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Maine Yankee Shutdown Assessment: A Report to Governor Joseph E. Brennan

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Executive Department
May 1986

Maine State Planning Office
Maine Office of Energy Resources
Maine Public Advocate



Note: On Wednesday, May 28, 1986, Secretary of Energy John S. Herrington of the U.S. Department of Energy announced that he was suspending indefinitely the search for a second repository site for the nation's high level nuclear waste, thereby eliminating Maine at least temporarily from consideration as a potential site.



STATE OF MAINE
EXECUTIVE DEPARTMENT

JOSEPH E. BRENNAN
GOVERNOR

May 23, 1986

The Honorable Joseph E. Brennan
Governor of Maine
The Blaine House
Augusta, Maine 04333

Dear Governor Brennan,

Maine now faces the difficult and costly choices that the nation deferred in its rush from the 1950's through the 1970's to realize the economic benefits of a civilian nuclear power program. Today, more than forty years into the nuclear era, there is no broad consensus on a technical solution to the nuclear waste disposal problem. In recent weeks, a major nuclear accident has occurred near Chernobyl in the Ukraine, the exact causes, dimensions, and full effects of which are unknown.

In this setting, you have asked us to respond to a series of questions on the impacts of a mandatory early shutdown of the Maine Yankee Atomic Power Plant, the State's principal source of low-level nuclear waste and its only source of high-level waste. We have organized the report around responses to each of your questions, addressing legal, technical, and economic considerations. Our conclusions depend on many assumptions about future oil prices, costs for alternative power sources, Maine Yankee operating costs, and the amount of compensation due to the plant's owners in the event of an early shutdown. They are, therefore, not precise forecasts, but informed judgments which bracket the likely possibilities.

The threshold question in any discussion of an early shutdown of Maine Yankee is whether it will pass basic legal and constitutional tests. We believe it will be very difficult, at best, for the State of Maine to acquire the legal means to force an early shutdown of Maine Yankee. It appears certain from a 1983 ruling of the United States Supreme Court, subsequent to the second Maine Yankee referendum, that any effort by a State to close a nuclear power plant because of health, safety, or operational considerations will be found unconstitutional under current federal law.

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This makes nuclear power reactors unique among industrial facilities, in the degree of their insulation from State regulation. In 1959, Congress amended the Atomic Energy Act of 1954 to provide federal pre-emption of any State responsibility in the area of health and safety. The reasons justifying pre-emption at the time - such as the lack of widespread expertise and the need to nurture a complex technology with major defense relationships - are no longer compelling. Consequently, we would recommend that as a precondition to another statewide referendum on Maine Yankee, the State seek repeal in the Congress of the pre-emptive features in the relevant federal statutes.

The Supreme Court has expressly affirmed the State's traditional regulatory authority over economic questions, however. Accordingly, a shutdown based on the economic costs of a serious accident might be more legally defensible. Indeed, if there is any argument to be made for a State-enforced closing of a civilian nuclear power plant which might succeed legally at present, we believe it is that the expected costs of a catastrophic accident would so far exceed available federal insurance protection. To make this case, however, one would have to address the question of accident probabilities, thereby encountering the Supreme Court's proscription of safety from radiation hazards as a basis for State regulation. It is, further, unlikely that the economic costs of the nuclear waste problem alone would suffice to enable State shutdown legislation to survive legal challenge. Finally, a decision that Maine Yankee power was uneconomic for Maine could simply result in the sale of Maine utilities' share of the plant, without compelling a shutdown.

An early shutdown of Maine Yankee would produce two principal benefits for Maine people. First, it would eliminate the possibility of a catastrophic operating accident; such a risk, however small statistically, is of deep concern to many Maine citizens. An accident with a nominal radiation release, as was the case at Three Mile Island, could be disastrously costly; a catastrophic release of radiation would have unparalleled costs to human and environmental health and the Maine economy. While we have not quantified the economic costs of such an accident, they could greatly exceed the economic savings from continued operation of Maine Yankee. The second benefit of an early shutdown would be that production of low-level waste and spent fuel at Maine Yankee would cease.

There would be two major areas of cost. First, alternative power sources would have to be found to replace Maine Yankee, which produces 27 percent of the electricity sold by Maine utilities at a wholesale price of 2.5 cents per kilowatt hour. This is considerably less expensive than any new sources of power generation which might replace Maine Yankee.

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Extensive computer modelling by the Maine Public Utilities Commission indicates that the total additional cost of electric power to Maine customers between 1989 and 2008 (the intended date of plant retirement) would be between \$380 million and \$3.4 billion in 1986 dollars (with the effect of inflation removed). The wide variation in these numbers reflects the range of possible events affecting prices of alternative energy sources, especially oil, and their volatility. We regard the high and low ends of the range as unlikely, and the mid-point, or about \$2 billion, as a reasonable statement of likely replacement power cost to Maine customers. The cost to out-of-State customers, who consume one-half of the Maine Yankee output, is likely to be similar in magnitude.

The total cost to Maine people of a 1989 shutdown, including compensation to the plant's owners, would lie between \$500 million and \$6.8 billion in today's dollars. This would amount to an increase of between 2.5 and 28 percent in annual electric bills, if compensation to out-of-State owners were included in the rate structure. Alternatively, compensation could add between \$120 million and \$3.4 billion in new demands on the State's General Fund, leaving an annual increase to electric ratepayers of between 2 and 14 percent for replacement power.

A State Planning Office analysis indicates that, in the short run, an early shutdown would result in the loss of between 1,000 and 1,800 full-time jobs, including 290 at Maine Yankee itself. Additional costs to industrial customers (estimated by Central Maine Power for its customers at \$806 million, 1989-2008) could inhibit business expansion, increase consumer prices, and materially damage Maine industries that depend heavily on purchased electricity. These immediate effects could be overcome in time through concerted State government leadership, accompanied by strong citizen support of more aggressive energy conservation, hydropower imports, and development of renewable energy sources which could more than offset the job losses at Maine Yankee.


There is no time before 2008 when a Maine Yankee shut-down can be scheduled without a net cost to Maine people. The least disruptive schedule, if an early shutdown decision were made now, would be to work toward the mid-1990's, allowing time to develop alternative energy sources, build the necessary transmission facilities, and implement strong conservation programs. We wish to emphasize, however, that devoting a portion of the State's energy conservation and renewable resource potential to replacing Maine Yankee would preclude their use to replace higher cost and environmentally damaging alternatives to meet present and future demand.

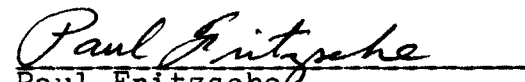
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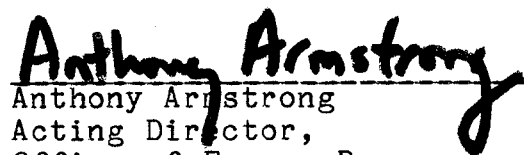
Finally, there is no more than a tenuous legal connection between the presence of a nuclear power generating plant and the placement of a high-level waste repository in Maine, as is now being contemplated by the U.S. Department of Energy. An early shutdown of Maine Yankee would still leave its existing wastes to be disposed of, and have no significant effect on the nation's nuclear waste disposal problem. Neither the Nuclear Waste Policy Act of 1982 nor federal regulations would require Maine to be removed from consideration if Maine Yankee were closed. The Act does require attention in repository siting to the proximity of waste sources; but closing a single plant in the Northeast would not materially affect this consideration.

We have not considered the many policy and ethical issues that lie outside the scope of your questions. We thank you for the opportunity to be of service to you and the people of Maine in this complex and important matter. We wish especially to express our gratitude to the staff who assembled the information and performed the analysis upon which this report is based; they and the reports they prepared are listed in Appendix B. These materials are available upon request from the Maine State Planning Office.

Most respectfully submitted,


Richard Barringer
Director,
State Planning Office


Paul Fritzsche
Public Advocate


Anthony Armstrong
Acting Director,
Office of Energy Resources

MAINE YANKEE SHUTDOWN ASSESSMENT

A REPORT TO

GOVERNOR JOSEPH E. BRENNAN

MAY 1986

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A. Legal Process

A State-mandated, early closing of Maine Yankee would be without precedent in United States legal history, so one cannot fully anticipate what arguments are likely to be raised, or how the courts will respond to them. It is not clear, however, that Maine now has available to it any constitutionally supportable tools to enforce an involuntary early shutdown of Maine Yankee.

1. What legal authority does the State of Maine have to shut down the Maine Yankee facility?

Under current federal law, Maine does not possess legal authority to close Maine Yankee solely on the basis of health and safety considerations. That power is held by the Nuclear Regulatory Commission, as stated by the United States Supreme Court in the Pacific Gas and Electric case in 1983.¹ The Court affirmed that under federal law, "the federal government maintains complete control of the safety and 'nuclear' aspects of energy generation." It noted that "a state judgment that nuclear power is not safe enough to be further developed would conflict directly with the countervailing judgment of the Nuclear Regulatory Commission." It is nearly certain, therefore, that

¹ 461 US 190; 103 S. Ct 1713 (1983) US Constitution Art. VI, Clause 2; see also 42 USC Sec. 2021(k).

any State effort to close Maine Yankee for reasons of health, safety, or nuclear operations will be found unconstitutional under present federal law.

Inasmuch as the law leaves to the States control over strictly economic aspects of nuclear power generation, Maine could potentially assert its legal authority to close Maine Yankee on the ground that the long run economic costs of continuing its operation and disposing of its wastes are excessive. Such an economic argument cannot credibly be made on the basis of waste disposal costs alone; currently, they are one-tenth of a cent, or 4% of the total Maine Yankee power cost of 2.5 cents per kilowatt hour. If these costs prove to be twice present estimates, they would still drive Maine Yankee power costs to just 2.6 cents per kwh.

In contrast, the effects of a nuclear accident on the Maine economy could be severe, especially if it resulted in a radiation release. They include the cost of dismantling a contaminated plant; the loss of residential, commercial, industrial and agricultural property; health care costs; losses in the tourism, fishing, agricultural, and other industries important to Maine; and disruption of local services. The costs could greatly exceed the insurance funds currently available, which are limited to \$600 million for public liability alone, under the federal

Price-Anderson Act. Even for an accident like Three Mile Island which resulted in no material release of radiation, repair and dismantling costs can be substantial, in the billions of dollars.

It is conceivable, and argued by some, that the State could acquire Maine Yankee through its power to condemn for a public use and purchase it against the wishes of its owners. While the purchase of Maine Yankee through condemnation cannot be dismissed out of hand, it poses serious legal questions. First, the constitutional question of public use for the property would be raised. If that use related to health and safety concerns, a collision with Nuclear Regulatory Commission authority would arise. Some other plausible basis, such as the unacceptable economic risk mentioned above, would have to be asserted and sustained in court.

Other federal issues of lesser weight might be raised in litigation following an early Maine Yankee shutdown. Since it would affect Maine Yankee owners and consumers in other States, issues of federal control over interstate commerce could arise. Specific questions relating to impairment of existing contracts between Maine Yankee and its suppliers and customers could be raised. Finally, there is a question of how Federal Energy Regulatory Commission powers over wholesale electric rates would affect Maine's ability to close Maine Yankee.

There now exist several constraints on spent fuel storage capacity at Maine Yankee and, therefore, on the prospects for its continued operation. In 1982, the Maine Legislature enacted a law that prevents on-site storage after 1992 of fuel rods more than three years old.² Some have asserted that this will require shutdown of Maine Yankee at that time. On its face, the 1982 law does not require closing the plant; rather, it appears only to render the owners vulnerable to a court order to remove the older rods, which would not necessitate closing the plant. If there is no place to which to remove the spent fuel rods, even closing the plant cannot result in compliance; but we assume that the owners will voluntarily choose not to operate Maine Yankee in violation of Maine law.

Further, a 1984 agreement between Maine Yankee and the Nuclear Regulatory Commission prevents Maine Yankee from using available technologies to compact its spent fuel, but allows further re-racking to increase storage capacity. This will result in the on-site spent fuel storage capacity being exhausted in the mid 1990's unless the Nuclear Regulatory Commission license is amended to authorize additional storage.

²35 MRSA, Sec. 3366.

2. How much, if anything, might it cost the State of Maine to compensate the present owners and energy purchasers of Maine Yankee in the event of early shutdown?

This question may be answered precisely only following what would certainly be extensive litigation. The likelihood is that out-of-state owners would be compensated through some fair market valuation of their replacement power costs. In-state owners might continue to receive debt service and return-on-equity now provided for in customer rates, so no added compensation would be due them.

Maine Yankee's owners may assert that its fair market value should be measured by the present value of power cost savings attributable to it. For Maine Yankee's out-of-state owners, this would amount to between \$380 million and \$3.4 billion. Clearly, the fair market valuation principle and its conversion to dollar sums would be vigorously contested in court.

"Book value" is the method commonly used to evaluate utility assets for ratemaking. It would make some sense to use it in eminent domain proceedings, as well; but this has not historically been done in, for example, town takeovers of private water systems. There, compensation commonly exceeds book value.

Book value is a measure of the plant's original cost, plus additions, less depreciation; it would probably establish the lower limit to compensation. The book value of Maine Yankee as of March 31, 1986, is \$314 million, of which about \$100 million is fuel; the book value of the plant itself is \$212 million. In mid-1989, the net electric plant's value will be \$185.4 million, and the fuel's value will be \$57.4 million, for a total of \$242.8 million.³ One-half of this figure, or roughly \$120 million, would be the low-end of compensation due to out-of-state owners from a 1989 shutdown. (See Table 1.)

Table 1

MAINE YANKEE SHUTDOWN
ESTIMATED COSTS 1989-2008
(Millions of 1986 \$)

	Low Case	High Case
Replacement Power for Maine Customers	\$380	\$3,400
Compensation to Out-of-State Owners	120	3,400
TOTAL COST	\$500	\$6,800

In the most unlikely event that the courts were to find the closing of Maine Yankee to be within the State's powers of condemnation without compensation, no payment to owners would be necessary.

³PUC Staff estimates.

Several other financial facts should be recorded here. Maine Yankee Atomic Power Company's common equity is \$68.8 million, of which CMP holds 38 percent and other Maine utilities hold an additional 12 percent; thus, 50 percent of Maine Yankee equity ownership is held by entities outside the State of Maine. Other obligations of Maine Yankee Atomic Power Company include \$8.5 million in preferred stock; \$75.6 million in mortgage bonds secured by the plant itself; and \$50 million (plus interest from 1983) to the federal government for pre-1983 spent fuel disposal charges. The Property Tax Division of the State Bureau of Taxation values Maine Yankee at \$287 million, while the Town of Wiscasset values the plant at \$380 million.

3. What will be the likely duration and costs to the State and to Maine utilities of litigation surrounding compensation to the owner-utilities in the event of early shutdown?

Considering the unprecedented and highly complex nature of such a case, we can venture no prediction of its likely duration or cost. Two separate issues would be litigated: whether the State has authority to close Maine Yankee; and, if the answer is yes, what if any compensation should be awarded?

If the State asserts the authority to close Maine Yankee, the litigation, while substantial, could be handled by the Office of the Attorney General without additional staff. If valuation

becomes an issue, the litigation will be substantially more complex and entail the use of expensive consultants. Proceedings in different courts are possible. The many utilities which own Maine Yankee, having the burden of proof, would spend much more than the State.

B. Decommissioning Constraints and Costs

This section addresses technical constraints which would affect the timing of a shutdown, and describes our best estimates of environmental and economic impacts of plant decommissioning.

4. and 8. Does the technology exist today for the safe decommissioning of a nuclear-powered generating plant? What are the costs of decommissioning?

No reactor of Maine Yankee's size (840 MW) has yet been dismantled. As a result, the decommissioning technology has not been demonstrated. Several theoretically safe decommissioning methods exist; but the absence of an actual demonstration creates serious misgivings about not only their safety, but also their economic and political acceptability.

Between 1954 and 1985, 34 reactors of various sizes were retired or dismantled, mostly small research and development reactors, operated for a few years. Extensive experience is

being accumulated on the damaged Three Mile Island 2. Research, engineering, and cost studies have been done on reactor decommissioning. Planning is underway to dismantle a 72 MW commercial reactor at Shippingport, Pennsylvania.

The Nuclear Regulatory Commission is currently working on its final decommissioning standards, which will not be available until 1987 or 1988. When these are completed, more definitive cost estimates and answers to questions of environmental and occupational hazards may be available.

Maine Yankee owners are required to fund its full decommissioning costs, estimated at \$200 million in 1986 dollars. In accordance with a Federal Energy Regulatory Commission ruling, Maine Yankee sets aside \$4 million each year in a trust fund for this purpose. As of March 31, 1986, the fund contained \$12.0 million; by 1989, it will be roughly \$30 million; and by 2008, \$150 million in 1986 dollars (assuming a 3% real investment yield). As decommissioning approaches, any unfunded amount will be paid through ratepayer charges.

Decommissioning costs cannot be avoided by early shutdown. If Maine Yankee were shut down early, ratepayers or taxpayers would still have to pay \$4-6 million per year for future decommissioning.

5., 6. and 7. What are the public safety and environmental risks of the decommissioning process? What level of risk will remain thereafter? Where will the contaminated components of the decommissioned plant be disposed of?

We cannot now say precisely how the wastes from either an early shutdown or the planned 2008 shutdown would be disposed of, where the waste disposal site would be located, or what the full costs would be.

Final dismantling of Maine Yankee will be accompanied by the handling of large quantities of radioactive waste, the removal of which will involve some level of hazard. Protecting workers and finding an acceptable disposal site are two of the most difficult decommissioning issues. The spent fuel must be removed before decommissioning can take place. Many of the remaining wastes, though technically defined as "low-level", are in fact highly radioactive. Much of the radioactivity will decay within 30 years of shutdown, but some will endure much longer.

Maine Yankee's current plans for shutdown envision permanent removal of the spent fuel and other radioactive material from the site to a federal repository. There will be no available permanent repository for spent fuel before 1998. A shutdown before then would entail storage of fuel and low level waste on-site for a period of years.

There is, at present, no known destination for the remaining, low-level decommissioning waste, the volume of which will be somewhat greater than that generated during the plant's planned operating lifetime. Low-level wastes now go to Barnwell, South Carolina, and Hanford, Washington, at a rising annual cost. By 1993, federal law requires Maine to have made some permanent arrangement for disposal of its own low-level waste. Before then, there is no assurance that the low-level wastes generated by post-shutdown activities will have a permanent disposal site.

The Nuclear Regulatory Commission requires that a nuclear plant site be decontaminated after dismantling, and assumes that any radiological hazards which would prevent its use for another purpose will be removed. Achieving this depends on the existence of waste disposal sites, suitable transportation methods, effective decontamination methods, and the skill with which they are applied. We think it wise to assume that parts of the site are unlikely to be returned to public use for many years.

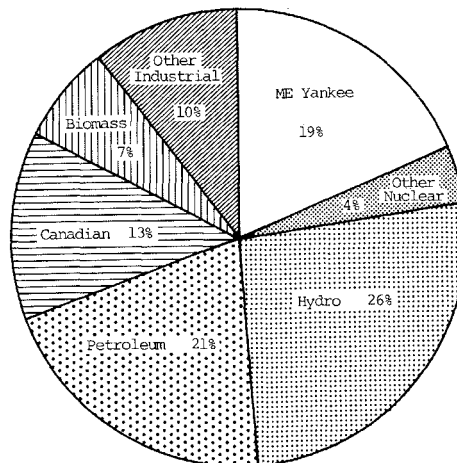
C. Public and Economic Costs and Benefits

This section reviews power supply, energy conservation, and replacement power costs and their economic impacts.

9., 10., and 11. How much electrical energy and electric generation capacity will we need to replace Maine Yankee? What are the available options?

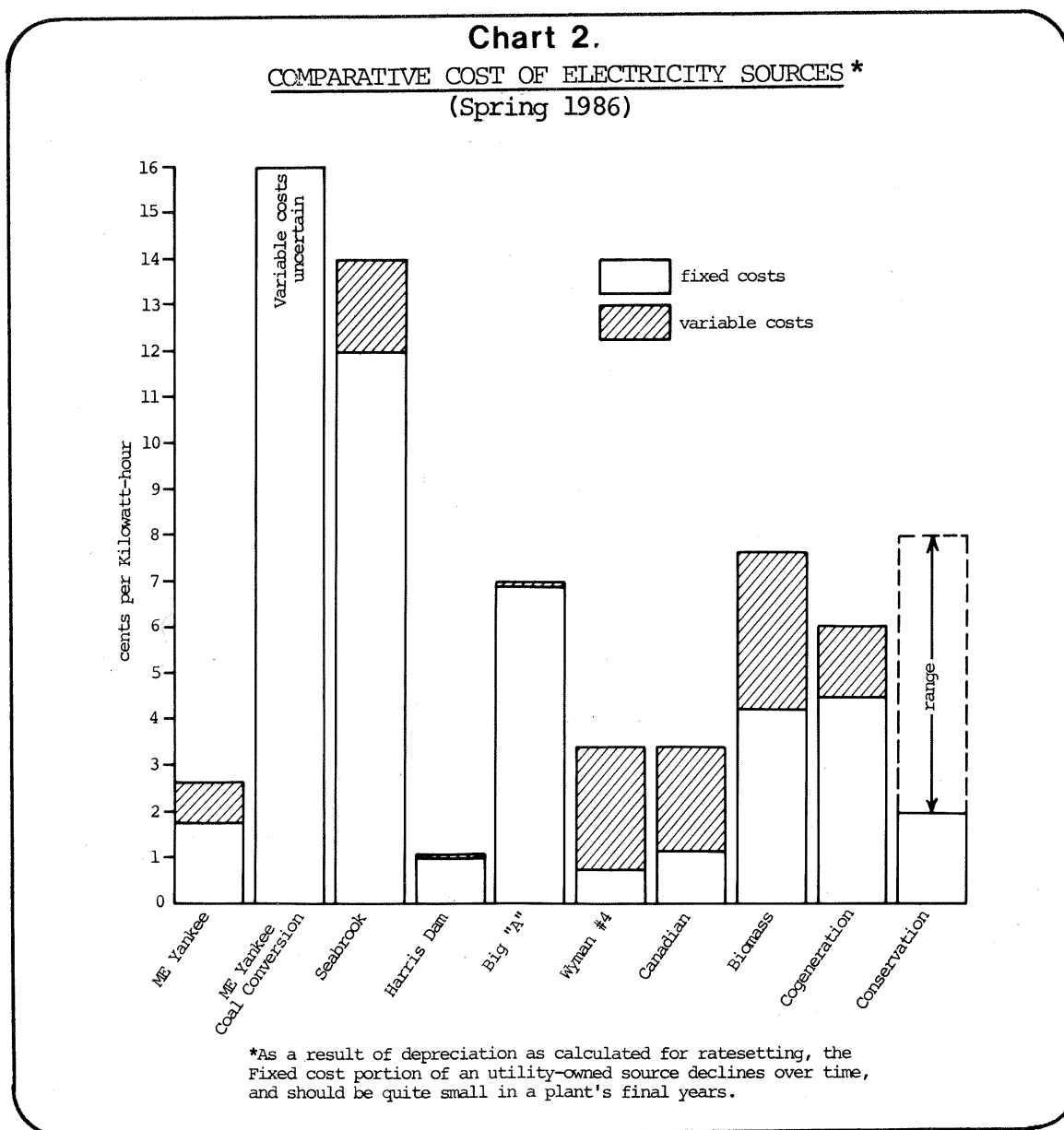
Maine Yankee has an average capacity of 840 megawatts (MWE) and produces 4.8 billion kwh each year, of which 2.4 billion is the share of Maine utilities. This is 27 percent of the total electricity sold by Maine utilities, and 19 percent of all electricity consumed in Maine. In addition, Maine utilities own small shares of nuclear power plants located outside of Maine, and rely on some nuclear power from New Brunswick. (See Chart 1.)

Chart 1.
SOURCES OF ELECTRICITY CONSUMED IN MAINE - 1984



"Other industrial" includes electricity generated with petroleum, wood waste, and pulp liquor. "Other nuclear" includes out-of-state nuclear power.

The energy to replace Maine Yankee would depend on four alternative sources: existing oil-fired plants in Maine; conservation; new generating capacity in Maine; and imports from outside the State. The feasibility of various mixes of these options depend upon the time-frame considered, the price of oil, and public policy decisions. Current data on relative costs are shown in Chart 2.



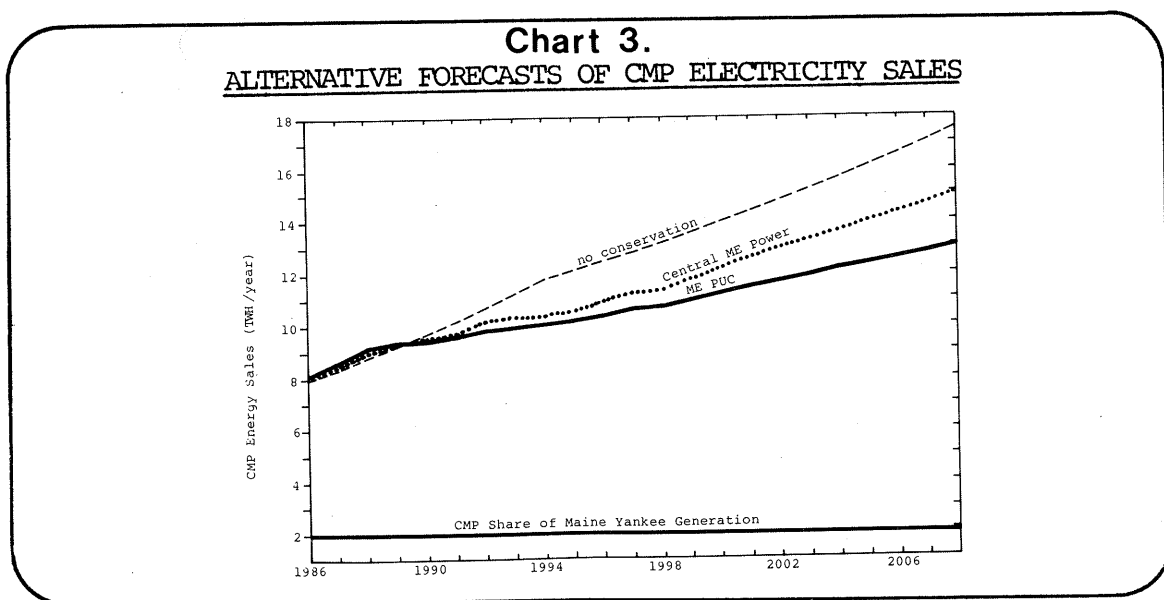
The near-term response to a Maine Yankee shutdown would be to import and generate power from the same sources currently used when Maine Yankee shuts down for maintenance. These include underutilized oil-fired plants in Maine, the least expensive available units in the New England Power Pool, or special arrangements with New Brunswick. Conditions are especially favorable at present because of a Canadian hydropower surplus, low oil prices, and idle oil-fired capacity in New England.

A significant volume of generation capacity could be displaced by electric energy conservation. The Maine Office of Energy Resources estimates that a concerted conservation program could displace the equivalent of a 400 MW power plant, or an amount almost equal to Maine's 50% share in Maine Yankee. The cost can be as low as 2-3 cents per kilowatt hour in today's dollars, which is competitive with Maine Yankee and much lower than any new supply option such as biomass, cogeneration, Canadian hydropower, in-State hydropower, coal, or oil.

Conservation measures which the Office of Energy Resources has recommended include electric rate design improvements, energy building standards, appliance efficiency standards, lighting and motor efficiency programs for commercial and industrial businesses, and new and stepped-up residential programs. Some of these programs are already established; some are in the demonstration stage; and others are in various stages of

development. Their success would depend upon concerted action among Maine's utility companies and Public Utilities Commission, the Legislative and Executive branches of government, and the general public.

Conservation policies and investments could hold down but not eliminate growth in electricity demand, however; and conservation that is used to replace Maine Yankee power will no longer be available to reduce the need for new and much more expensive power plants. The total mix of electrical energy sources will, therefore, be more expensive if conservation is used to replace Maine Yankee, rather than the most expensive power sources. Chart 3 illustrates the share of CMP electricity sales which Maine Yankee represents, and three alternative forecasts of future sales: that which assumes no conservation; that which is being used in the current CMP rate case (CMP); and that which assumes 2 percent demand growth per year, supplied by the Maine PUC staff (Me PUC).



Over 5-10 years, significant power replacement could be achieved by a combination of alternative sources. These include wood and other biomass; waste-to-energy plants; industrial cogeneration; and new oil, hydropower, coal, or gas-fired plants. Costs per kilowatt hour of all these sources are higher than at Maine Yankee; but developing some of them will help solve other resource management problems, as well, and will generate jobs and revenues within Maine.

At present, the growth in Canadian domestic electricity demand has fallen short of official expectations, creating a large Canadian hydropower surplus. Beyond a 10-15 year period, this surplus and the world oil market may tighten markedly.

12. and 13. What further amount of electricity will be needed to meet anticipated growth? What will be its cost? What will be its public safety risks and environmental costs?

Assuming demand growth of 2 percent per year to the year 2008, and allowing for a level of conservation which some find optimistic, CMP energy use will rise from 8,700 GWH in 1986 to 13,767 in 2008, or by almost 60 percent. CMP projects available capacity rising from 1,717 MW in 1986 to 2,078 MW in 2008. The cost of replacement power is discussed specifically in the response to question #14.

Meaningful comparison of the health and environmental impacts of the alternative energy sources available to Maine is a prodigious undertaking. Different national studies have come to different conclusions, and we would not feel confident in going beyond the following propositions.

First, however, no discussion of the environmental costs of alternative energy sources may proceed without some recognition of the grave public safety and environmental hazards associated with nuclear energy. During routine operation, U.S. nuclear reactors release very small amounts of radioactivity which cause few adverse health effects. The nuclear industry, the Nuclear Regulatory Commission, and the U.S. operating history to date offer strong assurances that the risk of a serious nuclear accident at any individual plant is extremely small. Critics of the nuclear industry contest these assurances.

If a catastrophic nuclear accident, however unlikely at a given plant, were to occur, it would have enduring impacts on public health, safety, the environment, and the economy that defy comparison with other energy sources. The nuclear fuel cycle includes the additional impacts of uranium mining and tailings, as well as the ultimate disposal of radioactive wastes, the difficulties of which are now well-known to Maine citizens and are discussed in detail in the recent "State of Maine Comments on

U.S. Department of Energy CRP Draft Area Recommendation Report"
(Governor's Task Force on High-Level Nuclear Waste, April 1986).

The lowest environmental and health risks among Maine's alternative energy sources are those associated with energy conservation; but even here, sensible safety and health procedures must be followed to avoid problems such as those which have occurred with certain types of foam insulation.

Imports of electricity have few direct environmental or health costs to Maine residents since their impacts occur elsewhere, except for transmission line construction. Over-reliance on imported electricity, however, carries with it the possibility of sudden disruption in supply.

Electricity generated by oil or coal has environmental and public safety costs that include oil spills, air pollution, and strip mining and mining accidents. There are also the world-scale environmental costs of depleting finite reserves and modifying the global carbon dioxide cycle, as well as the strategic risk of becoming overly-reliant on oil from politically unstable regions.

The use of Maine resources such as hydropower, wood, peat, and municipal waste would cause environmental impacts within Maine. Woodstoves have caused fatal fires and, in some cases,

contribute to local air pollution; waste-burning facilities may emit harmful chemicals; hydropower projects affect a river's ecosystems and alternative uses; peat mining can lower water tables and affect wildlife habitat; and increased harvesting of biomass carries with it costs associated with the high rate of worker accidents in the industry. Sensible government regulation, however, can keep the environmental costs of developing these energy resources within limits acceptable to most Maine citizens.

Natural gas is a clean-burning fuel which could be used much more widely in Maine in the long run. The construction of a pipeline through Maine would be the major environmental impact. At current prices, however, major gas expansions are not economical.

14. and 16. How much would electric rates increase from an early shutdown? What would be their overall effect on the Maine economy?

Our best estimates of the increased costs to replace Maine Yankee power are shown in Table 2. They were developed using cost models at the Public Utilities Commission. The ranges represent replacement costs under high and low assumptions for nuclear operating costs and oil prices. Load growth is 2 percent per year in all cases. While a far more complex set of

assumptions could be used, we feel that the model captures the most important relationships. A much more refined approach would not be likely to change the results materially, especially considering the wide uncertainties in future oil prices and nuclear costs.

Table 2

REPLACEMENT POWER COSTS FOR MAINE YANKEE
(all figures in millions of 1986 dollars)

	<u>Undiscounted</u>		<u>Present Value*</u> <u>Discounted</u> <u>at 5 percent</u>
	<u>Total</u>	<u>Annual</u> <u>Average</u>	<u>Total</u>
Maine Ratepayers	\$380-3,400	\$20-170	\$190-1,926
New England Ratepayers	750-6,800	40-340	380-3,850

*Present value represents the 1986 value of the future increase in costs occurring annually throughout the 1989-2008 period.

Power replacement costs for Maine Yankee to be borne by Maine people and businesses will be in the range of \$380 million to \$3.4 billion. This excludes the higher costs of doing business in Maine that would be passed along to Maine consumers in the prices they pay. Rate increases to cover replacement power costs would vary across the State and be significantly higher in Aroostook County, for example, where consumers depend more heavily on Maine Yankee power (45 percent) than the State as a whole. Table 3 shows the impacts on typical electric rates for CMP customers when compensation to out-of-state owners is added to power replacement costs.

Table 3

IMPACT OF MAINE YANKEE SHUTDOWN ON CMP ELECTRIC BILLS*
(all figures in dollars)

	<u>Present Annual Bill</u>	<u>Annual Increase, 1989-2008</u>		
		<u>Low Case</u>	<u>Mid-Range</u>	<u>High Case</u>
Residential customer:				
— without electric heat or hot water	\$320	\$ 8	\$49	\$ 90
— without electric heat, with electric hot water	600	15	91	168
— with both electric heat and hot water	1,280	32	196	360
Small business	20,000	500	2,800	5,600
Large industry	4,000,000	100,000	690,000	1,280,000

* Compensation to out-of-state owners is included in these estimates. If compensation is funded otherwise, the annual increases are cut approximately in half in the high case, and by one-quarter in the low case.

There are two ways in which compensation to out-of-state owners might be funded. Table 3 includes the funding of compensation through electric rates. Alternatively, compensation (between \$120 million and \$3.4 billion) would add a major demand on the State's General Fund and bonding capacity.

We have not fully examined all the economic effects of an early shutdown, but would point to several specific, likely outcomes. Because of the shutdown itself and business responses to higher energy costs, between 1,000 and 1,800 full-time equivalent jobs would be lost to Maine people by 1995, based on calculations using the State Planning Office's economic model. Maine Yankee itself accounts for 640 of these jobs, including part-time contractor employment. The range in job losses is far narrower than in replacement energy costs, because relatively few Maine jobs are highly sensitive to energy costs. The lost jobs would be less than 1 percent of the 260,000 full-time, year-round jobs now available. The reduction in personal income would be between \$67 and \$93 million per year, or 7 tenths of one percent of the State's personal income of \$13.4 billion annually.

Power supply and energy conservation projects developed to replace Maine Yankee would probably create far more jobs than those lost through a Maine Yankee closing. Studies indicate that energy conservation and renewable resource development could create as many as four times the number of jobs as nuclear power. In 1985, ongoing utility conservation projects created more than 100 jobs, and energy conservation projects are expected to yield far larger numbers of jobs as utility investment in conservation is increased. Maine's wood-to-energy industry created more than 600 jobs in 1985 for construction workers, woodworkers, and

truckers, according to a new study for the New England Governors' Conference. Using labor coefficients developed in that study, the Office of Energy Resources estimates that more than 2800 construction jobs and 2400 sustained jobs will be created by the wood-energy industry in Maine by 1990.

The jobs created by energy conservation and renewable resource development will come at a high cost to Maine people in the event of a Maine Yankee shutdown, however. They will be created at a lower cost if these energy sources are used to displace new and expensive power plants instead of Maine Yankee.

Maine Yankee pays State and local taxes of \$9.7 million annually, mostly in Wiscasset property taxes. When Maine Yankee shuts down, its property taxes will become minimal, causing a dramatic increase in local tax rates. Its State tax payments are nominal, and could be easily made up otherwise. We have not estimated the potential effect on State tax revenues of the job and local property tax losses; nor have we estimated any property tax gains from replacement sources.

15. and 17. How would business energy costs and investment decisions be affected by the uncertainty over the cost and availability of electricity resulting from an early shutdown?

CMP estimates that a 1989 shutdown would increase its

industrial users' power bills between 1989 and 2008 by a total of \$806 million, in 1986 dollars. We believe this to be a reasonable estimate. Because industrial power rates have a high fuel component, the relative effect of an early shutdown on industry would be greater than on residential customers.

To assess the effects of an early shutdown on Maine business, it is necessary to distinguish among different kinds of businesses. First, are the large, energy intensive users, like paper, chemical, and food processing companies. Most have high bills for purchased power, since they do not generate all the energy they need. Second, is the general range of manufacturing and commercial establishments for which electricity costs would be a concern, but of secondary importance in location and investment decisions. Finally, are the many retail and service firms whose electricity costs are small, and whose growth and expansion decisions are likely to be unaffected by power costs.

For heavy electric users, an immediate shift to replacement power would be difficult and costly in the short run. CMP estimates that its paper industry customers alone, already under intense competitive pressure, would pay \$5 million in increased power rates in the first year of an early shutdown. Long term adjustments could mitigate this effect to some extent.

For the second tier of users, uncertainty in electricity

costs would have significant short-term effects only for particular firms. An early shutdown would increase the importance of oil prices to industrial power rates; this would in turn increase the volatility of all rates, including those for Canadian power imports, whose price is generally tied to oil.

For the third tier of users, mostly in the retail and service sector, we would expect no noticable effect on their employment, output, or investment decisions. While they would certainly not welcome the rate increase caused by a Maine Yankee shutdown, they would not be significantly affected, as most of their increased costs would be passed on to consumers.

Finally, some observers may see an early Maine Yankee shutdown as an anti-business statement by the State of Maine. Such a perception could affect their current business investment choices among competing locations. Over time, Maine's natural advantages would re-assert themselves; but a temporary chilling effect among such people on Maine's reputation as a place to do business may be expected.

18. How will an early closing of Maine Yankee affect the State's long term energy independence and other energy related goals?

Maine's State Energy Plan declares that "the long-term policy of the State of Maine shall be to encourage increased

energy conservation, efficiency, and diversification, and the use of indigenous and renewable resources, so that the State can be more nearly self-sufficient. In the interim, the State should encourage the development and use of resources, consistent with this goal, which are the least harmful to the environment, which stimulate economic development, which promote security of supply, and which are available at the lowest possible cost. In addition, the State should be prepared to take emergency action in case of serious supply deficiencies."

The Maine Office of Energy Resources has established the following targets for 1990, to help carry out the State Energy Plan:

1. Increase the efficiency of energy use by 10 percent;
2. Diversify Maine's energy supplies, and decrease our dependence on petroleum to less than 55 percent of total State energy consumption (currently 60 percent); and
3. Increase the use of indigenous and renewable resources to 35 percent of total State energy consumption (currently 25 percent).

A 1989 Maine Yankee shutdown would compromise some of our energy policy goals in the short run, given the lack of time for adequate adjustment measures. It would increase our use of

petroleum products; remove from Maine's energy mix a supply of low-cost, in-state generated electricity; increase energy costs to consumers and energy-intensive businesses; and have at least a short-term, adverse affect on economic development in Maine.

Within a few years, aggressive State government and utility company policies, backed by strong public support, could place Maine on a sound energy supply path for the future. A concerted conservation effort in Maine government, industries, businesses, and homes would have a favorable impact on the State's long-term energy independence, job creation, and other goals. A major initiative could be made to replace Maine Yankee power with increased electric generation from indigenous, renewable resources, including biomass and hydropower. All this would be consistent with State energy policy and goals, since it would create jobs and develop secure, in-state, renewable supplies of energy.

The energy from renewable resources would, however, be far more expensive than Maine Yankee power, and so would compromise Maine's policy goal of supplying energy at the lowest available cost. Some conservation programs, while similar in cost to Maine Yankee electricity, would be otherwise used to offset the future need for new power sources which will be far more expensive than Maine Yankee. An early shutdown of Maine Yankee would increase energy costs to Maine consumers, who have traditionally paid a

higher percentage of their income for energy than residents of any other State in the country.

In addition to increasing energy costs, an early shutdown could be a setback to Maine's efforts to increase efficiency of electric supply through regional cooperation with the New England Power Pool. Other members of the Pool would be adversely affected by a unilateral decision by Maine to close the Maine Yankee plant.

19. How would an early shutdown affect the local economy and tax revenues in Wiscasset and neighboring communities?

Maine Yankee is an important part of both the tax and economic base of Wiscasset. The plant pays about 95 percent of the Town's property taxes; as a result, property values are higher than in adjacent towns. Maine Yankee's 290 full-time employees account for about one-fourth of the jobs in Wiscasset.

When one includes contractors, employment at Maine Yankee grows to roughly 640 person-years, according to CMP. The annual Maine Yankee payroll exceeds \$10 million; its purchases of contract goods and services constitute an additional \$15 million. In the event of an early shutdown, most of these jobs, wages, and spending flows would be lost to the area economy. Multiplier effects would increase the impact somewhat above these numbers,

and over a one-hour or larger commuting radius beyond Wiscasset.

20. If there is to be an early shutdown, what would be the least disruptive means and schedule to do so, from an economic point of view?

There is no time before 2008 when a Maine Yankee shut-down can be scheduled without net economic cost to Maine people. Easing the impact of an earlier shutdown of Maine Yankee would necessarily entail a careful, orderly planning process, involving fair compensation of the plant's owners and creditors.

With a vigorous effort and under favorable circumstances, some major sources of replacement power could be available within 2-3 years of a shutdown decision. Not until the mid-1990's, however, is it reasonable to expect enough of the factors to come into play which are critical to an orderly post-Maine Yankee energy replacement plan, including:

- purchase or construction of desirable and permanent replacement capacity;
- completion of needed transmission lines, facilitating power imports;
- an accelerated conservation effort, backed by strong public leadership and support;

- an improved Maine bargaining position as a result of not having to make power purchases on a "crash" basis;
- clarification of the disposal options and costs for low and high-level nuclear waste;
- better technical and economic knowledge about post-shutdown treatment and Nuclear Regulatory Commission regulations; and
- time to either consume or sell off commitments for nuclear fuel and uranium enrichment services.

While these developments would ease a transition, Maine would simultaneously face increased competition from other States for available power and power sources, as surplus capacity diminishes.

21. In light of these considerations, what would be the net benefits and costs to Maine citizens of an early Maine Yankee shutdown?

Not all the benefits and costs of an early shutdown are reducible to a common measure such as dollars; different individuals attach widely varying values to the goal of ending the use of nuclear power.

Benefits

An early shutdown would eliminate the risks of a catastrophic operating accident at Maine Yankee, the human and economic costs of which would be enormous. Low-level waste production would cease at Maine Yankee, the State's largest generator of this material. However, the wastes resulting from decommissioning would remain to be dealt with. Further production of spent fuel at Maine Yankee would cease, although this will not significantly alter the nuclear waste disposal problem for Maine or the nation.

It has been argued that a Maine Yankee shutdown, or even the threat of one, would reduce the likelihood of Maine's selection as a high-level nuclear waste repository. The Department of Energy's official position is that this will not be the case. There is only a tenuous legal connection between the operation of Maine Yankee and Maine's continued consideration as a candidate for a high-level nuclear waste repository.

An early shutdown might accelerate the effort to develop Maine's renewable energy resources, and prompt greater consumer commitment to conservation, largely through higher energy prices. Such a commitment is desirable in any case, and could occur without an early shutdown.

Costs

In the event of an early shutdown, Maine citizens would face costs for replacement power, compensation to owners and out-of-state customers, short-term job losses, and the compromise of some State energy policy goals.

Replacement costs for Maine Yankee power would add, on average, between 2 and 14 percent to the annual power bill of Maine customers, the equivalent of a \$20-170 million annual tax or rate increase. Together, replacement power plus compensation costs will yield likely rate increases to Maine customers of between 2.5 and 28 percent. This increase would be most burdensome to poor families and businesses already facing harsh financial and competitive problems. Some local industries and areas would be disproportionately affected because of heavier dependence on Maine Yankee power.

An early shutdown would entail the near-term loss of 1,000 to 1,800 full time jobs, including those at Maine Yankee itself. Uncertainty over power costs could last for several years, affecting some business investment decisions. This would likely produce an adverse, short-term effect on Maine's economy, which would need to be addressed through a vigorous adjustment program in those areas hardest hit by the impacts.

In the near-term, early shutdown would compromise Maine energy policy goals in the areas of in-state generation, foreign oil dependence, and overall energy costs. Beyond that time, energy conservation, technological changes, and investment in alternative energy generation could, with strong public leadership and support, place Maine on a sound, long term energy supply path, though at higher costs than if Maine Yankee were to continue operating.

Costs That a Shutdown Cannot Avoid

There are a number of important costs to Maine people that cannot be avoided by an early shutdown, and will remain to be borne in any case.

First, the plant will have to be decommissioned at a cost of roughly \$200 million (in 1986 dollars) at some future time; early shutdown does not alter or reduce this cost; ratepayers will continue to face costs of \$4-6 million per year for this purpose. Second, the plant's debt service and preferred stock dividends now covered by consumer rates amount to some \$7 million per year; they will decline over time, but must still be paid through 2008. Third, a remaining liability of \$50 million plus interest for pre-1983 spent fuel charges is owed by Maine Yankee to the U.S. Department of Energy. Finally, the spent fuel rods and any

wastes from the shutdown process will have to remain at the Maine Yankee site until at least 1993 for low-level wastes, and 1998 for the spent fuel, due to lack of permanent disposal facilities for them.

22. What conclusions, if any, may be drawn from the recent accident at the Chernobyl reactor in the USSR?

You have asked that we comment on the recent nuclear accident at Chernobyl in the Soviet Union.

Until much more is known about the causes and consequences of the accident, a precise assessment of its relationship to U.S. nuclear power plants in general, or to Maine Yankee in particular, will not be possible. Among other things, it is not yet clear what type of containment the Chernobyl reactor had, or whether an accident of this magnitude would have ruptured a U.S.-style containment. Nor is it clear that the graphite fire (which could not occur in most U.S. reactors) was a cause rather than a consequence of the accident itself.

Under these circumstances, we would not venture with confidence beyond the following general observations regarding the impact of Chernobyl on the economic and waste considerations you have asked us to address.

First, the Soviet accident may have some adverse effect on the cost of capital to utilities owning nuclear power plants.

Second, the accident makes very clear the need for much higher limits on liability than the current limit of some \$600 million written into the federal Price-Anderson Act. Indeed, a system of unlimited liability for total costs, coupled with some limit on the annual payment per reactor, may well be a fairer way to balance the interests of all parties than is the current Price-Anderson framework. The nuclear industry opposes this approach, however, as unlimited liability will increase the cost of nuclear power at new and existing plants.

Finally, there is no direct connection between the Soviet accident and the nuclear waste problem that initially triggered this review. An accident of this magnitude involving underground spent fuel does not appear possible. However, it is safe to say that any nuclear endeavor requiring popular approval and support will now be more difficult to carry out than it would have been before Chernobyl.

APPENDICES



STATE OF MAINE
OFFICE OF THE GOVERNOR
AUGUSTA, MAINE
04883

JOSEPH E. BRENNAN
GOVERNOR

March 11, 1986

Dr. Richard E. Barringer
Maine State Planning Office
State House Station 38
Augusta, Maine 04333

Dear Dick,

As you know, the public debate on the Maine Yankee atomic power plant has been re-opened by the actions of the U.S. Department of Energy and its failed, high-level nuclear waste storage policy. Accordingly, it is important that this Administration re-evaluate the implications for Maine people of an early shutdown of Maine Yankee.

Accordingly, I will be obliged if you, the Public Advocate, the Director of the Office of Energy Resources, and the Chairman of the Public Utilities Commission, in cooperation with the Office of the Attorney General, will address the following questions and report to me your findings at an early time. If in the course of your efforts other questions of direct interest arise, I trust that you will respond to them, as well.

In considering these questions, one should bear several things in mind. First, Maine Yankee must eventually be decommissioned; its current operating license from the federal Nuclear Regulatory Commission expires in the year 2008. Second, before its decommissioning, alternate sources of power with different costs and their own environmental and health effects will need to be developed in Maine, or purchased. Third, an early Maine Yankee shutdown would involve owners from out-of-state, and would affect power supply and costs for out-of-state utilities and consumers, as well as for those in Maine. Fourth, early shutdown of Maine Yankee will not in itself guarantee that Maine will not be the site of a nuclear repository, and might result in increased electrical costs to Maine people with no additional protection from our being the repository State.

There are at least three kinds of issues which should be addressed regarding a mandated early shutdown of Maine Yankee, including legal, technical, and economic:

A. Legal Process

1. What legal authority does the State of Maine have to shut down the Maine Yankee facility?
2. How much, if anything, might it cost the State of Maine to compensate the present owners and energy purchasers of Maine Yankee in the event of early shutdown?
3. What will be the likely duration and costs to the State and to Maine utilities of litigation surrounding compensation to the owner utilities, in the event of early shutdown?

B. Technical Constraints

4. Does the technology exist today for the safe decommissioning of a nuclear-powered generation plant?
5. How and where will the contaminated components of the decommissioned plant be disposed of?
6. What are the public safety and environmental risks of the decommissioning process?
7. What public safety and environmental risks remain after decommissioning process?
8. What are the costs for decommissioning the plant and the subsequent security and maintenance of the site?

C. Public and Economic Costs and Benefits


9. How much electric generation capacity will we need to replace Maine Yankee?
10. How much electrical energy will be needed to replace Maine's share of the electricity generated by Maine Yankee?

11. What are the options for supplying the replacement power or reducing the demand through conservation, and what are their economic costs?
12. What further amount of electricity will be needed to meet anticipated growth in demand, regardless of the date of the shutdown of Maine Yankee, and what will be its likely cost to consumers?
13. What are the public safety risks and environmental costs of alternative energy sources?
14. How much would electric rates increase for Maine consumers to replace Maine Yankee power with alternatively generated electricity?
15. How would an early shutdown of Maine Yankee affect the energy costs of Maine businesses?
16. What would be the overall effects of more expensive replacement power on the Maine economy, including State tax revenues?
17. How would business investment decisions be affected by the uncertainty over the cost and availability of electricity resulting from early shutdown?
18. How will an early closing of Maine Yankee affect the State's long-term energy independence and other energy-related goals?
19. How would an early shutdown affect the local economy and tax revenues in Wiscasset and neighboring communities?
20. If there is to be an early shutdown, what would be the least disruptive means and schedule to do so, from an economic point of view?
21. Finally, give all these factors, what would be the net benefits and costs to Maine citizens of an early shutdown of Maine Yankee?

Dr. Richard E. Barringer
Page four

Again, I thank you and your colleagues for your
readiness to assume this most important responsibility.

Sincerely,


JOSEPH E. BRENNAN
Governor

JEB:nv

cc: Peter Bradford, Chairman, Public Utilities Commission
Paul Fritzsche, Public Advocate
John Kerry, Director of Energy Resources
James Tierney, Attorney General
Senate President Charles Pray
Speaker John Martin
Senator John Baldacci
Representative Harry Vose

STAFF PARTICIPANTS

State Planning Office: Lloyd C. Irland, Harold Payson, and
Joyce Benson

Office of Energy Resources: Steve Buchsbaum, Mark Katz, and
Barbara Reinertsen

Public Utilities Commission: Elizabeth Paine, Richard Darling,
Richard Parker, Alfred W. Maxwell III, Joseph Sukaskas, and
Richard Kania

Public Advocate: Joel Shifman

Attorney General: Cabanne H. Howard

Word Processing: Barbara A. Macomber, Lorraine Lessard, and
Aline A. Lachance, State Planning Office

STAFF PAPERS

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Rusche, U.S. Department of Energy, March 21 and March 25,
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Note: Staff papers and correspondence are available upon request
from the Maine State Planning Office.

CHAIRMAN
Peter A. Bradford



COMMISSIONERS
Cheryl Harrington
David H. Moskovitz

STATE OF MAINE
PUBLIC UTILITIES COMMISSION
242 State Street
State House Station 18
Augusta, Maine 04333
(207) 289-3831

May 21, 1986

The Honorable Joseph E. Brennan
Governor
The State of Maine
Station No. 1
Augusta, Maine 04333

Dear Governor Brennan:

I have participated in this review in an individual capacity. The other PUC commissioners have not been involved.

Because both I and the PUC may have to review these matters again on a different future record, I have not signed the report itself lest that act be misunderstood as implying some prejudice with regard to future PUC proceedings. The conclusions reached are generally consistent with my present views.

Sincerely,

A handwritten signature in cursive script that reads "Peter A. Bradford".

Peter A. Bradford
Chairman

PAB/m

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Maine. State Planning
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Maine Yankee shutdown
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