWt	Passive Safe Storage (mothballed)	-
SRE (Sodium Reactor Experiment), Santa Susana, CA	Graphite moderated, sodium	20 MWt	Passive Safe Storage (mothballed - 1967) dismantling started 1976	Dismantling in progress

(a)Power ratings are given in thermal megawatts (MWt) or kilowatts(kWt).
(b)Dash indicates information is unavailable from the literature studies or is not applicable.
(c)Byproduct licenses may be either "Byproduct NRC" issued in accordance with 10 CFR Part 30 or "Byproduct State" issued by an agreement state in accordance with authority granted by 10 CFR Part 150.
(d)First to be placed in passive safe storage (mothballed); provided significant experience in developing criteria and methods.
(e)Implies the availability of other onsite security forces not specifically associated with the decommissioned facility. Had such not been available, NRC may have required other control measures.
(f)Title 10 CFR Part 50 §50.82 provides the rules by which a licensee may amend his operating license to a possession-only license. Once this possession-only license is issued, reactor operation is not permitted.
(g)The site is the first decommissioned commercial reactor to be approved by the government for [illegible]

Reference:

Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor, NUREG/CR-0672, Main Report, Chapter 4.

Appendix D

Low-Level Waste Disposal

State of Vermont

ADVISORY COMMISSION ON LOW-LEVEL RADIOACTIVE WASTE

Center Building
103 South Main Street
Waterbury, Vermont 05676

6 November 1987

MEMORANDUM

TO: Risk Sharing Group

FROM: Laurence Becker, Special Assistant, Radioactive Waste Management, Vermont Agency of Environmental Conservation

RE: Low Level Radioactive Waste Shipped from Vermont 1979-1986

Attached is information on generated waste shipped from Vermont from 1979-1986. Figures have been broken out for the two major generators (Vermont Yankee and the University of Vermont) and a category of other generators. Volume, curies, classifications where known, and an estimate of the number of shipments *are shown.

The information has been derived from a number of sources including: Telephone calls to Vermont Yankee and the University of Vermont; the Conference of Radiation Control Program Directors, 1984 survey; E, G, and G's State by State survey; and interviews with Ray McCandless, Director of Vermont's Occupational and Radiological Health Program.

An explanation for some of the figures is warranted. In 1983 and 1985 Vermont Yankee's curie content jumped because control rods were shipped. The higher volume figures from Vermont Yankee in 1985 were due to pipe replacement activities (@ 5700 ft' of the total figure is dismantled pipe). In 1983 there was a significant volume shipped by the General Electric Corporation. That year General Electric ended their testing program of uranium tipped anti-tank bullets and shipped the remainder of their waste from the test site.

LB/lw

*A shipment can represent a single package or as much as a truck load.

LOW-LEVEL RADIOACTIVE WASTE SHIPPED FROM VERMONT 1986

YEAR	GENERATOR	Ft³	% OF TOTAL	CURIES	% OF TOTAL	CLASS=Ft³/%TOTAL A,B & C	ESTIMATED SHIPMENTS
1986	Vermont Yankee	11,475	94.19%	310.	99.71 %	Class A=10,360 ft³ /90.28% Class B= 1,036 ft³ / 9.03% Class C= 79 ft³ / .69%	23
	Univ. of Vermont	675*	5.54%	.700	.221%	Class A = *675 ft³	2
	Middlebury College	15	.12%	.0022	.001%	Class A = 15 ft³	1
	V.A. Hospital	15	.12%	.011	.004%	Class A = 15 ft³	1
	Medical Center Hospital of VT	3	.03%	.200	.064%	Class A = 3 ft³	1
1986 Totals		12,183	100.00%	310.91	100.000%	Class A=11,068 ft³ /90.85% Class B= 1,036 ft³ / 8.50% Class C= 79 ft³ / .65%	28

183 cubic feet of this amount was stored for decay and shipped to a waste incinerator in Florida

LOW-LEVEL RADIOACTIVE WASTE SHIPPED FROM VERMONT 1982 - 1985

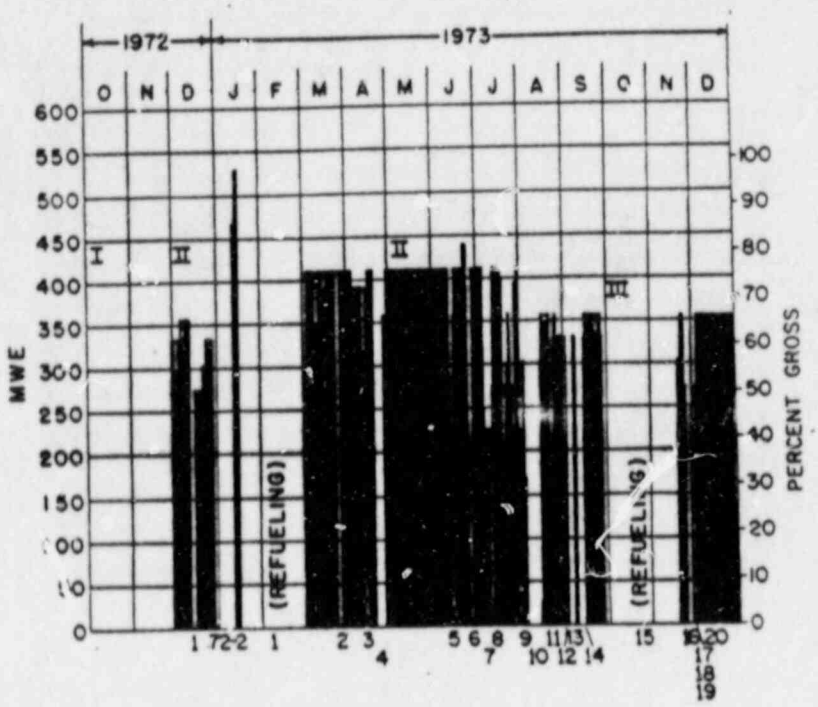
R	GENERATOR	Ft^3	% OF TOTAL	CURIES	% OF TOTAL	CLASS - Ft^3/% TOTAL A, B & C	ESTIMATED SHIPMENTS
2	Vermont Yankee	15,925	95.59%	209.400	99.52%	Not Available for 1982	35
	Univ. of Vermont	675	4.05%	.700	.33%	A - 675 ft^3	4
	3 Other Generators	60	.36%	.300	.15%	A - 60 "	3
	Totals	16,660	100.00%	210.400	100.00%		42
	Vermont Yankee	15,016	51.88%	57,501.000	99.9940%	Not Available for 1983	55
	Univ. of Vermont	893	3.08%	.700	.0010%	A - 893 ft^3	4
	General Electric	12,975	44.83%	2.645	.0045%	A - 12,975 "	88
	Other Generators	60	.21%	.300	.0005%	A - 60 "	5
	Totals	28,944	100.00%	57,504.645	100.0000%		152
	Vermont Yankee	12,298	94.14%	281.000	99.65%	A - 11,296 ft^3/91.85%; B - 340 ft^3/2.77%; C - 662 ft^3/5.38%	36
	Univ. of Vermont	705	5.40%	.906	.32%	A - 705 "	4
	3 Other Generators	60	.46%	.07458	.03%	A - 60 "	3
	Totals	13,063	100.00%	281.98058	100.00%	A - 12,061 ft^3/92.33%; B - 340 ft^3/2.60%; C - 662 ft^3/5.07%	43
	Vermont Yankee	19,414	96.57%	17,272.000	99.994%	A - 17,752 ft^3/91.44%; B-1,166 ft^3/6.01%; C - 495 ft^3/2.55%	45
	Univ. of Vermont	630	3.13%	.700	.004%	A - 630 "	4
	5 Other Generators	60	.30%	.300	.002%	A - 60 "	5
	Totals	20,104	100.00%	17,273.000	100.000%	A - 18,443 ft^3/91.74%; B-1,166 ft^3/5.80%; C - 495 ft^3/2.46%	54

LOW-LEVEL RADIOACTIVE WASTE SHIPPED FROM VERMONT 1979-1981

YEAR	GENERATOR	Ft³	% OF TOTAL	CURIES	% OF TOTAL	CLASS=Ft³ /%TOTAL A,B & C	ESTIMATED SHIPMENTS
1979	Vermont Yankee	9,551	88.53%	999.	99.80%	NA	25
	Univ. of Vermont	375	3.48%	.700	.07%	Class A = 375 ft³	4
	Medical	15	.14%	<1.	-	Class A = 15 ft³	NA
	Industrial	847	7.85%	<1.	-	Class A = 847 ft³	NA
1979 Totals		**10,788**	**100.00%**	**@ 1,001**			
1980	Vermont Yankee	17,072	94.94%	920.	99.78%	NA	50
	Univ. of Vermont	788	4.39%	.700	.08%	Class A = 788 ft³	4
	Medical	15	.08%	<1.	-	Class A = 15 ft³	NA
	Industrial	106	.59%	<1.	-	Class A = 106 ft³	NA
1980 Totals		**17,981**	**100.00%**	**@ 922**			
1981	Vermont Yankee	15,432	93.90%	1,109	99.82%	NA	44
	Univ. of Vermont	953	5.80%	.700	.06%	Class A = 953 ft³	4
	Medical	15	.09%	<1.	-	Class A = 15 ft³	NA
	Industrial	35	.21%	<1.	-	Class A = 35 ft³	NA
1981 Totals		**16,435**	**100.00%**	**@1,111**			

Appendix E

Operating History



SHUTDOWNS

72-1 : AEC OPERATOR LICENSE EXAMINATIONS
12/12(0300)-12/14(0800)

72-2 : LOSS OF STARTUP TRANSFORMER
12/27(1800)-1/10/73(0900)

73-1 : FUEL RECONSTITUTION 1
1/17(1100)-3/2(0500)

73-2 : DRYWELL EQUIPMENT MAINTENANCE (ie. RECIRC. CROSS-TIE AND VALVE PACKING)
3/24(0500)-3/25(1900)

73-3 : REACTOR SCRAM DURING TEST OF TURBINE EMERGENCY GOVERNOR
4/13(0400)-4/13(2100)

73-4 : IUG TIE-IN
4/21(0500)-4/27(1100)

73-5 : OFF GAS DETONATION (WITH LIGHTNING)
6/12(2400)-6/14(0800)

73-6 : RCIC VALVES #15 & #16 OUT OF COMMISSION
6/25(1900)-6/27(0600)

73-7 : REPAIR LEAK IN STEAM TRAP DRAIN LINE
7/5(1900)-7/7(0600)

73-8 : REACTOR SCRAM (DUE TO MSIV CLOSURE SIGNAL RESULTING FROM GROUNDS IN DC SYSTEM)
7/9(1600)-7/8(2200)

73-9 : REPAIR LEAK IN INSTRUMENT LINE ON FEED WATER LINE
7/31(0400)-8/1(0700)

73-10 : CONTROL ROD REACTIVITY TESTING AND FEED WATER LINE VIBRATIONS
8/3(2400)-8/14(0800)

73-11 : REACTOR SCRAM (DUE TO TURBINE TRIP RESULTING FROM ERRONEOUS LOW RX WATER LEVEL SIGNAL)
8/22(1100)-8/22(2400)

73-12 : OFF GAS DETONATION (WITH LIGHTNING)
8/31(1500)-9/1(0700)

73-13 : OFF GAS DETONATION (WITH LIGHTNING)
9/3(0500)-9/6(0600)

73-14 : OFF GAS DETONATION (WITHOUT LIGHTNING) AND AEC REACTOR OPERATOR LICENSE EXAMINATIONS
9/9(0400)-9/13(1600)

73-15 : AOG TIE-IN, FUEL RECONSTITUTION II, FUEL CHANNEL FROBLEMS, AND TURBINE INSPECTION
9/28(2400)-11/19(0500)

73-16 : H.P TURBINE FLANGE LEAK AND AOG ADJUSTMENTS
11/28(1700)-11/29(0300)

73-17 : FEEDWATER TRANSDUCER LEAKS
12/1(0100)-12/1(1600)

73-18 : AOG OPERATIONAL PROB.
12/1(1700)-12/2(0200)

73-19 : AOG OPERATIONAL PROB.
12/2(1000)-12/2(1600)

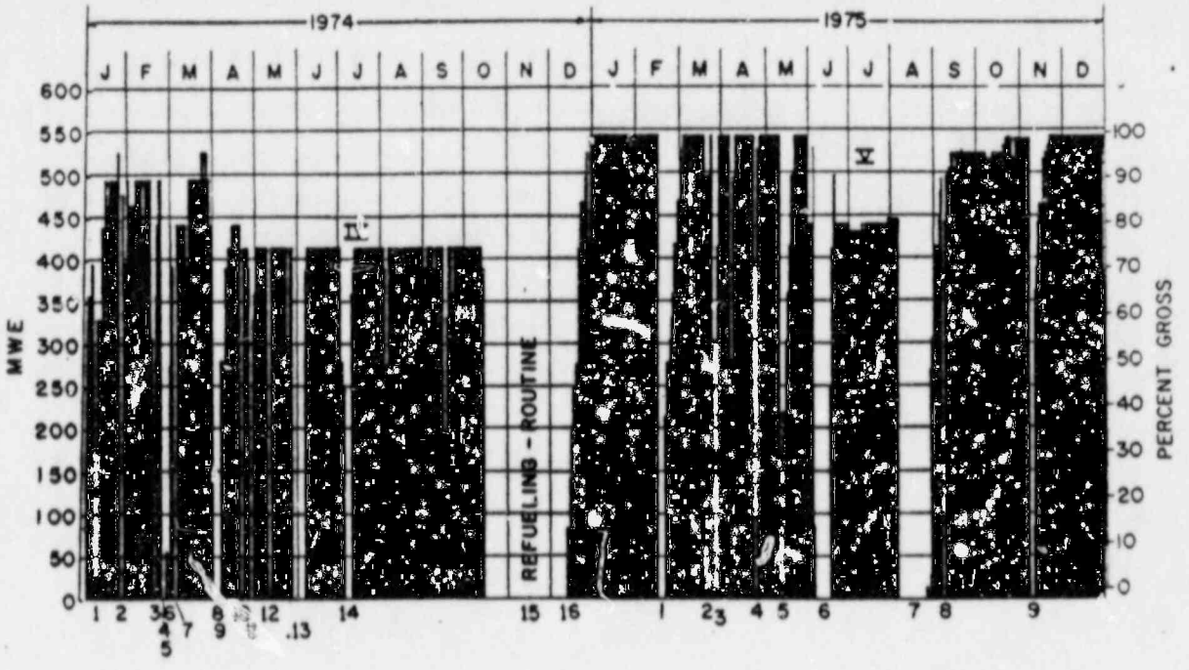
73-20 : STARTUP AOG SYSTEMS
12/8(0200)-12/9(0300)

LOAD RESTRICTIONS:

I INITIAL TESTING

II OFF-GAS LIMITATIONS

III FUEL DENSIFICATION



74-1 : STEAM LINE FLANGE LEAK AT TURBINE
1/5(0300) - 1/5(2200)

74-2 : REACTOR SCRAM FOR FEEDWATER PUMP TESTING
1/25(0900) - 1/26(1800)

74-3 : REACTOR SCRAM (TURBINE TRIP) FROM FULL LOAD REJECT TEST
2/17(1800) - 2/18(1800)

74-4 : REACTOR SCRAM FROM MSIV CLOSURE TEST
2/25(1100) - 2/26(1500)

74-5 : OFF-LINE (TURBINE TEST)
2/26(2300) - 2/27(0400)

74-6 : OFF-LINE (EXCITOR COOLING WATER LEAK)
2/27(2100) - 2/28(0200)

74-7 : REPAIR STEAM TRAP LEAK (MANUAL SCRAM)
3/3(0000) - 3/4(1000)

74-8 : SCRAM RESULTING FROM FULL LOAD REJECT TEST FOLLOWED BY CONTROL ROD TEST AND MAINTENANCE (AUTO SCRAM)
3/29(2200) - 4/4(1600)

74-9 : RECIRC. PUMP SPEED CONTROL (MANUAL S/D)
4/5(0400) - 4/5(0700)

74-10: MAINTENANCE WORK NEAR YAR-WAY (AUTO SCRAM)
4/19(1200) - 4/19(2200)

74-11: REPAIR LEAK IN RELIEF VALVE "D" (MANUAL S/D)
4/27(0000) - 4/28(1800)

74-12: LOSS OF COOLING WATER PUMP IN AOG (MANUAL S/D FROM 40%)
5/9(1300) - 5/10(0400)

74-13: RCU MAINTENANCE IN DRYWELL, LEAK AND DEFECTIVE WELD IN CRD RETURN LINE DISCOVERED (MANUAL S/D FROM 10%)
5/25(1600) - 6/5(1800)

74-14: SHUTDOWN BY MULTIPLE LIGHTNING STRIKES (AUTO SCRAM FROM 75%)
7/5(1400) - 7/8(1700)

74-15: REFUELING OUTAGE I
10/12(0300) - 12/13(1800)

74-16: SHUTDOWN FROM OUTSIDE CONTROL ROOM TEST
12/14(0600) - 12/14(1700)

75-1 : NRC DIRECTED CORE SPRAY WELD INSPECTION (NORMAL S/D WITH MANUAL SCRAM FROM 10%)
2/15(0300) - 2/19(2200)

75-2 : SWITCHYARD INDUCED FULL LOAD REJECT. (AUTO SCRAM FROM 100%)
3/17(1000) - 3/17(2000)

75-3 : REPAIR LEAKING RECIRC. BYPASS VALVE BONNET AND GENERATOR BEARING. (NORMAL S/D)
3/23(0900) - 3/26(1200)

75-4 : AUTO SCRAM FROM 100% POWER INDUCED BY ROUTINE I&C SURVEILLANCE TEST AND FUSE IN RESET RELAY
4/21(0900) - 4/21(1700)

75-5 : AUTO SCRAM FROM 100% POWER INDUCED BY ROUTINE TURBINE SURVEILLANCE TEST.
5/8(0500) - 5/11(1400)

75-6 : LOSS OF STARTUP TRANSFORMER
6/5(1100) - 6/15(2100)

75-7 : TIP/CHANNEL WEAR INSPECTION
8/7(0100) - 8/29(1300)

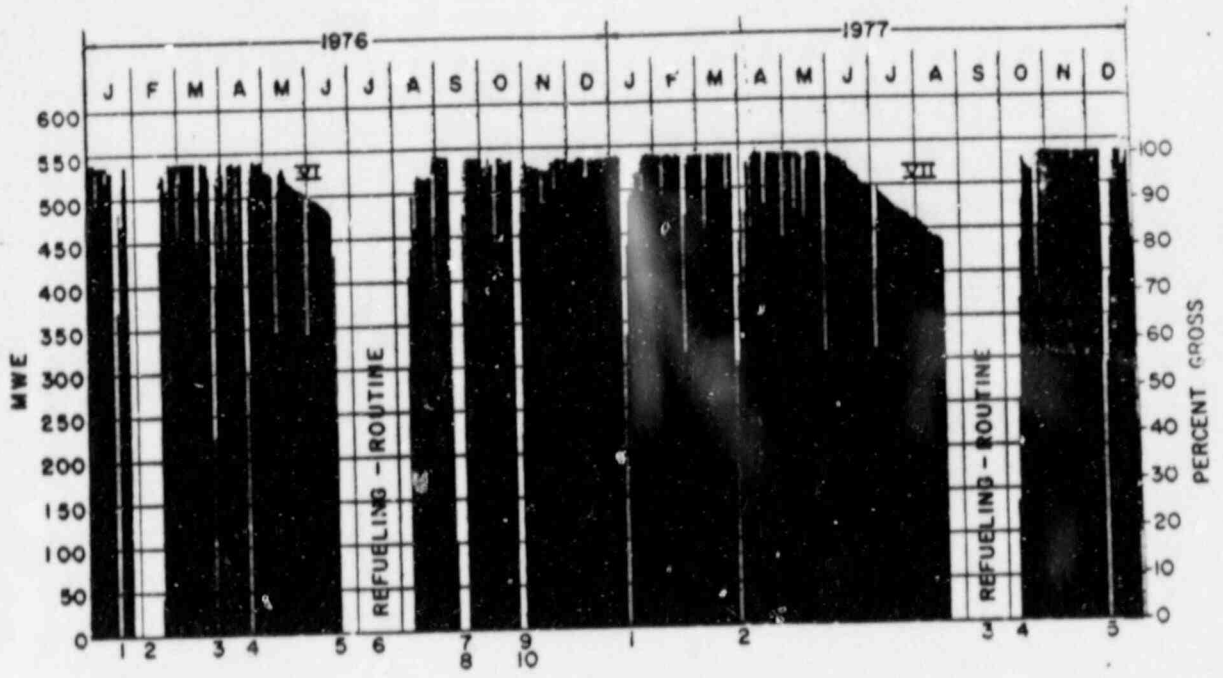
75-8 : REPAIR MOISTURE SEPARATOR DRAIN VALVE
9/7 (0500) - 9/7 (1200)

75-9 : STARTUP TRANSFORMER REPLACEMENT
11/8(2300) - 11/10(1100)

LOAD RESTRICTIONS

IV ADMINISTRATIVE LIMIT - 80% - HIGH OFF GAS

V ADMINISTRATIVE LIMIT - 80% - FUEL CHANNEL VIBRATION



76-1 : CONTROL ROD PATTERN CHANGE
1/16(2300)-1/18(1100)

76-2 : TORUS INTEGRITY EVALUATION
1/27(0001)-2/15(0300)

76-3 : DRY WELL COOLING FAN MAINTENANCE
3/22(0400)-3/23(0600)

76-4 : RESIDUAL HEAT REMOVAL VALVE REPAIR
4/16(0400)-4/18(0600)

76-5 : AUTO SCRAM FROM 88% POWER INDUCED BY REACTOR CONTROL INSTRUMENTATION.
6/16(1400)-6/17(1000)

76-6 : REFUELING OUTAGE II
6/19(0200)-8/7(1900)

76-7 : TURBINE BEARING VIBRATION
9/8(0500)-9/13(2000)

76-8 : RELIEF VALVE SOLENOID POWER SUPPLY GROUNDED
9/14(0000)-9/15(0900)

76-9 : STEAM LEAK (SJAE ROOM)
10/23(0100)-10/24(0700)

76-10 : "B" CLEAN-UP SYSTEM FLOW SWITCH MALFUNCTION
10/25(0400)-10/26(0500)

77-1 : ROD PATTERN CHANGE AND SCHEDULED MAINTENANCE
1/8(0300)-1/9(0900)

77-2 : ROD PATTERN CHANGE, DRYWELL INSPECTION AND STEAM LEAK REPAIR
3/26(0200)-3/27(1600)

77-3 : REFUELING OUTAGE III
8/19(2400)-10/8(1800)

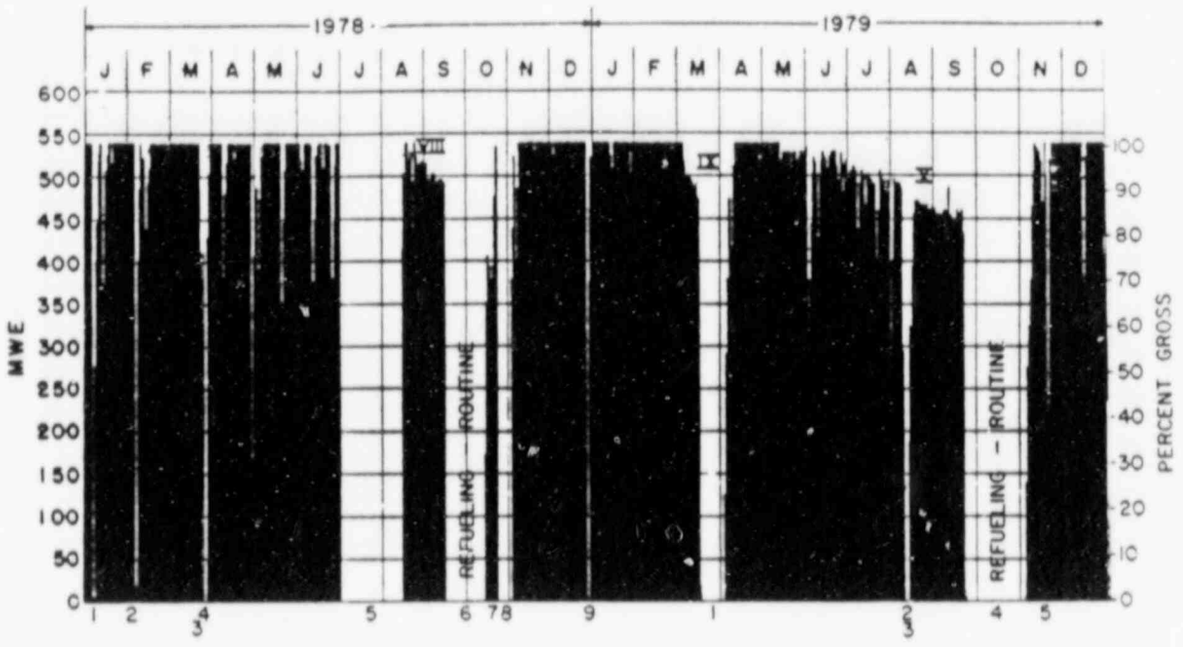
77-4 : AUTO SCRAM FROM 25% POWER INDUCED BY REACTOR INSTRUMENTATION
10/9(1200)-10/9(2400)

77-5 : ROD PATTERN CHANGE AND DRY WELL MAINTENANCE
12/10(0100)-12/11(1400)

LOAD RESTRICTIONS

VI FUEL COAST - DOWN

VII FUEL COAST DOWN



78-1 : STEAM LEAK IN MOISTURE SEPARATOR
1/6(1200)-1/7(1300)

78-2 : AUTO SCRAM INDUCED BY INSPECTION BULLETIN COMPLIANCE
2/3(1400)-2/4(0300)

78-3 : AUTO SCRAM INDUCED BY INSTRUMENT SURVEILLANCE TEST
3/21(1000)-3/21(2100)

78-4 : RECIRC PUMP OIL COOLER LEAK
3/23(0100)-3/26(1000)

78-5 : TORUS SUPPORT MODIFICATION AND SURFACE CRACK REPAIRS
7/1(2300)-8/14(0900)

78-6 : REFUELING OUTAGE IV
9/16(0200)-10/13(1500)

78-7 : AUTO SCRAM INDUCED BY RECIRC PUMP OVERSPEED
10/18(0100)-10/19(0300)

78-8 : TURBINE BEARING OVERHEAT
10/23(0100)-11/1(1300)

78-9 : AUTO SCRAM INDUCED BY MSIV SURVEILLANCE TEST
12/25(1700)-12/26(1200)

79-1 : CORE RECONSTITION
3/16(0222)-4/3(1625)

79-2 : "A" RECIRC PUMP DISCHARGE VALVE MAINTENANCE
8/10(1700)-8/14(1003)

79-3 : AUTO SCRAM INDUCED BY EPR INSTRUMENTATION INSTABILITY
8/14(1803)-8/15(0727)

79-4 : REFUELING OUTAGE V
9/22(0113)-11/3(2143)

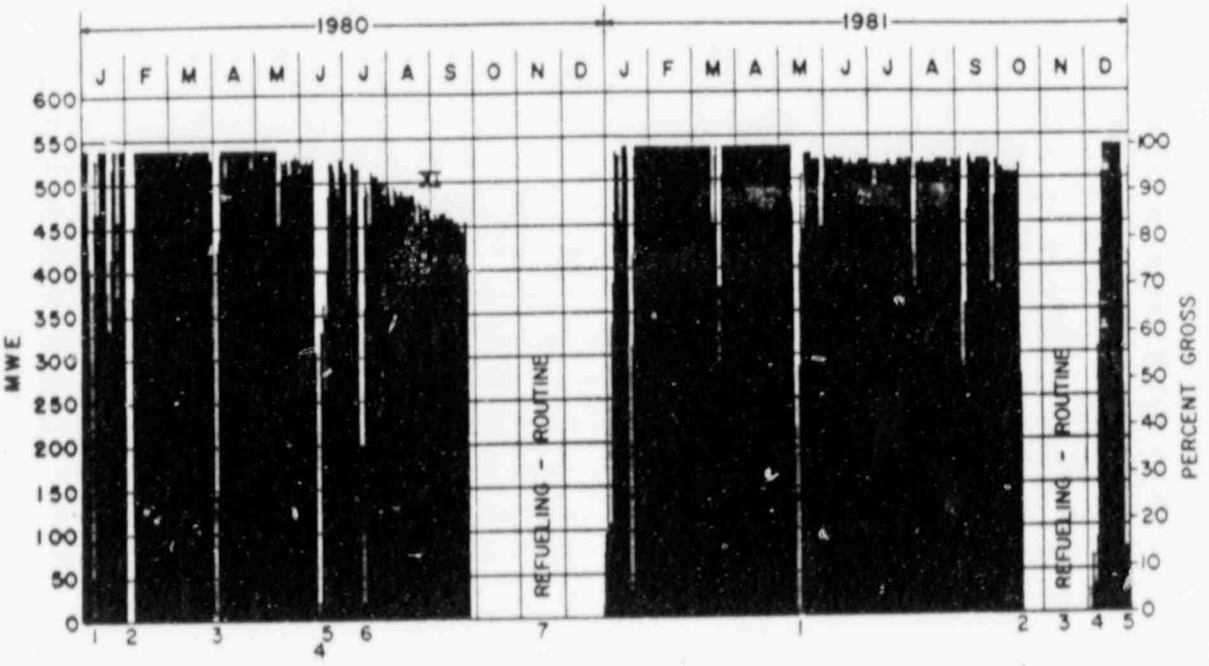
79-5 : AUTO SCRAM INDUCED BY REACTOR INSTRUMENT PANEL VIBRATION
11/19(2201)-11/20(1102)

LOAD RESTRICTIONS

VIII FUEL COAST DOWN

IX ADMINISTRATIVE LIMIT - 90%- FUEL CLADDING PERFORATIONS

X FUEL COAST DOWN



80-1: RHR VALVE PACKING MAINTENANCE (DRYWELL)
1/5(0915)-1/6(1221)

80-2: NRC NUREG-0578 MODIFICATIONS
1/31(1709)-2/4(2332)

80-3: MAIN TURBINE STEAM SEAL REGULATOR LEAK
3/31(0126)-4/2(1222)

80-4: FEED WATER CHECK VALVE LEAK
6/11(1710)-6/13(2043)

80-5: AUTO SCRAM CAUSED BY TURBINE TRIP DUE TO HIGH WATER LEVEL IN MOISTURE SEPARATOR DRAIN TANK
6/17(1401)-6/17(2231)

80-6: "B" RECIRC PUMP DISCHARGE BYPASS VALVE LEAK AND CONTROL ROD DRIVE SYSTEM TEST
7/12(1125)-7/13(1736)

80-7: REFUELING OUTAGE VI
9/26(2334)-12/28(1948)

81-1: BLOWN FUSE IN REACTOR PROTECTION SYSTEM
5/11(1002)-5/13(0335)

81-2: AUTO SCRAM DUE TO MPR MALFUNCTION
10/16(1250)-10/16(2400)

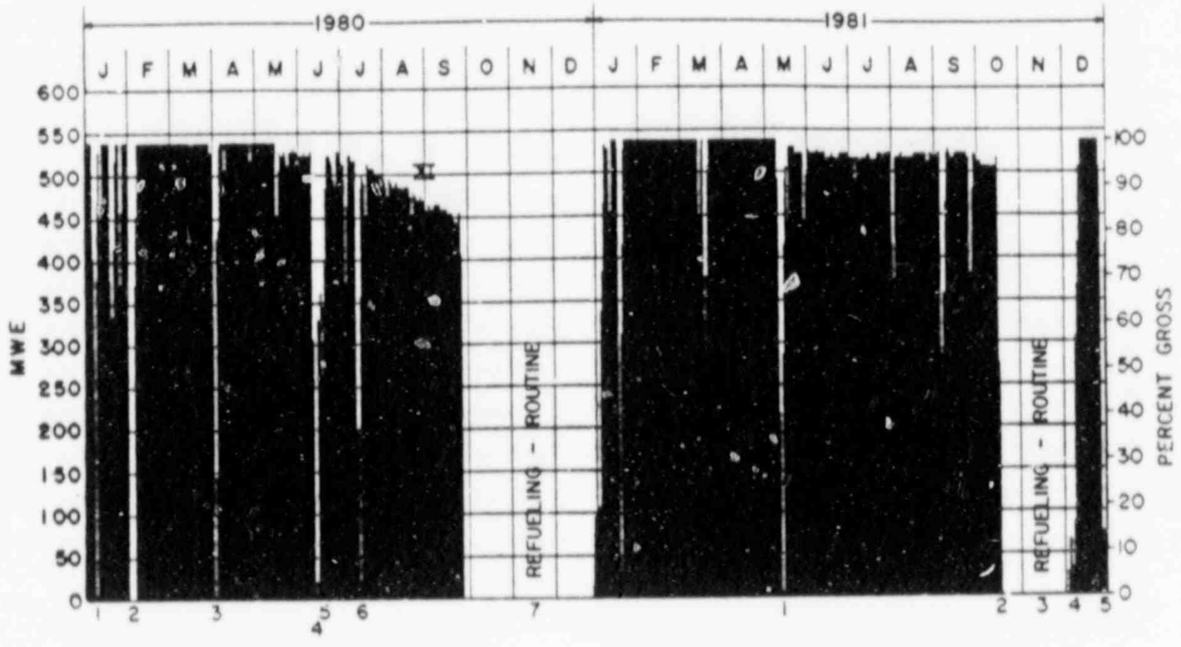
81-3: REFUELING OUTAGE VII
10/17(0001)-12/4(1333)

81-4: RECIRC PUMP SEAL LEAK
12/5(0220)-12/7(1114)

81-5: AUTO SCRAM DUE TO MAIN TURBINE PRESSURE REGULATOR MALFUNCTION
12/26(1944)-12/27(2035)

LOAD RESTRICTIONS

XI FUEL COAST DOWN



80 - 1: RHR VALVE PACKING MAINTENANCE (DRYWELL) 1/5(0915) - 1/6(1221)

80 - 2: NRC NUREG - 0578 MODIFICATIONS 1/31(1709) - 2/4(2332)

80 - 3: MAIN TURBINE STEAM SEAL REGULATOR LEAK 3/31(0126) - 4/2(1222)

80 - 4: FEED WATER CHECK VALVE LEAK 6/11(1710) - 6/13(2043)

80 - 5: AUTO SCRAM CAUSED BY TURBINE TRIP DUE TO HIGH WATER LEVEL IN MOISTURE SEPARATOR DRAIN TANK 6/17(1401) - 6/17(2231)

80 - 6: "B" RECIRC PUMP DISCHARGE BYPASS VALVE LEAK AND CONTROL ROD DRIVE SYSTEM TEST 7/12(1125) - 7/13(1736)

80 - 7: REFUELING OUTAGE XI 9/26(2334) - 12/28(1948)

81 - 1: BLOWN FUSE IN REACTOR PROTECTION SYSTEM 5/11(1002) - 5/13(0335)

81 - 2: AUTO SCRAM DUE TO MPR MALFUNCTION 10/16(1250) - 10/16(2400)

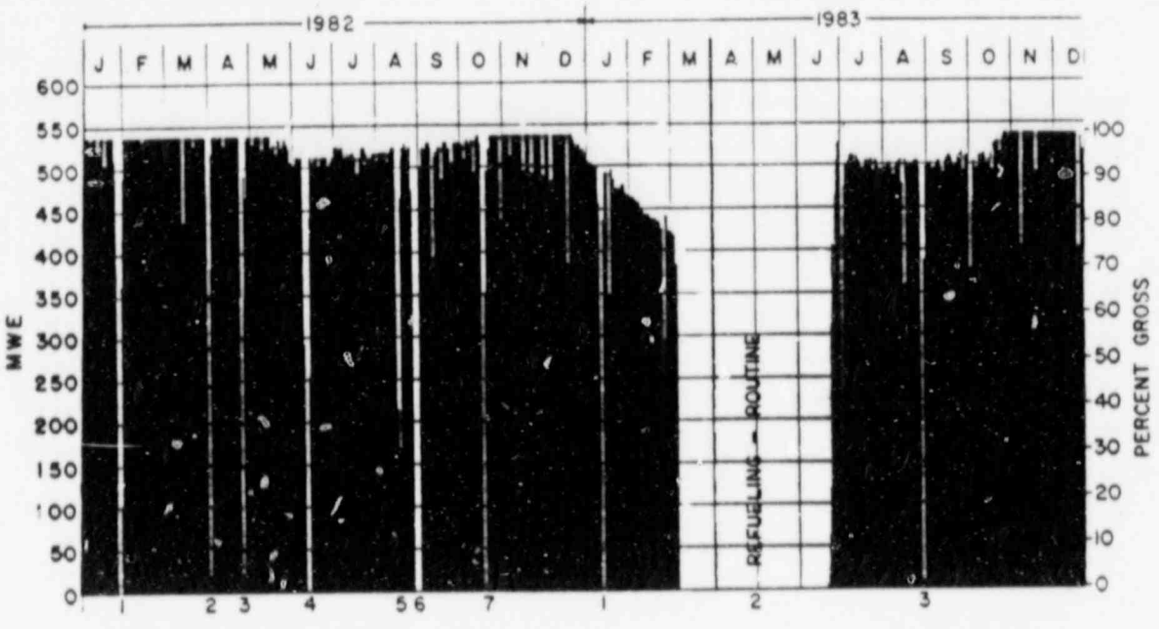
81 - 3: REFUELING OUTAGE XII 10/17(0001) - 12/4(1333)

81 - 4: RECIRC PUMP SEAL LEAK 12/5(0220) - 12/7(1114)

81 - 5: AUTO SCRAM DUE TO MAIN TURBINE PRESSURE REGULATOR MALFUNCTION 12/26(1944) - 12/27(2035)

LOAD RESTRICTIONS

XI FUEL COAST DOWN



82 - 1: MOISTURE SEPARATOR DRAIN LINE REPAIR 1/26(0142)-1/28(1129)

82 - 2: AUTO SCRAM DUE TO HIGH NEUTRON FLUX 3/30(2040)-3/31(2040)

82 - 3: AUTO SCRAM ON LOW REACTOR VESSEL LEVEL DUE TO A FEED WATER CONTROL SYSTEM MALFUNCTION 4/24(0059)-4/24(2315)

82 - 4: DRYWELL FAN REPAIR 6/8(1658)-6/11(0355)

82 - 5: AUTO SCRAM DUE TO MANUAL PRESSURE REGULATOR MALFUNCTION 8/15(1030)-8/16(0843)

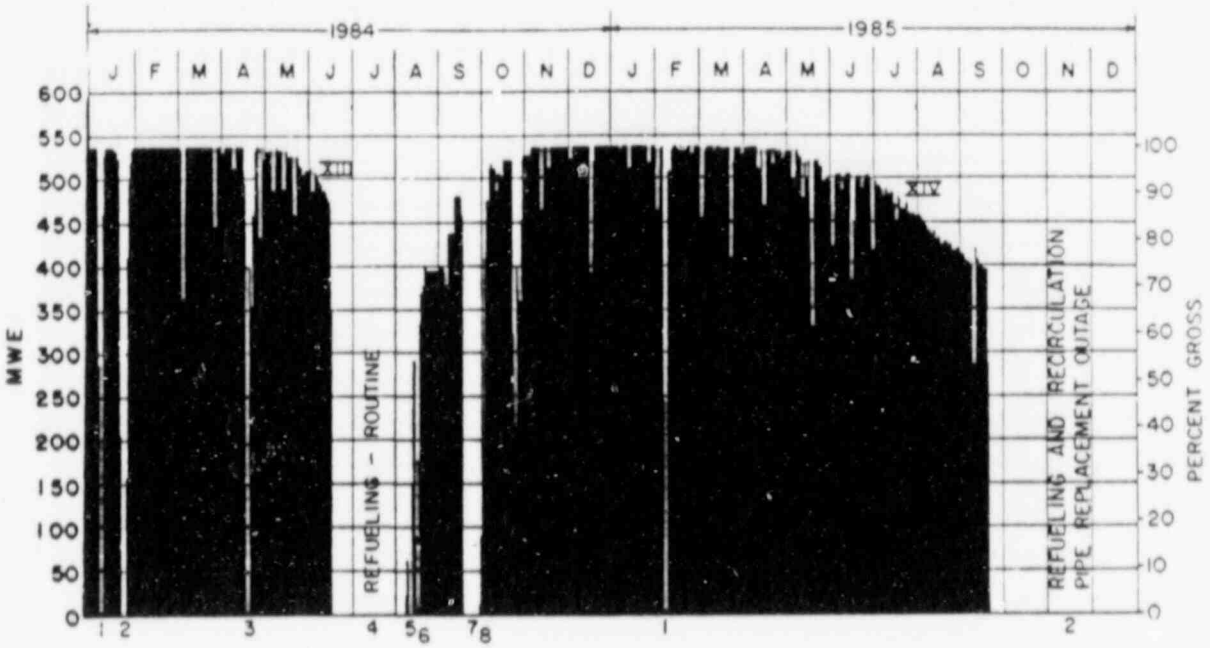
82 - 6: RECIRC PUMP SEAL REPLACEMENT 8/27(2337)-9/1(0132)

82 - 7: MAIN TURBINE MOISTURE SERARATOR STEAM LEAK KO/14(0311)-10/16(2331)

83 - 1: MANUAL SHUTDOWN TO REPAIR STEAM LEAK IN MOISTURE SEPARATOR DRAIN LINE PIPING 1/8(0413)-1/10(0901)

83 - 2: REFULEING OUTAGE 3/5(0000)-6/19(0501)

83 - 3: AUTO SCRAM FROM 93% POWER HIGH VESSEL WATER LEVEL - OPERATOR ERROR WHEN GOING FROM AUTO TO MANUAL FEEDWATER CONTROL 8/27(0030)-8/28(1243)



84 - 1: AUTO SCRAM FROM FULL POWER-PRESSURE SPIKE ON TURBINE CONTROL SYS. 1/5(1252)-1/7(0514)

84 - 2: MANUAL SHUTDOWN TO REPLACE EXPANSION JOINT ON MAIN CONDENSER 1/10(1258)-1/24(0955)

84 - 3: AUTO SCRAM INADVERTENT MSIV CLOSURE 4/16(0742)-4/17(0102)

84 - 4: REFUELING OUTAGE 6/15(2149)-8/9(0118)

84 - 5: MANUAL SHUTDOWN INBOARD MSIV POSITION INDICATION PROBLEM 8/9(2216)-8/12(0554)

84 - 6: MANUAL SHUTDOWN HIGH CONDUCTIVITY CONDENSER TUBE LEAK 8/14(1232)-8/15(1940)

84 - 7: MANUAL SHUTDOWN TO INVESTIGATE STEAM CARRY UNDER CONDITION IN REACTOR VESSEL 9/18(0518)-9/29(0921)

84 - 8: MANUAL SHUTDOWN TO INVESTIGATE MSIV TIMING PROBLEMS 9/30(1500)-10/2(0921)

85 - 1: AUTO SCRAM CAUSED BY TURBINE TRIP INITIATED BY FAULTY CORE SPRAY TEST SWITCH 2/6(1104)-2/7(0731)

85 - 2: REFUELING OUTAGE X AND RECIRCULATION PIPE REPLACEMENT EFFORT 9/20(2144)-7/5/86

LOAD RESTRICTIONS

XIII FUEL COAST DOWN
XIV FUEL COAST DOWN

VERMONT YANKEE NUCLEAR POWER CORPORATION
Average Cost of Net Power Generated
Since date of Commercial Operation November 30, 1972

Period	Net KWH	Cost	Mills per Net KWH	Cum. Mills per Net KWH
1972	176,029,830	3,754,342	21.33	
1973	1,814,375,000	48,077,127	26.50	
Cum.	1,990,404,830	51,831,469		26.04
1974	2,482,564,000	51,019,038	20.55	
Cum.	4,472,968,830	102,850,507		22.99
1975	3,561,206,000	56,493,212	15.86	
Cum.	8,034,174,830	159,343,719		19.83
1976	3,260,016,000	53,014,861	16.26	
Cum.	11,294,190,830	212,358,580		18.80
1977	3,537,675,000	61,111,795	17.27	
Cum.	14,831,865,830	273,470,375		18.44
1978	3,240,697,000	61,637,509	19.02	
Cum.	18,072,562,830	335,107,884		18.54
1979	3,448,842,000	65,981,810	19.13	
Cum.	21,521,404,830	401,089,694		18.64
1980	2,979,214,000	78,339,803	26.30	
Cum.	24,500,618,830	479,429,497		19.57
1981	3,568,707,000	88,170,620	24.71	
Cum.	28,069,325,830	567,600,117		20.22
1982	4,174,255,000	106,256,013	25.46	
Cum.	32,243,580,830	673,856,130		20.90
1983	2,874,475,000	113,069,705	39.34	
Cum	35,118,055,830	786,925,835		22.41
1984	3,335,832,000	117,008,959	35.08	
Cum.	38,453,887,830	903,934,794		23.51
1985	2,999,402,000	118,867,577	39.63	
Cum.	41,453,289,830	1,022,802,371		24.67
1986	2,058,426,000	126,878,055	61.64	
Cum.	43,511,715,830	1,149,680,426		26.42

Reconciliation of Generation reported by Treasury Department with
Generation reported by Operating Department
Cumulative through December 31, 1985

Generation reported by Operating Department (1)	43,758,676,000 KWH
Generation reported by Treasury Department (2)	43,511,715,830 KWH
Difference	246,960,170

Reasons for Difference:

Generation prior to commercial operation date included in Operation Department total but not in Treasury Department	
Total	246,960,570
1972 generation rounded to nearest thousand by Operation Department but not by Treasury Department	(400)
Total	246,960,170

(1) N.R.C. Monthly Statistical Report
(2) See File Folder No. 73

GJM 2/3/87

Appendix F

Vermont Yankee Operating
Expense Projections

SCENARIO: 1987 SHUTDOWN WITH CONDEMNATION PAYMENT FOR THE TAKING OF AN ASSET

ASSUMPTIONS

- Base O & M, Operating Projects, YNSD reduced to the following percentages of 1987 expenses adjusted for inflation

Year	Percent 1987 Expense
1988	75%
1989	50%
1990-2003	25%

- Shutdown Expenses eliminated after 1987
- Spent Fuel is not shipped until 2003
- Variable and Fixed Expenses (except for Insurance and Decommissioning) eliminated
- Insurance reduced to 25% of 1987 level adjusted for inflation, 0 after 2003
- Decommissioning - same as Base Case
- Capital Expenditures taper off beginning in 1988 to the following levels adjusted for inflation

Year	Percent 1987 Expense
1988	75%
1989	50%
1990	35%
1991	15%
1992-on	0%

Reference

Information and assumptions supplied to the Department by William J. Daley in letters dated November 6, 1987 and November 19, 1987.

VERMONT YANKEE NUCLEAR POWER CORPORATION
LONG RANGE FINANCIAL PLANNING MODEL: 2007 SHUTDOWN SCENARIO

INCOME STATEMENT

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CURRENT YEAR	2000	2001	2002	2003	2004	2005	2006	2007
BASE OPERATING EXPENSE	76,620	81,570	86,864	92,504	98,534	104,973	111,848	119,190
OPERATING PROJECTS	14,707	15,356	16,453	17,403	18,407	19,469	20,592	21,781
SHUTDOWN PROJECTS	1,777	26,858	28,408	2,103	31,781	776	11,733	869
TOTAL DIRECT EXPENSES	93,112	123,992	131,725	112,014	148,724	125,219	144,173	141,840
NMSB	14,846	15,782	16,648	17,567	18,580	19,652	20,786	21,986
INTEREST	11,507	11,483	11,805	11,648	11,221	10,785	8,610	3,360
PROPERTY TAX	3,706	3,630	3,544	3,261	3,009	2,705	1,714	0
INSURANCE	9,998	10,575	11,185	11,830	12,513	13,235	13,999	14,806
VT USE TAX/ACCRUALS	634	664	697	731	768	806	847	890
NYSERC	(1,730)	(1,767)	(1,816)	(1,895)	(1,968)	(2,119)	0	0
TOTAL VARIABLE EXPENSES	24,115	24,585	25,415	25,575	25,522	25,412	25,170	19,077
DEPRECIATION	19,158	21,234	23,796	26,243	28,419	30,390	32,137	50,695
FINAL DAY AMORT	1,213	1,370	1,563	1,808	2,133	2,590	3,306	4,851
DECOMMISSIONING	13,756	14,719	15,750	16,852	18,032	19,294	20,645	22,090
INCOME TAXES	4,706	4,703	4,700	4,693	4,690	[illegible]	5,491	5,771
NET INCOME	9,015	9,015	9,015	9,015	9,015	9,015	9,015	9,015
TOTAL FIXED EXPENSES	47,848	51,041	54,824	58,611	62,288	66,181	71,604	92,422
TOTAL CAPACITY	179,921	215,321	220,572	213,768	255,114	236,464	261,734	275,324
FUEL	42,337	36,720	37,580	45,229	39,491	40,366	48,675	42,011
TOTAL OPERATING EXPENSE	222,258	252,049	264,152	258,984	294,606	276,831	310,409	318,335
COST PER KWH (CENTS/KWH):								
TOTAL	5.40	7.25	7.66	6.31	8.45	7.96	7.56	9.16
CAPACITY	4.37	6.19	6.58	5.21	7.32	6.80	6.37	7.92
FUEL	1.03	1.06	1.08	1.10	1.13	1.16	1.19	1.24
THREE YEAR MOVING AVG	6.14	6.43	6.77	7.07	7.47	7.57	7.79	8.23
CUMULATIVE CENTS PER KWH	4.86	5.01	5.17	5.24	5.41	5.54	5.65	5.81
NET KWH GENERATION	4,117	3,476	3,476	4,106	3,486	3,476	4,106	3,476
PER CAPACITY FACTOR	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%	91.19%	77.20%
VERMONT YANKEE MARKET VALUE CALCULATIONS:								
REPLACEMENT POWER COST PER KWH	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
VY POWER COST PER KWH	5.40	7.25	7.66	6.31	8.45	7.96	7.56	9.16
COST PER KWH DIFFERENCE	2.60	0.75	0.34	1.69	(0.45)	0.04	0.44	(1.16)
ANNUAL NET GENERATION (KWH 000)	4,117	3,476	3,476	4,106	3,486	3,476	4,106	3,476
POWER COST DIFFERENCE	107,121	26,033	11,930	69,491	(15,761)	1,252	18,070	(40,252)
DISCOUNTED POWER COST DIFFERENCE	22,122	4,762	1,933	9,972	(2,003)	141	1,802	(3,555)
PRESENT VALUE OF POWER COST DIFFERENCE	35,173	13,051	8,289	6,356	(3,616)	(1,612)	(1,753)	(3,555)
DISCOUNT RATE	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%

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VERMONT YANKEE NUCLEAR POWER CORPORATION
LONG RANGE FINANCIAL PLANNING MODEL: 2007 SHUTDOWN SCENARIO

INCOME STATEMENT

CURRENT YEAR

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BASE OPERATING EXPENSE	30,622	35,099	37,520	40,295	42,971	45,719	48,653	52,054	55,646	59,503	63,562	67,849	71,991
OPERATING PROJECTS	7,248	5,937	7,973	8,393	8,877	9,389	9,931	10,504	11,110	11,751	12,429	13,146	13,905
SHUTDOWN PROJECTS	12,514	919	12,765	14,491	1,873	16,211	17,146	1,270	19,182	29,289	1,562	22,698	24,008
TOTAL DIRECT EXPENSES	50,384	41,964	58,258	63,279	52,921	71,320	75,730	63,827	85,938	91,544	77,513	103,693	109,904
NFSD	8,003	9,060	9,317	9,574	9,832	10,089	10,346	10,603	11,215	11,862	12,546	13,270	14,036
INTEREST	12,827	12,523	12,629	12,876	12,868	12,565	12,348	12,349	12,729	12,622	12,364	11,890	11,496
PROPERTY TAX	6,421	6,717	6,645	6,953	6,791	6,141	6,037	3,922	3,525	3,699	3,427	3,260	3,688
INSURANCE	6,503	5,170	5,429	5,705	6,035	6,383	6,751	7,141	7,553	7,988	8,449	8,937	9,453
NY USE TAX/ACCRUALS	263	376	389	405	622	641	460	481	503	525	551	577	605
AFUDC	(1,781)	(1,383)	(1,389)	(1,418)	(1,441)	(1,456)	(1,467)	(1,508)	(1,525)	(1,572)	(1,612)	(1,656)	(1,693)
TOTAL VARIABLE EXPENSES	29,314	23,403	23,743	24,467	24,195	24,093	24,315	22,585	23,185	23,464	23,179	23,007	23,948
DEPRECIATION	15,256	14,636	14,748	14,968	15,340	15,312	16,873	16,752	17,353	18,670	19,528	20,759	19,660
FUEL INV AMORT	600	440	465	496	532	574	629	673	734	803	862	975	1,804
DECOMMISSIONING	6,648	6,108	6,505	6,952	7,443	8,006	8,564	9,144	9,808	10,695	11,229	12,015	12,856
INCOME TAXES	6,607	6,275	6,221	6,163	5,819	4,964	4,905	4,846	4,787	4,715	4,717	4,716	4,710
NET INCOME	9,784	9,659	9,577	9,495	9,413	9,330	9,248	9,144	9,083	9,001	9,001	9,013	9,013
TOTAL FIXED EXPENSES	36,753	35,118	35,539	36,115	37,787	38,383	39,413	40,603	41,964	43,695	45,358	47,479	47,543
TOTAL CAPACITY	116,256	107,547	125,856	131,835	122,736	141,887	147,804	137,619	162,322	170,364	158,596	187,251	195,432
FUEL	26,123	32,429	23,546	26,003	29,391	26,160	26,711	33,130	30,057	30,701	29,490	34,330	35,107
TOTAL OPERATING EXPENSE	142,379	139,986	149,402	157,838	152,126	168,047	174,515	170,749	192,380	201,065	188,086	221,581	230,539
COST PER KWH (CENTS/KWH):													
TOTAL	4.08	3.60	4.30	4.52	3.70	4.82	5.02	4.16	5.53	5.77	4.82	6.37	6.63
CAPACITY	3.33	2.61	3.62	3.77	2.99	4.07	4.25	3.35	4.67	4.89	3.86	5.39	5.62
FUEL	0.75	0.79	0.68	0.75	0.72	0.75	0.77	0.81	0.86	0.88	0.96	0.99	1.01
THREE YEAR MOVING AVG	4.78	4.53	3.93	4.07	4.17	4.35	4.52	4.67	4.90	5.13	5.38	5.66	5.94
CUMULATIVE CENTS PER KWH	4.46	3.71	3.90	4.04	3.97	4.10	4.23	4.22	4.36	4.49	4.52	4.67	4.81
NET KWH GENERATION	3,489	4,117	3,476	3,476	4,106	3,486	3,476	4,106	3,476	3,486	4,106	3,476	3,476
NER CAPACITY FACTOR	77.48%	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%
VERMONT YANKEE MARKET VALUE CALCULATIONS:													
REPLACEMENT POWER COST PER KWH	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
VY POWER COST PER KWH	4.08	3.60	4.30	4.52	3.70	4.82	5.02	4.16	5.53	5.77	4.82	6.37	6.63
COST PER KWH DIFFERENCE	3.92	4.40	3.70	3.48	4.30	3.18	2.98	3.84	2.47	2.23	3.18	1.63	1.37
ANNUAL NET GENERATION (MWH 000)	3,489	4,117	3,476	3,476	4,106	3,486	3,476	4,106	3,476	3,486	4,106	3,476	3,476
POWER COST DIFFERENCE	136,729	180,793	128,680	121,044	176,353	110,797	103,568	157,730	85,782	77,779	130,373	56,501	47,543
DISCOUNTED POWER COST DIFFERENCE	136,729	167,752	100,953	84,111	108,543	60,401	50,005	67,459	32,466	26,997	38,752	14,873	11,985
PRESENT VALUE OF POWER COST DIFFERENCE	934,484	797,675	629,923	528,970	444,859	336,316	275,914	225,905	158,446	125,981	99,683	61,131	46,258
DISCOUNT RATE	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%

VERMONT YANKEE NUCLEAR POWER CORPORATION
LONG RANGE FINANCIAL PLANNING MODEL
1987 SHUTDOWN SCENARIO WITH CONDEMNATION PAYMENT

INCOME STATEMENT

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CURRENT YEAR	2000	2001	2002	2003	2004	2005	2006	2007
BASE OPERATING EXPENSE	13,967	14,772	15,625	16,526	0	0	0	0
OPERATING PROJECTS	3,677	3,889	4,113	4,351	0	0	0	0
SHUTDOWN PROJECTS	0	0	0	0	0	0	0	0
TOTAL DIRECT EXPENSES	17,643	18,662	19,738	20,877	0	0	0	0
TMSD	4,466	4,723	4,996	5,284	0	0	0	0
INTEREST	0	0	0	0	0	0	0	0
PROPERTY TAX	0	0	0	0	0	0	0	0
INSURANCE	2,284	2,416	2,556	2,703	0	0	0	0
VT USE TAX/ACCRUALS	0	0	0	0	0	0	0	0
AFUDC	0	0	0	0	0	0	0	0
TOTAL VARIABLE EXPENSES	2,284	2,416	2,556	2,703	0	0	0	0
DEPRECIATION	0	0	0	0	0	0	0	0
FINAL INV WORT	0	0	0	0	0	0	0	0
DECOMMISSIONING	13,756	14,719	15,750	16,852	18,032	19,294	20,645	22,090
INCOME TAXES	0	0	0	0	0	0	0	0
NET INCOME	0	0	0	0	0	0	0	0
TOTAL FIXED EXPENSES	13,756	14,719	15,750	16,852	18,032	19,294	20,645	22,090
TOTAL CAPACITY	38,149	40,520	43,040	45,716	48,032	19,294	20,645	22,090
FUEL	812	812	812	812	812	812	812	812
TOTAL OPERATING EXPENSE	38,961	41,332	43,852	46,528	48,844	20,106	21,457	22,902
COST PER KWH (CENTS/KWH)								
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAPACITY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FUEL	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THREE YEAR MOVING AVG	0.00	9.00	0.00	0.00	20.34	29.91	21.53	22.19
CUMULATIVE CENTS PER KWH	14.02	17.21	18.46	19.00	0	0	0	0
NET KWH GENERATION	0	0	0	0	0	0	0	0
PER CAPACITY FACTOR	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

NOTE: THIS DATA WAS GENERATED IN SUPPORT OF VERMONT YANKEE'S REPORT TO THE DEPARTMENT OF PUBLIC SERVICE ON HB 173. THE EXPENSE SUMMARY ABOVE ASSUMES THAT A LUMP SUM PAYMENT WOULD BE MADE TO VERMONT YANKEE'S OWNERS IN THE EVENT OF A SHUTDOWN MANDATED BY STATE ACTION. HENCE, THE EXPENSES CONSIDER THE COST OF OPERATION OF THE PLANT BY THE STATE ONCE IT IS "PURCHASED" FROM THE JOINT OWNERS.

VERMONT YANKEE NUCLEAR POWER CORPORATION
LONG RANGE FINANCIAL PLANNING MODEL: 2007 SHUTDOWN SCENARIO

INCOME STATEMENT

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CURRENT YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BASE OPERATING EXPENSE	30,622	35,109	37,520	40,395	42,971	45,719	48,653	52,054	55,644	59,503	63,562	67,649	71,991
OPERATING PROJECTS	7,248	5,937	7,973	8,393	8,877	9,369	9,931	10,564	11,110	11,751	12,429	13,146	13,905
SHUTDOWN PROJECTS	12,514	919	13,765	14,491	1,073	16,211	17,146	1,270	19,142	20,289	1,535	22,698	24,008
TOTAL DIRECT EXPENSES	50,384	41,964	59,258	63,279	52,921	71,329	75,730	63,827	85,956	91,544	77,513	103,493	109,904
TVSD	8,803	9,060	9,317	9,574	9,832	10,089	10,346	10,603	11,215	11,862	12,546	13,270	14,036
INTEREST	12,827	12,523	12,639	12,874	12,848	12,565	12,548	12,549	12,735	12,822	12,364	11,890	11,696
PROPERTY TAX	4,421	4,717	4,585	4,493	4,291	4,161	4,037	3,922	3,925	3,699	3,427	3,260	3,868
INSURANCE	4,503	5,170	5,429	5,705	6,035	6,383	6,751	7,141	7,553	7,988	8,449	8,937	9,453
VY USE TAX/ACCRUALS	263	276	389	485	622	441	460	481	503	526	551	577	605
AFUDC	(1,701)	(1,383)	(1,389)	(1,410)	(1,441)	(1,456)	(1,462)	(1,508)	(1,535)	(1,572)	(1,612)	(1,656)	(1,693)
TOTAL VARIABLE EXPENSES	29,314	21,403	21,743	22,067	22,195	22,093	22,315	22,585	23,185	23,464	23,179	23,007	23,948
DEPRECIATION	15,356	14,636	14,740	14,968	15,340	15,512	16,073	16,752	17,553	18,470	19,528	20,759	19,880
FUEL INV AMORT	488	448	465	496	532	574	629	673	734	803	882	975	1,084
DECOMMISSIONING	4,648	6,108	6,335	6,593	7,483	8,006	8,564	9,164	9,808	10,495	11,229	12,015	12,856
INCOME TAXES	6,607	6,275	6,221	6,163	5,819	4,964	4,903	4,846	4,787	4,726	4,717	4,716	4,710
NET INCOME	9,784	8,659	9,577	9,495	9,413	9,330	9,248	9,164	9,083	9,001	9,001	9,015	9,013
TOTAL FIXED EXPENSES	36,755	35,118	35,329	36,115	37,787	38,385	39,413	40,603	41,964	43,495	45,358	47,479	47,545
TOTAL CAPACITY	116,256	107,347	125,856	131,935	122,734	141,807	147,804	137,619	162,323	170,364	158,596	187,251	195,432
FUEL	25,123	32,429	23,546	25,903	29,391	26,168	26,711	33,130	30,057	30,701	39,490	34,330	35,107
TOTAL OPERATING EXPENSE	142,379	139,776	149,402	157,838	152,124	168,047	174,515	170,749	192,380	201,065	198,086	221,581	230,539
COST PER KWH (CENTS/KWH):													
TOTAL	4.08	3.40	4.30	4.52	3.70	4.82	5.02	4.16	5.53	5.77	4.82	6.37	6.63
CAPACITY	3.33	2.61	3.62	3.77	2.99	4.07	4.25	3.35	4.67	4.89	3.86	5.39	5.62
FUEL	0.75	0.79	0.68	0.75	0.72	0.75	0.77	0.81	0.86	0.88	0.96	0.99	1.01
THREE YEAR MOVING AVG	4.72	4.33	3.93	4.07	4.17	4.25	4.52	4.67	4.90	5.13	5.38	5.66	5.94
CUMULATIVE CENTS PER KWH	4.06	3.71	3.90	4.04	3.97	4.10	4.23	4.22	4.36	4.49	4.52	4.67	4.81
NET KWH GENERATION	3,489	4,117	3,476	3,476	4,106	3,486	3,476	4,106	3,476	3,486	4,106	3,476	3,476
PER CAPACITY FACTOR	77.48%	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%	91.19%	77.20%	77.20%
VERMONT YANKEE MARKET VALUE CALCULATIONS:													
REPLACEMENT POWER COST PER KWH	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
VY POWER COST PER KWH	4.08	3.40	4.30	4.52	3.70	4.82	5.02	4.16	5.53	5.77	4.82	6.37	6.63
COST PER KWH DIFFERENCE	3.92	4.60	3.70	3.48	4.30	3.18	2.98	3.84	2.47	2.23	3.18	1.63	1.37
ANNUAL NET GENERATION (KWH 000)	3,489	4,117	3,476	3,476	4,106	3,486	3,476	4,106	3,476	3,486	4,106	3,476	3,476
POWER COST DIFFERENCE	136,729	189,353	128,680	121,944	176,355	110,797	103,564	157,730	85,782	77,779	130,373	56,501	47,543
DISCOUNTED POWER COST DIFFERENCE	136,729	167,752	100,353	84,111	108,543	60,401	50,009	67,459	32,444	26,097	38,752	14,873	11,085
PRESENT VALUE OF POWER COST DIFFERENCE	934,604	797,875	629,923	529,570	444,859	336,316	275,914	225,905	158,446	125,961	99,843	61,131	44,258
DISCOUNT RATE	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%	12.90%

VERMONT YANKEE NUCLEAR POWER CORPORATION
LONG RANGE FINANCIAL PLANNING MODEL
1987 SHUTDOWN SCENARIO WITH CONDEMNATION PAYMENT

INCOME STATEMENT

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CURRENT YEAR	2000	2001	2002	2003	2004	2005	2006	2007
BASE OPERATING EXPENSE	13,967	14,773	15,625	16,526	0	0	0	0
OPERATING PROJECTS	3,677	3,889	4,113	4,351	0	0	0	0
SHUTDOWN PROJECTS	0	0	0	0	0	0	0	0
TOTAL DIRECT EXPENSES	17,643	18,662	19,738	20,877	0	0	0	0
TMSB	4,446	4,723	4,996	5,284	0	0	0	0
INTEREST	0	0	0	0	0	0	0	0
PROPERTY TAX	0	0	0	0	0	0	0	0
INSURANCE	2,284	2,416	2,554	2,703	0	0	0	0
VT USE TAX/ACCRUALS	0	0	0	0	0	0	0	0
AFUDC	0	0	0	0	0	0	0	0
TOTAL VARIABLE EXPENSES	2,284	2,416	2,554	2,703	0	0	0	0
DEPRECIATION	0	0	0	0	0	0	0	0
FINAL INV ADJ	0	0	0	0	0	0	0	0
DECOMMISSIONING	13,756	14,719	15,750	16,852	18,032	19,294	20,645	22,090
INCOME TAXES	0	0	0	0	0	0	0	0
NET INCOME	0	0	0	0	0	0	0	0
TOTAL FIXED EXPENSES	13,756	14,719	15,750	16,852	18,032	19,294	20,645	22,090
TOTAL CAPACITY	38,149	40,529	43,040	45,716	18,032	19,294	20,645	22,090
FUEL	812	812	812	812	812	812	812	812
TOTAL OPERATING EXPENSE	38,961	41,332	43,852	46,528	18,844	20,106	21,457	22,902
COST PER KWH (CENTS/KWH):								
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAPACITY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FUEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THREE YEAR MOVING AVG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CUMULATIVE CENTS PER KWH	16.02	17.21	18.46	19.80	20.34	20.91	21.53	22.19
NET KWH GENERATION	0	0	0	0	0	0	0	0
PER CAPACITY FACTOR	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

NOTE: THIS DATA WAS GENERATED IN SUPPORT OF VERMONT YANKEE'S REPORT TO THE DEPARTMENT OF PUBLIC SERVICE ON HB 173. THE EXPENSE SUMMARY ABOVE ASSUMES THAT A LUMP SUM PAYMENT WOULD BE MADE TO VERMONT YANKEE'S OWNERS IN THE EVENT OF A SHUTDOWN MANDATED BY STATE ACTION. HENCE, THE EXPENSES CONSIDER THE COST OF OPERATION OF THE PLANT BY THE STATE ONCE IT IS "PURCHASED" FROM THE JOINT OWNERS.

VERMONT YANKEE NUCLEAR POWER CORPORATION
LONG RANGE FINANCIAL PLANNING MODEL
1987 SHUTDOWN SCENARIO WITH CONDEMNATION PAYMENT

INCOME STATEMENT

MODEL YYSD87NP.CMP
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CURRENT YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BASE OPERATING EXPENSE	30,622	24,097	16,842	8,865	9,376	9,917	10,489	9,975	10,551	11,159	11,803	12,484	13,205
OPERATING PROJECTS	7,248	5,703	3,986	2,038	2,219	2,347	2,483	2,626	2,778	2,938	3,107	3,287	3,476
SHUTDOWN PROJECTS	12,514	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DIRECT EXPENSES	50,384	29,800	20,828	10,903	11,595	12,265	12,972	12,601	13,329	14,097	14,911	15,771	16,681
YNSD	8,803	6,527	4,842	2,548	2,695	2,851	3,015	3,189	3,373	3,568	3,774	3,992	4,222
INTEREST	12,827	0	0	0	0	0	0	0	0	0	0	0	0
PROPERTY TAX	4,421	0	0	0	0	0	0	0	0	0	0	0	0
INSURANCE	4,503	1,181	1,238	1,304	1,379	1,450	1,542	1,631	1,726	1,825	1,930	2,042	2,160
NI USE TAX/ACCRUALS	253	0	0	0	0	0	0	0	0	0	0	0	0
AFUDC	(1,701)	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL VARIABLE EXPENSES	20,314	1,181	1,238	1,304	1,379	1,450	1,542	1,631	1,726	1,825	1,930	2,042	2,160
DEPRECIATION	15,256	8,419	0	0	0	0	0	0	0	0	0	0	0
FINAL DAY AMORT	600	0	0	0	0	0	0	0	0	0	0	0	0
DECOMMISSIONING	4,608	6,108	6,535	6,993	7,483	8,006	8,564	9,164	9,808	10,495	11,229	12,015	12,856
INCOME TAXES	6,607	0	0	0	0	0	0	0	0	0	0	0	0
NET INCOME	9,784	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL FIXED EXPENSES	36,750	14,527	6,535	6,993	7,483	8,006	8,564	9,164	9,808	10,495	11,229	12,015	12,856
TOTAL CAPACITY	116,256	52,435	33,443	21,808	23,153	24,580	26,096	26,588	28,235	29,966	31,844	33,820	35,919
FUEL	26,123	812	812	812	812	812	812	812	812	812	812	812	812
TOTAL OPERATING EXPENSE	142,379	53,247	34,255	22,620	23,965	25,392	26,908	27,400	29,047	30,778	32,656	34,632	36,731
COST PER KWH (CENTS/KWH):													
TOTAL	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAPACITY	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FUEL	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THREE YEAR MOVING AVG	4.72	3.40	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CUMULATIVE CENTS PER KWH	4.00	5.61	6.59	7.24	7.92	8.65	9.42	10.21	11.04	11.92	12.86	13.85	14.91
NET MWH GENERATION	3,489	0	0	0	0	0	0	0	0	0	0	0	0
PER CAPACITY FACTOR	77.48%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

NOTE: THIS DATA WAS GENERATED IN SUPPORT OF VERMONT YANKEE'S REPORT TO THE DEPARTMENT OF PUBLIC SERVICE ON NR 173. THE EXPENSE SUMMARY ABOVE ASSUMES THAT A LUMP SUM PAYMENT WOULD BE MADE TO VERMONT YANKEE'S OWNERS IN THE EVENT OF A SHUTDOWN MANDATED BY STATE ACTION. HENCE, NYE EXPENSES CONSIDER THE COST OF OPERATION OF THE PLANT BY THE STATE ONCE IT IS "PURCHASED" FROM THE JOINT OWNERS.

Appendix G

Plant Capacity Factors

APPENDIX G

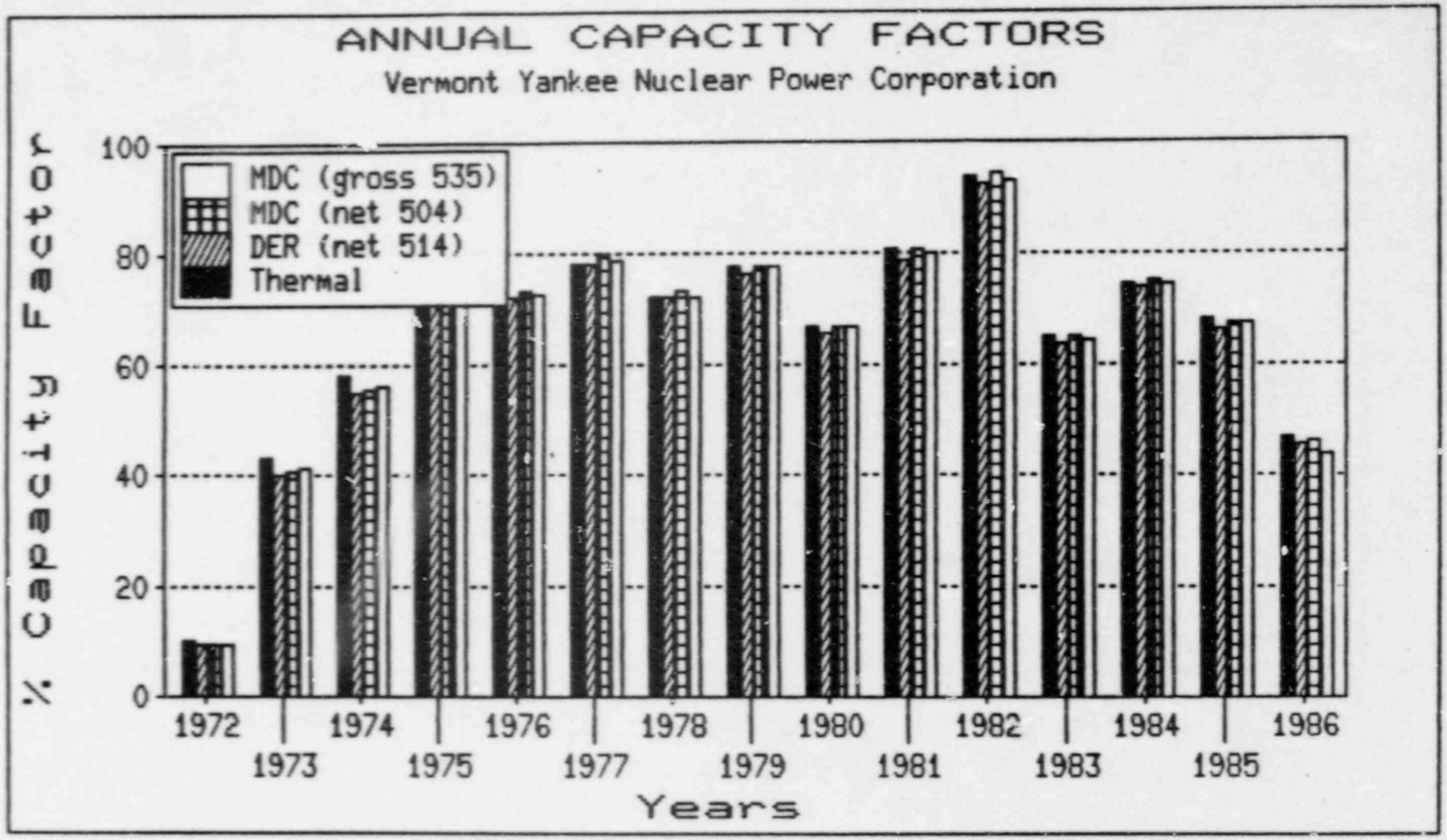
Vermont Yankee Nuclear Power Plant
Plant Capacity Factor

1972 - 1986

Year	Capacity Factor
1972	33.6
1973	40.3
1974	55.1
1975	79.1
1976	72.2
1977	76.6
1978	72.0
1979	76.6
1980	65.9
1981	79.2
1982	94.4
1983	63.8
1984	73.9
1985	66.6
1986	45.7

Plant Capacity Factor shows actual output by a generating station as a percentage of its full potential.

(dps.12/87.co)


ANNUAL CAPACITY FACTORS
Vermont Yankee Nuclear Power Corporation
% Capacity Factor
100
80
60
40
20
0
MDC (gross 535)
MDC (net 504)
DER (net 514)
Thermal
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
Years

Appendix H

Vermont Yankee Ownership

APPENDIX H

Vermont Yankee Nuclear Power Plant

Plant Ownership

Joint Owners	Ownership
Green Mountain Power Corporation	17.88
Central Vermont Public Service Corporation	31.29
New England Power Company	20.00
The Connecticut Light & Power Company	9.50
Public Service Company of New Hampshire	4.00
Central Maine Power Company	4.00
City of Burlington Electric Light Department	3.57
Western Massachusetts Electric Company	2.50
Cambridge Electric Light Company	2.50
Montaup Electric Company	2.50
Vermont Electric Cooperative, Inc.	1.05
Washington Electric Cooperative, Inc.	0.61
Village of Lyndonville, Vermont - Electric Department	0.60
	100.00

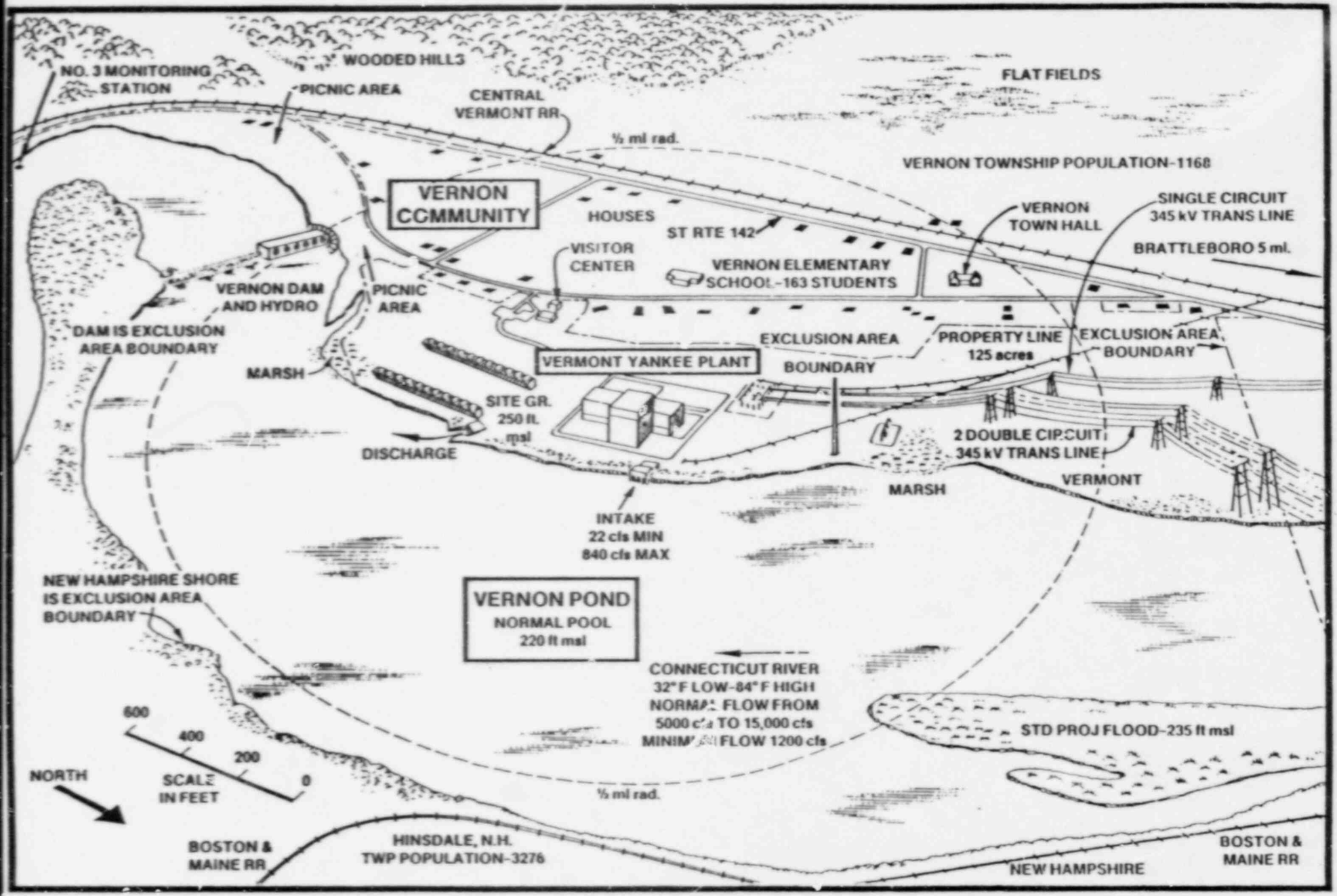
Non-Owners	
Village of Morrisville	0.28
Village of Northfield	0.43
Village of Stowe	0.26
Village of Hardwick	0.11
Village of Orleans	0.24
Rochester Electric Co.	0.06
Allied Power Co.	0.18

Owners of the Yankee plant receive dividends in an equal percentage of plant ownership. Their share of the plant's cost and output is limited to the percentage of ownership. Non-owners are obligated to pay their share of costs and receive their percentage of output but do not receive dividends.

(dps.12/87.co)

Appendix I

Community Surrounding Vermont Yankee


NO. 3 MONITORING STATION
WOODED HILLS
PICNIC AREA
CENTRAL VERMONT RR
½ mi rad.
FLAT FIELDS
VERNON TOWNSHIP POPULATION-1168
VERNON COMMUNITY
HOUSES
ST RTE 142
VERNON TOWN HALL
SINGLE CIRCUIT 345 kV TRANS LINE
BRATTLEBORO 5 mi.
VISITOR CENTER
VERNON ELEMENTARY SCHOOL-163 STUDENTS
VERNON DAM AND HYDRO
PICNIC AREA
DAM IS EXCLUSION AREA BOUNDARY
EXCLUSION AREA BOUNDARY
PROPERTY LINE 125 acres
EXCLUSION AREA BOUNDARY
VERMONT YANKEE PLANT
MARSH
SITE GR. 250 ft. msl
DISCHARGE
2 DOUBLE CIRCUIT 345 kV TRANS LINE
VERMONT
MARSH
INTAKE 22 cfs MIN 840 cfs MAX
NEW HAMPSHIRE SHORE IS EXCLUSION AREA BOUNDARY
VERNON POND
NORMAL POOL 220 ft msl
CONNECTICUT RIVER
32° F LOW-84° F HIGH
NORMAL FLOW FROM 5000 cfs TO 15,000 cfs
MINIMUM FLOW 1200 cfs
STD PROJ FLOOD-235 ft msl
600
400
200
0
SCALE IN FEET
NORTH
½ mi rad.
BOSTON & MAINE RR
HINSDALE, N.H. TWP POPULATION-3276
NEW HAMPSHIRE
BOSTON & MAINE RR