



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

June 23, 1978

MEMORANDUM FOR: Commissioner Gilinsky
Commissioner Kennedy
~~Commissioner Bradford~~

FROM: Ken Pedersen *Dennis Rathbun for*

SUBJECT: SENSITIVITY OF COST OF DELAY TO NEED FOR POWER
PROJECTIONS FOR SEABROOK

As I indicated to you in my memo yesterday, relating cost of delay estimates for the Seabrook plant to need for power in the Public Service of New Hampshire service area is a complex issue. Certainly, the comments which follow here should in no sense be regarded as a definitive exposition of the subject.

Need for power. As the following summary indicates, the Seabrook proceeding on the need for power issue has been less than definitive in establishing with any degree of certainty when the Seabrook plant would, in fact, be needed.

The Appeal Board in ALAB-422 addressed the need for power issue for the Seabrook plant. The Appeal Board noted that the Licensing Board had found that the plant would be needed in the early to middle 1980's to meeting anticipated load in New England with an appropriate reserve margin, although Dr. Salo concluded in a dissent that there was "considerable doubt" that the Seabrook plant would be needed before 1985 or 1986. However, because of procedural errors the Licensing Board committed, the Appeal Board was not prepared to find that the plant was needed for NEPOOL system reliability purposes before the mid-80's. But both the Appeal Board and the Licensing Board decided that there was a strong factual basis for bringing the Seabrook plant on line in the early 1980's to substitute for fossil (primarily oil) plants.

There is no recent and systematic statistical information in the Seabrook record which updates the old forecasts of need for power in the Public Service of New Hampshire service area. However, I have attached a copy of the need for power chapter from the Seabrook EIS of December 1974. Other, more recent statistical data are available for the NEPOOL power pool which were presented by the NRC staff in the Pilgrim proceeding. (See attachment 2.) It is interesting to note that the data for winter

CONTACT:
Dennis Rathbun (OPE)
634-1541

applicant's estimates. I understand that the Seabrook plant is currently scheduled to operate about the beginning of 1983. If one knew for a fact that the plant would not be needed until the beginning of 1985 (for instance), then it would make no financial sense to complete the plant, then to remain idle for two years as an alternative to slipping the construction schedule two years now. This would be true so long as the carrying charges on the completed plant at 9.5 percent exceed the rate of price escalation at 7 percent (necessary maintenance expense aside).^{1/} However, as will be discussed below, such a scenario is highly unlikely, and the plant--if built--will be used.

Relationship of cost of delay to need for power. I noted earlier that the delay cost components mentioned by the applicant are essentially insensitive to need for power so long as the plant is ultimately built. However, I believe that additional cost penalties which were not mentioned in the applicant's materials would be involved if the Seabrook plant was completed either earlier or later than the date when the plant was actually needed. However, the potential cost penalties could consist of different components:

- Plant completed late: Reserve margins fall and risk of blackout and brownout in NEPOOL increase. Rates to consumers would rise due to the need for Public Service of New Hampshire to either (a) burn more coal (or oil) and increase capacity factors on other Public Service units or (b) purchase make-up electricity from another utility in which case the consumers would pay the full cost (i.e., fuel, O&M, and capital charges).
- Plant completed early: Reserve margins increase (potentially excessive). Rates to Public Service of New Hampshire consumers either rise or fall (on balance) through the net effect of three forces (a) reduced fuel costs in the service area due to substitution of nuclear for fossil plants, (b) increased capital costs during the period of excess capacity, less (c) any electricity sales by Public Service of New Hampshire to neighboring NEPOOL utilities.

OPE has made a quick estimate to illustrate the cost factors which would likely be involved under the assumption that the Seabrook plant becomes operational in early 1983 but was actually not needed for capacity and system reserve reasons until the beginning of 1984. The scenario here assumes that the one year excess capacity attributable to Seabrook allows substitution of nuclear for oil (which tracks the Appeal Board's theory in justifying the Seabrook plant).

^{1/}Conversely, if the price of reactors (or escalation) was increasing at a faster rate--for instance 15 percent per year in the early 70's--than the cost of borrowing to build them--say, 7 to 8 percent per year in the early 70's, then building reactors would be financial prudent so long as they could be needed and used someday. What's at work here is the general principle of financial speculation equally applicable to gold, stocks, real estate, or reactors.

For the Commission

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1. Cost of nuclear generation for Seabrook during 1983 (at 1200 MWe and 65 percent capacity factor, i.e., 6.8 billion KWH):

-- Capital		
17 percent charge rate x \$2.06 billion	=	\$350 million
-- Operation and Maintenance		
3 mills/KWH x 6.8 billion KWH	=	20 million
-- Fuel		
8 mills/KWH x 6.8 billion KWH	=	<u>54 million</u>
		\$424 million

2. Cost of oil for 6.8 billion KWH (assuming \$20/Bbl.): \$240 million

Assuming a \$7 million reduction in O&M costs for the idled oil-burning units, the cost penalty for early operation would appear to be about \$177 million in 1983 dollars (or about \$125 million in 1978 dollars--at 6 percent escalation). Of course, the exact specification of what constitutes the "need" for the Seabrook plant--and the associated cost penalties for early or late operation--are much more complex than shown here. In conclusion, I would note that it would be extremely unlikely that the plant would not be used when completed, even if completed in advance of need. The lower variable costs of the nuclear (the sum of O&M plus fuel or \$74 million in OPE's example) relative to oil (or coal) (or \$247 million in the OPE example) would lead NEPOOL to idle or reduce the use of fossil plants in favor of nuclear.

Enclosures:
As stated

cc: James Kelley
Sam Chilk

8. THE NEED FOR POWER

8.1 RESERVE REQUIREMENTS FOR THE NEW ENGLAND POWER POOL

The New England Power Pool (NEPOOL) is one of the three power pool areas in the northeastern United States; the other two areas are the New York Power Pool (NYPP) and the Pennsylvania-New Jersey-Maryland Interconnection (PJM). Together, these three areas formed, for the Federal Power Commission's 1970 National Power Survey, the Northeast Regional Advisory Committee (Fig. 8.1). All the members of the NEPOOL and the NYPP are further associated with the Northeast Power Coordinating Council and make up the majority of its membership. In general, the power pools are mostly concerned with economical planning and operation (see below), whereas the coordinating organizations are concerned with long-range plans for bulk power supply system reliability and security.¹ The Northeast Power Coordinating Council also furnishes a mechanism whereby the NEPOOL and the NYPP can cooperate and coordinate their activities with Canadian electrical systems through the Canada Eastern United States Connection.

The Northeast Power Coordinating Council has established area-wide (New England, New York, New Brunswick, and Ontario) requirements related to bulk power supply reliability. The Council has determined that each area's generating capacity should be such that its generating supply will equal or exceed area load at least 99.9615% of the time (ER, Sect. 1.1, p. 1.1-13). This is equivalent to a loss of load probability of one day in ten years (based on a 250-day year; that is, the load model excludes weekends since the load is usually depressed on these days and therefore their inclusion does not contribute measurably to the annual risk of load loss.⁴ This probability has therefore been used by the New England Power Pool in determining its reserve requirements.

The region encompassed by the NEPOOL and the areas of load concentration within this power pool are shown in Fig. 8.2. Maine constitutes the FPC Power Supply Area 1, while Area 2 encompasses the rest of New England. Members of the NEPOOL are responsible for about 95% of the total electrical energy requirements for this region.² The main objective of NEPOOL is to attain maximum practicable economy, consistent with proper standards of reliability, in the supply of bulk power (New England Power Pool Agreement, Sept. 1, 1971, p. 10). This objective is to be attained through joint planning, central dispatching, and other cooperative aspects related to construction, operation, and maintenance of electric generation and transmission facilities and to coordination with other power pools. The primary benefits of power pooling are lower installed reserve requirements, lower spinning reserve requirements, the ability to install larger generating units (resulting in economy of scale), and the ability to exchange economy energy.³ Economy of scale is a consequence of the general proposition that the bigger the plant, the lower are construction and operating costs per unit of production.

Adequate reserves for a power pool are determined by several factors. Generating capacity for forced outages make up the largest required block of reserves. This capacity is related to the reliability standards for the region (the loss of load probability mentioned above for NEPOOL), the type of generating capacity (fossil fuel, hydroelectric, or nuclear), and the size of the individual units. Reserves are also required for off-peak maintenance and to provide for uncertainties in estimating load growth. The Federal Power Commission has estimated reserve requirements for the different regions of the United States; for the Northeastern region the FPC estimates were 21 and 22% of peak demand for 1980 and 1990, respectively.⁵ The applicant has indicated that, for NEPOOL as a whole, the installed reserve requirements for 1979 to 1982 are about 24% of winter peak load requirements (ER, Sect. 1.1, Table 1.1-8). The applicant used these same reserve margins in calculating the reserve generating capacity necessary for its system. The staff considers that the estimated reserve requirements for NEPOOL and for the applicant's system are reasonable for the years 1979 to 1982. Although they are somewhat higher than that estimated (about 21%) for the period 1973 to 1978, it is generally more desirable to overestimate these requirements than to underestimate them since installation of new generating capacity can be delayed for a year or so much easier than such a project can be accelerated by a year.⁶

Since construction of new generating capacity in New England is planned and coordinated on a NEPOOL-wide basis and since the proposed Seabrook Nuclear Station is to be owned and operated by several New England Utilities (ER, Sect. 1.3, pp. 1.3-1 and 1.3-2), the need for power which the Seabrook units will satisfy will first be considered in relation to the total NEPOOL power requirement. Following this, the need for power in the area served by the applicant will be evaluated. The applicant will utilize 60% of each unit's output.⁷

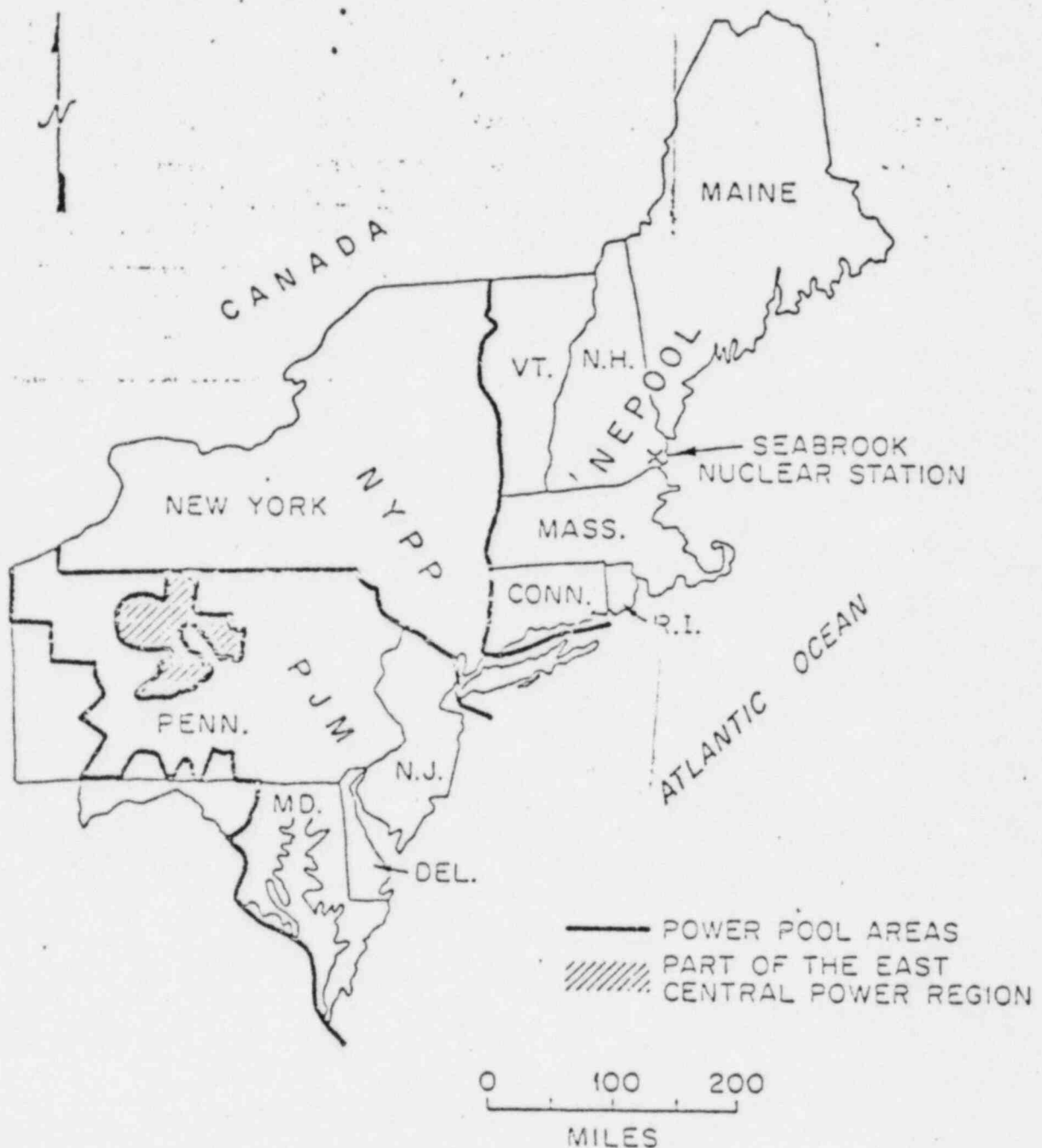


Fig. 8.1. Federal Power Commission's Northeast Regional Advisory Committee.

8.2 THE NEED FOR POWER BY THE NEW ENGLAND POWER POOL

Winter heating and lighting create the New England region's peak load in December of each calendar year. The historic peak load growth rate for the period 1965 through 1972 has averaged about 7.2%/year.⁶ The increase in annual electrical energy consumption (kWhr/year) has closely paralleled that of the peak load. For New England, total electrical sales have increased at the rate of about 7.6%/year since 1960, with the increase for the last five years averaging about 8.0%/year.⁷ This growth rate may be compared with the average annual increase in national electrical energy sales of 7.4% for the period 1961 to 1971.^{8,9,10} Thus, the historic trend of electrical energy consumption (and peak loads) for New England is very similar to that for the United States as a whole.

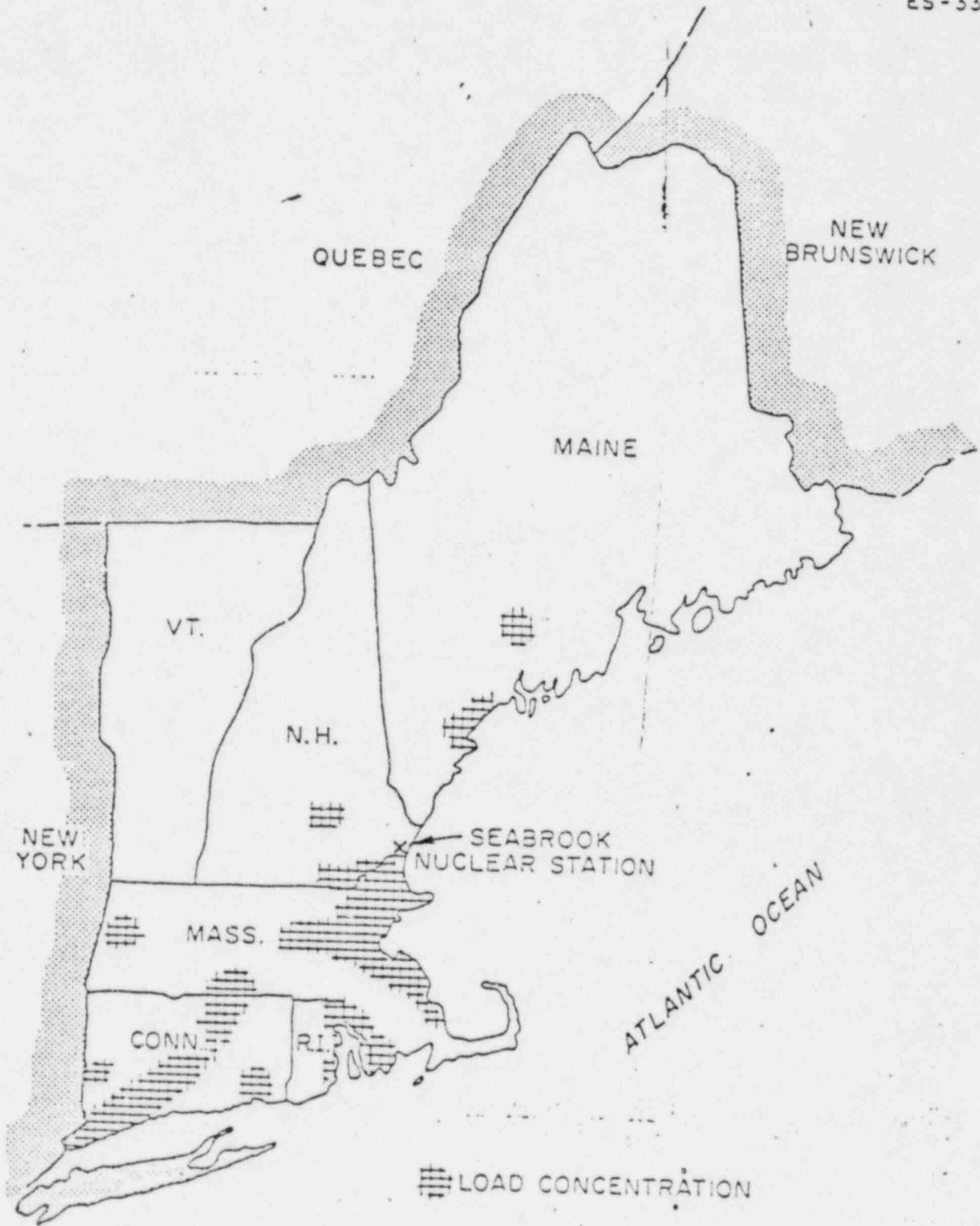


Fig. 8.2. Areas of load concentration in the New England Power Pool (NEPOOL).

Predictions of future peak demands for the New England region have been made by several organizations. The applicant has reported projected peak demands as estimated by NEPLAN, the planning arm of NEPOOL (ER, Sect. 1.1, Table 1.1.3); these are shown in Fig. 8.3, along with the historic peak demands. The projected growth rate of NEPOOL's winter peak load is about 7.8%/year. Peak load forecasts have also been made by the New England Energy Policy Staff (NEEPS), an agency of the New England Regional Commission which operates organizationally as a part of the staff of the New England Governor's Conference. For their forecasts, consumers of electricity were divided into four categories: residential, commercial, industrial, and other. Of these four categories, residential and commercial sales currently constitute a significantly larger share of the total than ten years ago.⁷ Sales in the industrial and other (which includes street lighting) categories have correspondingly decreased. It should be noted that the New England area has no major energy-intensive industries; so residential and commercial loads are a relatively high proportion of total demand. Projected residential sales (currently about 39% of the total) were based on projected population increases, on projected increases in per capita electrical energy consumption, and on other factors. The New England Energy Policy Staff expects that the annual rate of growth in per capita consumption will decrease somewhat from its 1972 rate of 8.4%/year. Commercial loads (about 28% of the total), currently increasing at the rate of about 10%/year, are expected by NEEPS to decline in growth rate to about 8.6%/year by 1980. The industrial-load (about 31% of the total) growth rate is expected to continue at an annual rate of increase of about 3.5% until 1980. The "other" category, only about 3% of the total, is expected by NEEPS to have an annual growth rate of about 4%. In their projections, NEEPS related annual consumption to peak demands to obtain the projections indicated in Fig. 8.3,¹² which are only slightly lower than those projected by NEPOOL. The Federal Power Commission has also estimated peak demands, at five-year intervals, for this region for the period 1970 to 1990;¹¹ their estimates (see Fig. 8.3) are somewhat lower than those from the other two studies, having an annual growth rate of about 5.6%.

Another estimate of future peak demands was obtained from the recent projections of electrical energy demand made by Chapman, Tyrell, and Mount.¹⁴ The staff assumed a direct proportionality between the electricity demand (kWh/year) reported by these authors and annual peak loads to obtain the curve indicated in Fig. 8.3. This latter projection agrees reasonably well with the other projections for the mid-1970's, but for succeeding years the projections are significantly lower than the other predictions. (In 1980, the lower estimate is 85% of NEPOOL's estimate.) These lower projections are primarily the result of assumptions by Chapman, Tyrell, and Mount that expected increases in the price of electricity will result in a decrease in consumption, and the degree to which their predictions may be borne out will not become readily apparent until the late 1970's. The staff concludes that peak electrical demands for the New England Power Pool will probably fall within the limits shown in Fig. 8.3 for the period 1975-1985.

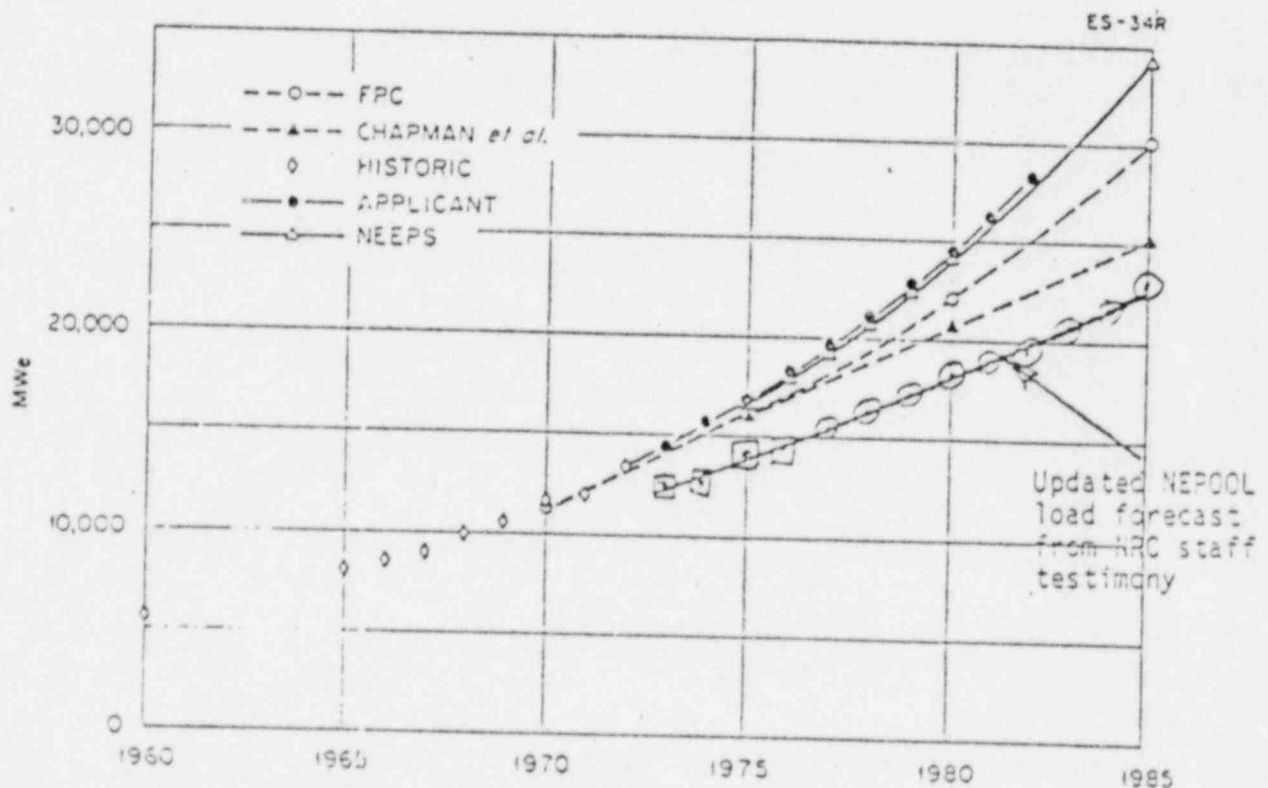


Fig. 8.3. Historic and predicted annual peak demands for the New England Power Pool.

8.3 THE APPLICANT'S NEED FOR POWER

Public Service Company of New Hampshire supplies electricity to a service area having an estimated population of 639,000 (1972); this includes about 80% of the population of New Hampshire, 13 border towns in Maine, and 6 border towns in Vermont.¹⁵ The applicant also supplies electricity at wholesale prices to another 10% of New Hampshire's population.¹⁶ The applicant's service area encompasses about 5349 square miles,¹⁷ which represents about 64% of the land area of New Hampshire. Their retail and wholesale service areas are shown in Fig. 8.4.

In 1972, the applicant had a total effective generating capability within its service area of 853.1 MWe, which included 691.1 MWe from fossil-fueled steam stations (five stations with capacities ranging from 14.6 to 456 MWe); 48 MWe hydro (ten stations with capacities ranging from 1 to 16 MWe); 111 MWe gas turbine (four stations with capacities ranging from 18 to 46 MWe); and 3 MWe diesel (one station). The applicant also owns a 7% interest in Yankee Atomic Electric Company, a 5% interest in Connecticut Yankee Atomic Power Company, a 5% interest in Maine Yankee Atomic Power Company, and a 4% interest in Vermont Yankee Atomic Power Company. A 400-MWe fossil-fueled steam station at Newington is scheduled to be available in June 1974 (ER, App. L, p. 54). No further additions are scheduled until 1979 and 1981, when Units 1 and 2 of Seabrook are expected to add 575 MWe each to the system. Scheduled retirements in 1973 were expected to reduce the hydro capability by 4 MWe (three stations) and the fossil-fueled station capability by 14.6 MWe (one station) (ER, App. L, p. 52).¹⁸ The major generating units which will be a part of the system by the end of 1974 are shown in Fig. 8.4.

The applicant's sales increased at an annual rate of about 11.1% during the period 1967 to 1972 and at about 9.5% since 1961. The peak load has increased at a rate of about 10.6%/year in the period 1967 to 1972 and at about 9.2%/year since 1961. These rates are about 2 to 3% higher than those given earlier for New England as a whole, indicating that New Hampshire's consumption of electricity is increasing at a significantly higher rate than the average for New England. This is apparently related to population trends; New Hampshire is the fastest growing of the New England states. Historic peak loads for the applicant are shown in Fig. 8.5.

The applicant has estimated annual peak loads (expected to occur in December of each year), from 1973 to 1982 (ER, Sect. 1.1, Table 1.1-2); these are included in Fig. 8.5. Future growth is projected at the rate of about 10.1%/year. The applicant's values were obtained by projecting relevant historical peak-hour demands and verifying these by comparison with forecasted kilowatt-hour sales. For this purpose, sales were divided into five categories: residential, commercial, industrial, public street lighting, and other public utilities.

Peak loads for New Hampshire have also been estimated by NEEPS¹² and are also shown in Fig. 8.5. These estimates indicate annual increases at the rate of about 3.3% and are considered by NEEPS to represent minimum generation needs — those that might be expected if effective energy conservation measures are implemented. If future price increases (which are reasonably to be expected) tend to reduce the consumption of electricity,¹⁹ then lower peak loads than the applicant predicts might be anticipated. In the preceding section it was indicated that, if such price elasticity was assumed, then the demand expected on that basis might be about 15% lower than NEPOOL's predictions for 1980 for New England (see Fig. 8.3). A corresponding value for 1980 for New Hampshire (85% of the applicant's projection) is very close to the value projected by NEEPS. The predicted values shown in Fig. 8.5 represent a range of about 215 and 310 MW for 1979 and 1981, respectively. Since nationwide implementation of strict energy conservation measures beginning in late autumn 1973, the applicant's energy sales and monthly peak demands have generally been below earlier predictions contained in the Environmental Report. From November 1973 through May 1974, the applicant's monthly energy sales increased an average of about 0.9% as compared to the previous year's values.¹³ Normalizing with respect to degree-days for each period gave an increase of 1.5% from the previous year's values. Increases in energy demand for the same period averaged 4% comparing the actual previous year's monthly demands and, normalized, averaged about 8.3% below the predicted demand. The applicant has recently revised his projected energy sales and peak loads for the period 1974 to 1982.¹⁹ The revised demands are given in Fig. 8.5 and average about 12.0% lower than the values predicted earlier. The decrease in energy sales averages about 6.6% lower than the values predicted earlier.

Figure 8.5 is a plot vs time of the applicant's power-producing capability according to fuel type, the estimated peak power demand, and the demand plus NEPOOL-required reserves. These reserves have been calculated on a pool-wide basis and represent a desirable reserve margin that the applicant is expected to maintain. This figure indicates that the applicant's planned capacity will be adequate to supply the anticipated demands but that the reserve margin will generally be less than is considered desirable.

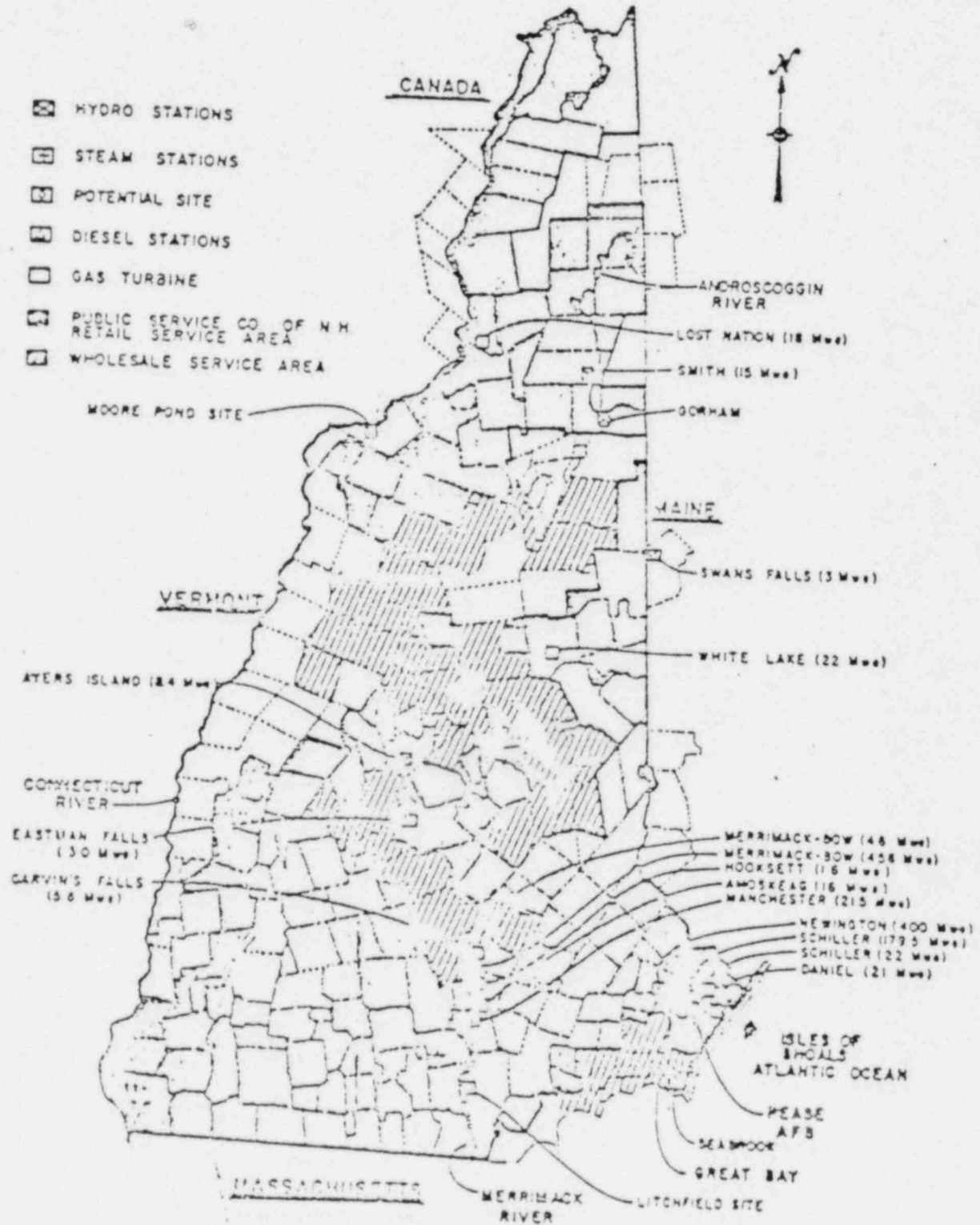


Fig. 8.4. Applicant's service area and station locations.

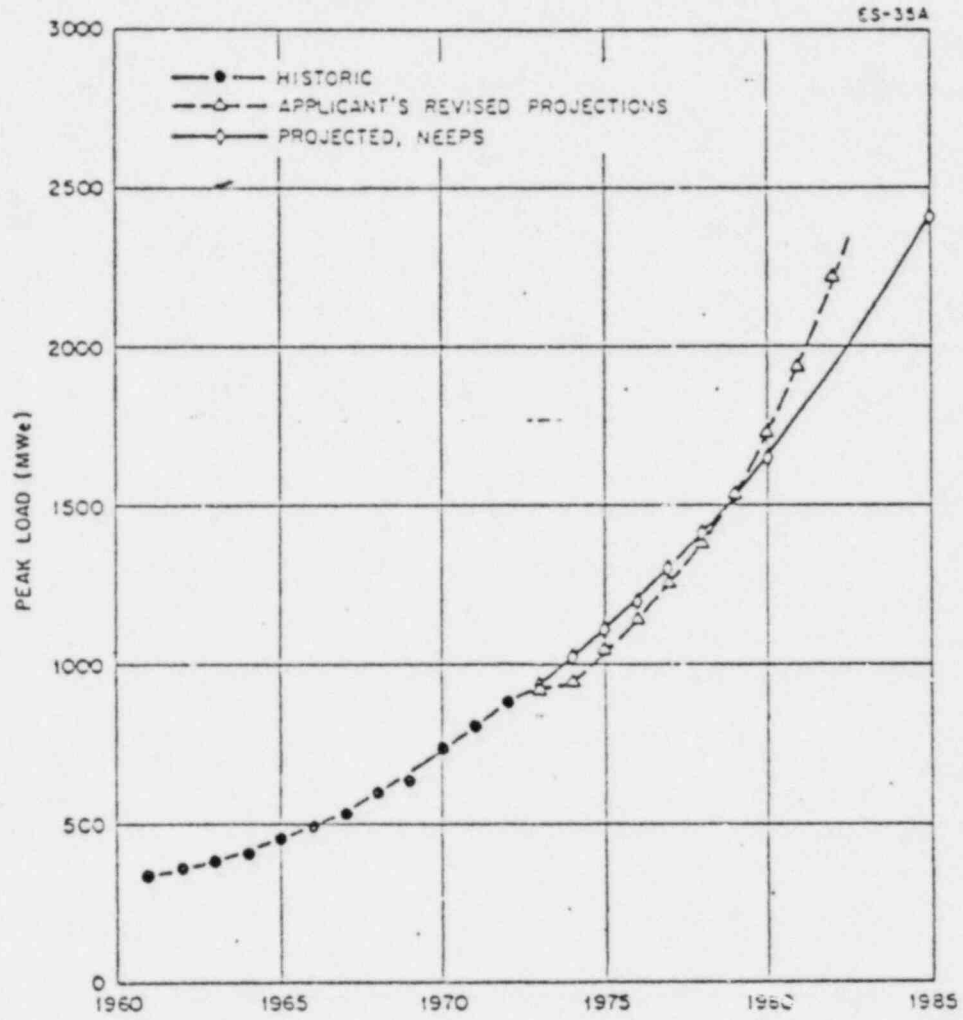


Fig. 8.5. Historic and predicted annual peak demands for the applicant's service area.

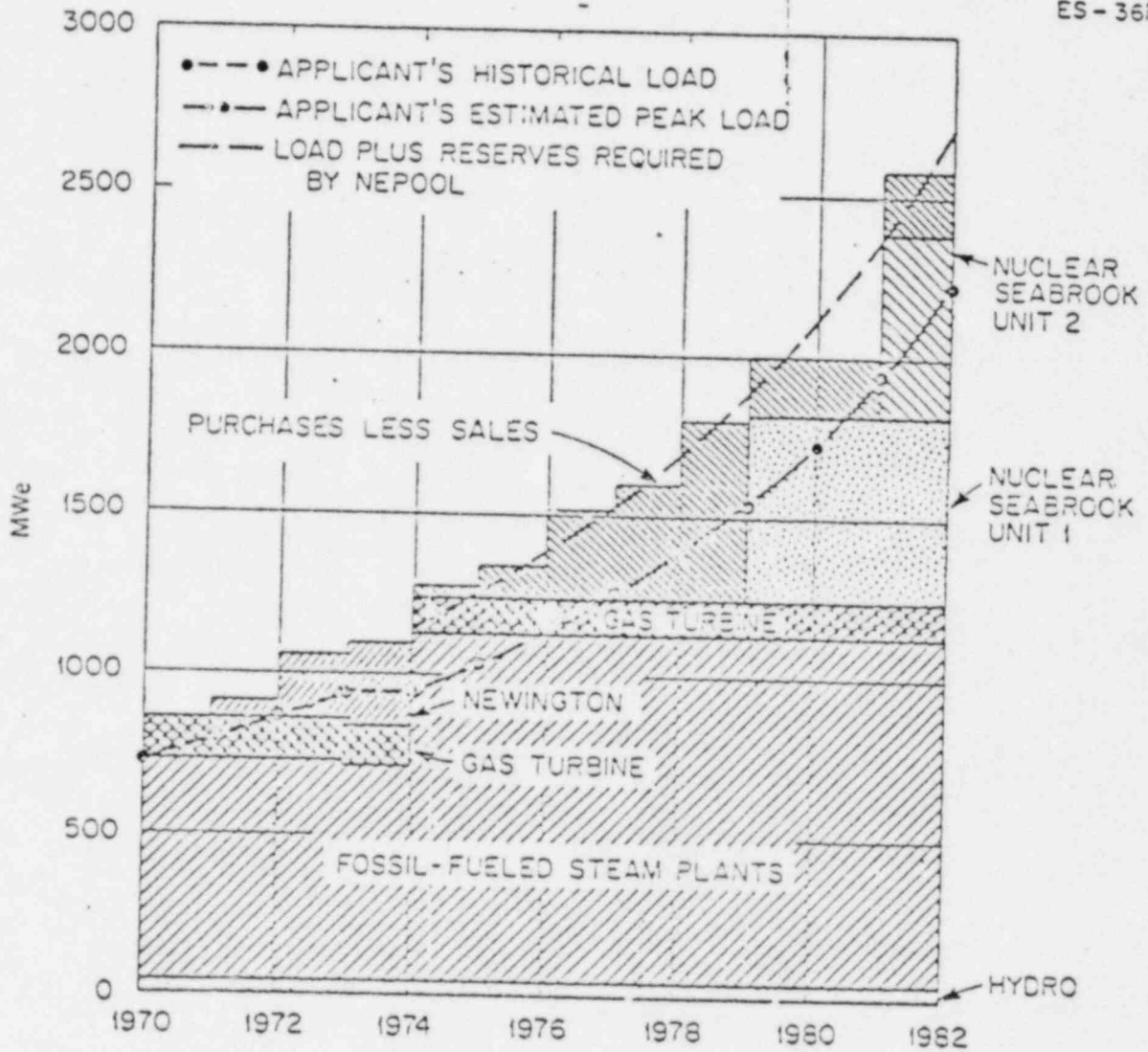


Fig. 3.6. Power-producing capacity existing and planned by Public Service Company of New Hampshire.

8.4 IMPACT OF CONSERVATION OF ENERGY ON NEED FOR POWER

Today's energy "crisis" has focused the nation's attention on the importance of energy conservation. In fact, conservation of energy has been recommended by the Report to the President on the Nation's Energy Future²⁰ as one of five major efforts in meeting the energy needs of the future. Conservation of energy is related to eliminating the need for power to be produced by the Seabrook Station is considered in the following sections.

8.4.1 Promotional advertisement

In the past, electric utilities have attempted through advertising to accelerate the demand for electricity in their service areas. The advertising program was primarily aimed at promoting uses of electricity which would create electrical demand during off-peak periods. The need for expensive peaking capacity could thereby be shifted to lower-cost base-load capacity. In this regard, electric heating and all-electric houses and apartments have gained acceptance by builders and buyers throughout the United States. All-electric homes are even more important today as a result of the reduced supply of fuel oil and the restricted supply of natural gas. Recent projections of national use of electric space heating indicate that it will grow from 7.6% of all homes in 1970 to 16% in 1980 and to 27% in 1990.²¹ This anticipated growth level is based more strongly on projected socioeconomic factors (such as per capita income, housing developments, and life styles) and technical factors (such as availability) than on the resulting impact of promotional advertising by the utilities. The applicant terminated newspaper promotional advertising in October 1971; electric water heating allowances in February 1971; residential electric space heating wiring allowance in February 1973; and non-residential allowance in April 1973. Currently the only advertisement is concerned with conservation of energy and good management of electricity.²² Federal Power Commission now requires utilities to report the conservation of energy methods they are employing in their service area monthly.²³ However, promotional advertising by manufacturers of electric appliances and equipment has not been eliminated. These manufacturers spent an estimated \$450 million in promotional advertising in 1970.²⁴ This amount may be increased to replace the loss of utility advertisement if considered necessary to maintain or increase their present sales. For these reasons the reduction in future demands brought about by reduction in promotional advertising by the utility is only speculative.

8.4.2 Change in utility rate structure

The Federal Power Commission regulates the transmission and sale of energy in interstate commerce²⁵ and for resale in the applicant's area, while the New Hampshire Public Utilities Commission regulates the rates utilities charge the ultimate consumer in the applicant's service area.²⁶

Historically, utility rate structures were designed to encourage consumption of electricity primarily by using the declining block rate, which reflected the declining average cost of furnishing additional kilowatt hours of electrical energy to each customer. In the past the economic logic for declining block rates was never seriously disputed. Today, however, under conditions of increasingly scarce fuel resources, declining block rates, by lowering the price of each additional kilowatt hour, may tend to encourage unnecessary use of electricity by individual consumers and also encourage individual consumers to use more and more electricity at the expense of other energy sources.

The most commonly mentioned alternatives to declining block rates to dampen demand for electricity are increasing block rates and peak load pricing. With sufficient economic incentive, total demand could be reduced, or at least its rate of growth reduced. Table 8.1 presents some statistics on the average cost of electricity to consumers and the average energy (kilowatt-hours) used per customer from 1964 through 1971. In this time period the average energy used by a customer in the three major classifications (residential, commercial, and industrial) of energy users has steadily increased. From 1964 to 1968 the average cost to all three classes of consumers decreased. The cost started to increase in 1970 for residential and commercial consumers, while industrial consumers' rates started increasing in 1969. Statistics such as these indicate that, even though the price of electricity is increasing across the United States, the demand is still increasing. The question that statistics such as these do not answer is at what point the costs of residential and commercial electricity will cause the consumer to significantly decrease his demand.

Since the demand for electricity is also sensitive to such other factors as gross national product, the local economy, the substitution of electricity for more scarce fuels, population growth, and local temperature variations, there are questions of how long it would take a rate change to have a detectable effect considering these other variables. It has been demonstrated by one study based on 1970 data that even assuming near zero population growth, a drop to one-half the present rate of growth in individual wealth, and a corresponding 50% reduction in the current rate of increase in power use in the next decade, the U.S. consumption of electricity

will still triple by 1990.²⁷ This study suggests that conservation programs instituted today will most likely not produce a major impact on electrical demand until 1990 or later. Even if rates were proved to have an immediate effect on demand, the time required for the Public Service Commissions to change their present rate structure would result in a still longer period of time before the desired consumer response would have a detectable effect.

Table 8.1. Statistics on cost and consumption of electricity^a
(1964-1971)

Year	Average cost to consumers (cents per kilowatt-hour)			Average kilowatt-hours per customer (thousands)		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
1971	2.32	2.20	1.10	7.639	42.598	1735.482
1970	2.22	2.08	1.02	6.700	40.480	1695.087
1969	2.21	2.06	0.98	6.246	37.607	1666.019
1968	2.25	2.07	0.97	5.706	35.009	1578.366
1967	2.31	2.11	0.98	5.200	32.234	1481.496
1966	2.34	2.13	0.98	4.931	30.238	1445.802
1965	2.39	2.18	1.00	4.618	28.093	1289.949
1964	2.45	2.26	1.02	4.377	25.450	1217.878

^aFederal Power Commission, *Statistics of Privately Owned Electric Utilities in the United States, 1971*, FPCS 226, U.S. Government Printing Office, Washington, D.C., October 1972.

8.4.3 Selective load-shedding during peak demand

In determining the possibility of using load shedding as a technique that might eliminate the need for additional electricity from the plant, it is first important to distinguish between load curtailment or load relief measures and load shedding.

Load curtailment measures include all methods of reducing demands on electric utility systems during periods when capacity is inadequate, for whatever reason, to serve load. A list of load curtailment measures follows: (a) Curtailment of all nonessential electric power usage at all utility-owned power plants and office facilities. (b) Discontinuing service to contractually interruptible loads. Interruptible loads are served under contracts which provide for the interruption of electric service with little or no prior notice. The number and duration of the interruption may also be specified in the contract. In return for the lower quality of service the interruptible customer is charged reduced rates. (c) Voltage reduction. Generally, voltage levels may be reduced 3 to 5%, but in exceptional situations an 8% reduction may be effected. (d) Voluntary curtailment of nonessential loads of large commercial and industrial customers. These methods of decreasing demand during emergency periods have been used successfully by many utilities. The applicant has no contracts for interruptible service.²⁸ However, for interruptible load contracts to be effective in system planning, the load reduction must be large enough to be effective in system stability planning. Thus, this type contract is primarily related to industrial customers. Even if the applicant had 1200 Mwe of interruptible load, it is speculative to project that the customers would continue this contractual relationship if faced with frequent and long periods with no electrical service. The other load curtailment measures described are desirable only for emergency procedures.

Load shedding, whether manual or automatic, involves interrupting or disconnecting customer service for a period of time necessary to restore the system frequency to normal conditions. Load shedding is generally accomplished in blocks of 5 to 10% of system load. The total magnitude of load shedding generally varies between 25 and 35% of system load.²⁹

The applicant has a load curtailment and load shedding plan consisting of emergency procedures to go into effect when required by power shortages; however, no-load shedding has occurred in the past 5 years.

Voltage reductions have been imposed on occasion. A tabulation of frequency of voltage reduction is given below:

<u>Year</u>	<u>Frequency</u>
1969	35
1970	33
1971	11
1972	4
1973	27

In November 1973 the applicant imposed a daily voltage reduction of 5% during the hours of 5 to 7 pm (6 to 10 pm EDT) as a means for conserving oil. The voltage reduction has not been used during those periods with longer daylight hours.

The Federal Power Commission's report on the major load shedding that occurred during the Northeast Power Failure of November 9 and 10, 1965, indicates that reliability of service of the electrical distribution systems should be given more emphasis, even at the expense of additional costs.¹⁰ This report identified several areas that are highly impacted by loss of power, such as elevators, traffic lights, subway lighting, prisons, and communication facilities. It is the serious impact on areas such as these that result in load shedding as only a temporary method to overcome a shortage of generating capacity during an emergency. It cannot be considered as a viable alternative for required additional capacity.

3.4.4 Factors effecting the efficient utilization of electrical energy

Promoting the efficient utilization of electrical energy by developing new standards for insulation, new lighting requirements for buildings, and energy-efficient labeling will result in reduction in long-term growth of energy requirements in the applicant's service area.

In general, municipalities adopt and enforce local building codes which govern the standards for buildings and structures. Apart from these requirements, the owner of a house or commercial building would increase the economically optimum quantity of insulation. As local building codes are changed and insulation in existing structures increased, the change in both summer and winter demand in the applicants' service area will be reflected in their historical loads. However, it is speculative at this time to predict which codes will be changed and which homeowners will add insulation so that the projected peak demand could be reduced.

With respect to new lighting requirements, electrical energy savings do to some extent appear possible for both new and existing residential and commercial buildings. Encouraging residential customers in existing houses to use lower-wattage electric bulbs and reduce usage is important in the next decade as an emergency conservation measure and will complement savings brought about by institution of new standards and requirements in new house construction. Fluorescent lighting is about four times more efficient than incandescent lighting and is presently in widespread use in industry and commerce. Most residential houses have incandescent lighting. One study indicated that if all households in 1970 had changed to fluorescent from incandescent lighting, the residential use of electricity for lighting would have been reduced approximately 75%, and total electrical sales would be reduced approximately 2.5%.²¹ However, since the majority of residential lighting occurs in off-peak hours, the reduction on peak demand would be less than 1%. Thus the electrical savings resulting from new lighting changes on peak demand is uncertain.

The importance of energy efficiency labeling of appliances is that it will allow the consumer to select the most energy-efficient appliance. Table 8.2 projects the average annual use of electricity by household appliances based on historical trends. As indicated, space heating, water heating, air conditioning, freezers, cooking, and clothes drying are among the large uses of electricity in residential appliances. Of these appliances, improvement in the efficiency of air conditioners has been a major area of consideration since air conditioners contribute substantially to the peak summer demand.

For instance, making air conditioners function with lower energy demand typically requires a combination of increased heat exchanger size and higher-efficiency compressors. This results in higher initial cost. Estimates of the cost differential for a typical room air conditioner to double the efficiency from 5.5 to 11 Btu per watt is approximately \$100.²² For this conservation of energy method to be effective, the consumer must be convinced that it is profitable for him in the long term to purchase the more expensive machine. This will require a public educational program and effective energy-efficiency labeling. In addition, selection of central air conditioners by subdivision developers has historically been based on minimizing front end costs

consistent with meeting local building codes. This approach continues to favor the lower-cost units. Thus the reduction in peak demand due to energy-efficiency labeling is undeterminable at this time.

Table 8.2. Projections of average annual electricity use^a

	Average annual electricity use in households having the appliance (kWhr/household)		
	1970	1980	1990
Refrigerators	1,300	1,600	1,800
Air conditioning			
Room	1,946	2,000	2,000
Central	3,560	3,600	3,600
Lighting	750	850	900
Space heating	14,558	15,000	15,000
Water heating	4,500	4,800	4,800
Clothes drying	993	1,000	1,000
Cooking	1,175	1,200	1,200
Television	417	440	470
Food freezers	1,384	1,500	1,600

^a Tansil, *Residential Consumption of Electricity 1950-1970*, ORNL-NFS-EP-51, July 1973.

In addition, the staff is aware that the National Institute of Occupational Safety and Health has recommended best stress standards to the Occupational Safety and Health Administration which, if adopted, would require a significant number of employers to air condition their plants.³¹ This possible requirement, coupled with future substitution of electrical energy for fuels in short supply, namely oil and natural gas, will tend to increase the demand for electrical power and thus make any reduction in the future peak demand for electricity due to this conservation of energy measure speculative.

8.5 SUMMARY AND CONCLUSIONS

The staff has considered the historic power usage of New Hampshire, New England, and the United States as a whole and has evaluated predictions made by the applicant, and others, as to power requirements for New Hampshire and New England for the period 1973 to 1985. The staff recognizes the obligation of the applicant to plan for capacity adequate to meet any reasonably anticipated growth of demand and electrical energy consumption in its service area with the high degree of reliability required by the power pool to which it belongs. The staff realizes also that these plans must be initiated, for base-load power stations, 5 to 10 years or more in advance of power production. The staff also takes cognizance of the shortage of energy which has recently occurred throughout the United States and which is expected to continue for about a decade. The staff takes note of energy conservation measures which have been implemented throughout the country and which have apparently significantly reduced electrical energy demand and consumption since late 1973.³² The extent to which this demand continues to be reduced as a result of energy conservation, or is further reduced by price elasticity considerations, or is increased as a result of substitution of electrical energy for petroleum is extremely difficult to predict at this point. Even in more "normal" situations, the Federal Power Commission's Advisory Committee on Load Forecasting Methodology concluded "that no single method, or group of methods currently in use by the industry alone can assure success in load forecasting and that judgment based on intimate knowledge of the service area is an indispensable element in any load forecast."³³ The staff anticipates that reduced demand will only delay, and not eliminate, the need for additional capacity. However, building unneeded generating capacity will result in excess system capacity, reduced load factor, and probably less-economical production of electrical power. The cost of overbuilding, to the consumer, will occur if the annual expenses due to long-term fixed charges on the new excess capacity exceed the savings resulting from the lower cost of fuel used in the new capacity. The capital costs of the new excess capacity will also potentially contribute to increased consumer costs since a private utility's allowed profit (by State Public Service Commission) is usually related to its capital investment; therefore, adding a station with large dollar/kwh capital costs to a utility's rate base, with no significant increase in kilowatt-hour

production, will generally result in a significant increase in kilowatt-hour costs to the consumer. These costs can be alleviated somewhat by a lengthening in the construction schedule of new power-generating capacity if the power demand grows less rapidly than current projections. Adverse effects of underbuilding include increased probability of voltage reductions and blackouts as a consequence of lessened reliability of the system.

Another factor to consider with respect to supplying power is the availability and cost of fuels used in the applicant's existing plants. As discussed in Sect. 9, there is substantial uncertainty with respect to the availability and prices of fossil fuels, particularly coal and oil, for electrical power generation in New England. Moreover, these fuels are more versatile resources than uranium since they can be used for a variety of purposes other than power production. Therefore the availability of uranium-fueled Seabrook Units 1 and 2 to substitute for fossil-fuel-consuming power stations might be desirable even though overall power requirements may not be at the applicant's predicted levels by 1979 to 1982.

The staff concludes that the applicant's predictions of future peak power demand and energy requirements are reasonable and consistent with independent analyses of power needs in the New England region. Further, in view of the projected amounts of base-load power expected to be supplied from the Seabrook Station and the uncertainties about fossil fuels, it is prudent for the applicant to proceed with construction as proposed.

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