THE UNITED STATES OF AMERICA
BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION

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| RE: THE APPLICATION OF THE MONTAUP ELECTRIC COMPANY FOR AUTHORITY TO INCREASE RATES | Dockets No. ER81-749-000 and No. ER82-325-000 (Phase II) |

# TESTIMONY OF PAUL CHERNICK
# ON BEHALF OF THE
# ATTORNEY GENERAL OF MASSACHUSETTS

April 27, 1984

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### 1 - INTRODUCTION AND QUALIFICATIONS

Q: Mr. Chernick, would you state your name, occupation and business address?

A: My name is Paul L. Chernick. I am employed as a research associate by Analysis and Inference, Inc., 10 Post Office Square, Suite 970, Boston, Massachusetts.

Q: Mr. Chernick, would you please briefly summarize your professional education and experience?

A: I received a S.B. degree from the Massachusetts Institute of Technology in June, 1974 from the Civil Engineering Department, and a S.M. degree from the Massachusetts Institute of Technology in February, 1978 in Technology and Policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, and the engineering honor society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi.

I was a Utility Analyst for the Massachusetts Attorney General for over three years, and was involved in numerous aspects of utility rate design, costing, load forecasting, and evaluation of power supply options. My work has considered, among other things, the need for new power supply investments, and the likely costs of those investments, particularly in nuclear power, and the availability and cost of alternatives to proposed supply sources.

In my current position, I have advised a variety of clients on utility matters. My resume is attached to this testimony as Appendix A.

Q: Mr. Chernick, have you testified previously in utility proceedings?

A: Yes. I have testified approximately twenty-five times on utility issues before such agencies as the Massachusetts Department of Public Utilities, the Massachusetts Energy Facilities Siting Council, the Texas Public Utilities Commission, the Illinois Commerce Commission, the New Mexico Public Service Commission, the District of Columbia Public Service Commission, the New Hampshire Public Utilities Commission, the Connecticut Department of Public Utility Control, the Michigan Public Service Commisssion, and the Atomic Safety and Licensing Board of the U.S. Nuclear Regulatory Commission. A detailed list of my previous testimony is contained in my resume. Subjects I have testified on include cost allocation, rate design, long range energy and demand forecasts, costs of nuclear power, conservation costs and potential effectiveness, generation system reliability, fuel efficiency standards, and ratemaking for utility production investments and conservation programs.

Q. Do you have a track record of accurate predictions in capacity planning?

A. Several of my criticisms of utility projections have been confirmed by subsequent events or by the utilities themselves. In the late 1970's, I pointed out numerous errors in New England utility load forecasts, and predicted that growth rates would be lower than the utilities expected. Many of my criticisms have been incorporated in subsequent forecasts, and load growth has almost universally been lower than the utility forecast.

For example, in my testimony in MEFSC 78-33, filed November 27, 1978, I described a large number of errors in EUA's 1978 forecast, most of which would exaggerate growth rates. The 1978 forecast projected a peak of 761 MW in 1982 and 1029 MW in 1989. Since the 1982 peak was actually 680 MW (about 1% higher than the 1978 peak), and since EUA's current forecast predicts 733 MW in 1989, reality has confirmed my criticisms and EUA has implicitly, and in some cases explicitly, accepted them. The history of EUA's load forecasts since 1976 is displayed in Figure 1.1.

A similar situation arose in MDPU 19494, Phase I, and MEFSC 78-33. My joint testimony with Susan Geller, filed June 12, 1978, discussed in considerable detail some of the errors and overstatements in Boston Edison's 1978 forecast. A number of other witnesses addressed other problems with the methodology. That 1978 BECo forecast projected a peak of 2427 MW in 1983 and 2966 MW in 1988, as compared to an actual 1983 peak of 2233 MW, and a current forecast of 2399 MW in 1988. Figure 1.2 shows the evolution of BECo's load forecasts.

My analyses of other utility forecasts, including Northeast Utilities, Public Service of New Hampshire, Central Maine Power, the NEPOOL forecasts, and various smaller utilities, have been similarly confirmed by the low load growth over the past few years, and by repeated downward revisions in utility forecasts.

My projections of nuclear power costs have been somewhat more recent, but utility projections have already to confirmed my analyses. For example, in the Pilgrim 2 construction permit proceeding (NRC 50-471), Boston Edison was projecting a cost of $1.895 billion. With techniques similar to those used in this testimony, I projected a cost between $3.40 and $4.93 billion in my testimony of June, 1979. Boston Edison's final cost estimate (issued when Pilgrim 2 was canceled in September 1981) stood at $4.0 billion. Figure 1.3 displays the history of BECo's estimates of Pilgrim 2 construction cost; Figure 1.4 shows the changes in BECo's in-service date projections.

In MDPU 20055, PSNH projected in-service dates for Seabrook of about 4/83 and 2/85, at a total cost of $2.8 billion. I predicted in-service dates of 10/85 and 10/87, with a cost around $5.3-$5.8 billion on PSNH's schedule or $7.8 billion on a more realistic schedule. At the time I filed my testimony in NHPUC DE 81-312, PSNH was projecting in-service dates of 2/84 and 5/86, with a total cost of $3.6 billion, while I projected dates of about 3/86 and 6/89, and a cost of about $9.6 billion. Within two months of my filing, PSNH had revised its estimates to values of 12/84, 7/87, and $5.2 billion. On March 1, 1984, PSNH released a new cost estimate of $9 billion, with inservice dates of 7/86 and 12/90. Thus, PSNH's estimates of Seabrook in-service dates and costs have increased by a factor of more than three since the filing of DPU 20055, and are now relatively close to my projections. Figure 1.5 compares the history of PSNH cost estimates for Seabrook to my estimates.

Critiquing and improving on utility load forecasts and nuclear power cost projections has not been very difficult over the last few years. Many other analysts have also noticed that various of these utility projections were inconsistent with reality.

Q: What is the subject of your testimony?

A: I have been asked to review the information available to Montaup and BECo in connection with their various decisions to initiate and continue their involvement in the Pilgrim 2 nuclear power plant construction project. I have specifically been asked to determine what a responsible and prudent utility would have known at critical points in the project, and to describe appropriate responses to the information whilch was available at those times.

Q: How is your testimony structured?

A: The second section of my testimony will discuss the state of the nuclear power industry in 1972, when Montaup signed the Pilgrim 2 Joint Ownership Agreement, and describe some of the facts of which Montaup was, or should have been, aware at that time. I will then consider, in section 3, the changes in circumstances between 1972 and 1976, and identify some of the concerns with which the Pilgrim 2 participants should have been dealing. The fourth portion of this testimony will consider the state of the industry, Pilgrim 2, and the participants in 1980. In the fifth section, I will review the testimony of Montaup's witnesses in this case, particularly Mr. Gmeiner and Mr. Staszesky, to correlate the attitudes and misconceptions revealed in their testimony with the errors their respective companies made in the course of attempting to construct Pilgrim 2. Finally, in my conclusions, I will summarize and interpret the results of the previous sections, and suggest appropriate actions for Montaup and the Commission, in light of the facts I present.

## 2 - THE NUCLEAR INDUSTRY IN 1972

Q: Why is the status of the commercial nuclear power industry in 1972 pertinent to this proceeding?

A: One of Montaup's arguments for recovery of its Pilgrim 2 costs appears to run as follows:

1. Montaup's decision to sign the Pilgrim 2 Joint Ownership aggrement in 1972 was appropriate;

2. Montaup had no control over the terms of that agreement;

3. those terms denied Montaup of any control over the Pilgrim 2 project;

4. given that lack of control, Montaup had no interest, ability or need to review the status and viability of the project, unless it contemplated selling its ownership share; and

5. by the time that sale of its Pilgrim 2 interest was an attractive alternative, there were no buyers.

Therefore, Montaup appears to argue that it made, and had an obligation to its ratepayers to make, only one decision:

whether to enter into the ownership agreement.

Q: When it entered into the ownership agreement, were there any particular considerations of which Montaup should have been aware?

A: Yes. Any utility with large enough a staff to keep up with the general industry literature,[1] should have been aware of two crucial facts:

1. Nuclear cost estimates were unreliable and almost always understated, and

2. Nuclear schedules were unpredictable and usually stretched out well beyond the expectations of the owners and their architect/engineers.

Q: On what do you base this statement?

A: I have two sources. First, there is the data itself. Table 2.1 summarizes the cost estimate histories of all the commercial nuclear power plants which were in commercial operation by the end of 1972, and which were built without any extraordinary cost guarantees.[2] For each of these six

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1. Examples of this literature would include **Electrical World** and **Power Engineering** magazines.

2. I have excluded both the turnkey plants, for which the manufacturers provided at least partial cost caps, and the reactors for which the federal government provided cost sharing.

units, Table 2.1 lists the actual commercial operation date (COD), the actual construction cost, the date of the first cost estimate for which I was able to obtain suitable data, and the estimated cost and COD for that estimate. It is certainly not difficult to determine that both the cost estimates and construction schedules of these units grew significantly during their planning and construction.

Most of my cost and schedule history data is drawn from the database listed in Appendix B, which shows all of the changes in cost or schedule indicated in cost estimate history summaries provided by EIA. Those summaries are condensations of the Quarterly Construction Progress Reports (Form HQ-254 and Form EIA-254) filed by most nuclear utilites with the AEC, and later with ERDA and EIA. This data base also includes later estimates for these units. Where important data was missing from the HQ-254's, data from various published sources was used. Final cost and commercial operation date information, for example, is generally from reports to the FPC and the FERC, and the operation date information may therefore differ from NRC figures.

To quantify the extent of the errors in cost and schedule estimation for these six units, I have computed four statistics for each estimate: the projected years to COD (or "duration") at the time of the estimate, the ratio of final cost to the projected cost at the time of the estimate (the "cost ratio"); the cost ratio expressed as a growth rate, annualized by the estimated time to completion (the "myopia factor"); and the ratio of the actual remaining time until commercial operation to the projected time (the "duration ratio"). These terms are all fairly self-explanatory, except for myopia, which is defined as

$$(\text{cost ratio})^{(1/\text{estimated duration})}$$

Roughly speaking, the average myopia indicates that the actual cost of these units was typically 18% greater than the estimate, for each year that construction was expected to take. The cost ratio demonstrates that the average plant cost over twice as much to complete as initially estimated, while the duration ratio indicates that the plants took almost half again as long as was projected.

Q: What do these results imply for Pilgrim 2?

A: If the nuclear industry's ability to forecast costs had not improved, it would be appropriate to apply these results to the initial cost and schedule estimates for Pilgrim 2 ($402 million and a COD of 11/78, or 6.75 years from the 2/72 estimate date), to produce revised estimates. Multiplying $402 million by the average cost ratio of 2.06 produces a corrected cost estimate of $828 million. However, the estimated duration for Pilgrim 2 was somewhat longer than for the units in Table 2.1, so applying the average myopia factor of 18.1% for 6.75 years would produce a cost ratio of 3.07, and a Pilgrim 2 cost of $1236 million. Finally, multiplying the estimated Pilgrim 2 duration ratio by the average duration ratio of 1.479 produces a corrected duration estimate of 9.98 years, and a COD of 2/82. Thus, if the factors which had caused other nuclear power plant estimates to be incorrect also operated for Pilgrim 2, it would be considerably more expensive and time-consuming to construct than was implied by the official BECo/Bechtel projections.

Q: Have you performed any other analyses of the nuclear power plant cost and schedule information available by the end of 1972?

A: Yes. Table 2.2 repeats the duration analysis in Table 2.1, but for the turnkey and demonstration units excluded from the previous table. As would be expected, the cost estimates for the turnkey units tended to be somewhat more stable than for the conventionally priced units, but the two demonstration units for which I have data are even worse than the later commercial units. The duration ratio for this entire set is nearly as bad as for the commercial units.

Tables 2.3 and 2.4 list the units which were planned or under construction as of the end of 1972, and for which at least two cost or schedule estimates were available. For each unit, these tables list the earliest available estimate and the most recent estimate as of the end of 1972. I have computed two summary statistics. The first statistic is the "cost growth rate", simply the annual rate of increase in the cost estimate, from the first projection to the most recent. The second statistic is the "progress ratio", which is the ratio of progress towards completion (the decrease in projected months to operation), divided by elapsed months, both calculated from the first available estimate to the most recent estimate as of 12/72. The data from which this analysis is taken may also be found in Appendix B. To calculate the effect on Pilgrim 2 if these trends had extended to its cost and schedule evolution, we may divide the projection of 6.75 years by the average progress ratio of 46%, to yield a corrected duration of 14.67 years (indicating that Pilgrim 2 would have been completed in 10/86) and increased the cost estimate of $402 million by 14.67 years of cost growth at 20.8% annually, for a final cost of $6.4 billion.

Q: What significance do these results have for Montaup's decision to enter into the Pilgrim 2 joint ownership agreement?

A: They indicate that both Montaup and BECo knew, or should have known, while Montaup was deciding to join in constructing Pilgrim 2, that construction cost and duration estimates for other nuclear units had been significantly understated, and thus that the cost and schedule estimates for Pilgrim 2 were less reliable than estimates for other (non-nuclear) utility projects.

Q: Are there any particular reasons to believe that Montaup and BECo knew, or should have known, that nuclear cost and schedule estimates were subject to very large overruns?

A: Yes. The cost and schedule estimate histories for New England nuclear units which entered commercial operation by 1972 are listed in Table 2.5.[3] The cost data for Connecticut Yankee and Millstone 1 reflects their turnkey status. Not only were these units in the figurative back yard of both utilities, but they both had interests in some of them:

1. BECo owns Pilgrim 1, and Montaup had (and has) a life-of-unit contract to purchase 11% of the plant's output,

2. both utilities own portions of Connecticut Yankee (9.5% for BECo and 4.5% for Montaup), and

3. Montaup owns 2.5% of Vermont Yankee and 4% of Maine

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3. Yankee Rowe is omitted for lack of data.

Yankee.

The 240% cost overrun of Pilgrim 1 is especially significant, since exactly the same utility and architect/engineer (A/E) were involved in that unit as in the Pilgrim 2 estimate.

In light of both the national and the regional experience with completed nuclear plants, and the national experience with those still under construction, it would not have been reasonable to place much faith in the quality of conventional cost estimates for Pilgrim 2.

Q: What was the second source of your belief that Montaup and BECo should have known in 1972 that nuclear cost and schedule estimates were likely to be unreliable and understated?

A: It was common knowledge within the utility industry that nuclear plant costs and schedules had been subject to what were then considered to be shocking amounts of escalation and slippage. Representatives of one A/E, Gilbert Associates, identified a large number of problems facing nuclear construction:[4]

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4. To simplify the presentations of quoted material, I have not generally included ellipses (. . .) between paragraphs to indicate the omission of material between the quoted sections. Hence, two sequential quoted paragraphs in this testimony may or may not have been sequential in the original.

> The utility industry, about eight years ago, believed that a large light water reactor plant could be built for $125 per kilowatt or less. Today plants to be completed about eight years hence are generally being estimated at close to $400 per kilowatt, which is more than a 300 percent increase in expected costs over an eight-year period. Nuclear plant costs, than, have not merely evolved in eight years; they have exploded.
>
> [U]tility executives . . . [who] believe that they can build plants for less. . . [may be] more fortunate than most utilities with regard to such factors as construction labor, site availability, and environmental opposition within their service areas. On the other hand, maybe they are continuing the industry's past record of underestimating nuclear plant costs.
>
> Any analysis of past and current estimates quickly indicates the fact that almost all past estimates and many current estimates are far below what will actually be experienced.
>
> . . . 1968 estimates for plants to be completed in the early 1970's . . . shows that original cost estimates were about $150 per kilowatt lower than will actually be experienced for those plants.
>
> The full cost impact of environmental and safeguards backfitting has not yet been realized. In fact, the door has just been opened to cost increases resulting from environmental activity.
>
> While it is true that very few new safeguards have been introduced since 1968, existing requirements have been broadened, and the study depth extended. There is no real indication of policy change nor saturation of areas requiring design analyses for contingency situations. The cost of providing a "safe plant" will continue to increase in the foreseeable future.
>
> This will probably add a significant amount each year to plant cost. (McTague, *et al.* 1972)

That analysis also projected costs for plants entering service in 1978 of $450/kw to $800/kw, depending on the escalation rate assumed, as compared with BECo's estimate of $350/kw for Pilgrim 2. The same problem was described by employees of another A/E (Burns and Roe) as

> The rising trend of construction and capital costs for new electrical generating plants is a matter of increasing concern to the entire utility industry. (Roe and Young 1972)

Those authors discussed several reasons for the increased costs, including construction delays and unanticipated complexity of work, especially for nuclear plants, and observed that

> Of course current licensing problems with nuclear plants must be cleared up if [potential nuclear] cost savings are to be realized,

and concluded that

> In summary, still another crisis is at hand in the electrical generating industry. Continuation of the rapid growth in capital costs will make financing and provision of badly needed increases in electrical generating capacity even more difficult to achieve. The task is clear, but the solutions will not come easily. A combined effort by business, labor, government and the public will be necessary if the rapid growth of plant costs is to be controlled . . .

**Electrical World**'s annual series of nuclear surveys indicated similar concerns. For example, the 1971 survey, entitled "Nuclear Schedules Face Uncertainty", observed that

> The big news is the continuing stretchout in schedules. In last year's survey, 1975 was the "big year," with more than 20,000 Mw scheduled for commercial operation. Reàppraisals during the year

> now place the total for 1975 at only 13,049 Mw, and shift the peak to 1977.
>
> The National Environmental Policy Act, and particularly the Calvert Cliff court decision forcing new AEC interpretation of that law, have recently added even more dramatic uncertainties to plant schedules. Indeed, says Walter Mitchell III, VP of Southern Nuclear Engineering, pending changes in licensing procedures brought about by the Calvert Cliff's decision may soon make obsolete many of the schedule dates tabulated on the following pages.

and the 1972 survey, although it was headlined "Lead Times Stabilizing", noted that

> 58 units in this year's listing show scheduled completion dates that have been set back since last year.
>
> Some optimism has been shown in the schedules reported by utilities for 1974-75, suggests Mitchell. "Several 1975 schedules look hard to meet," he says. Perhaps significantly, only two units are now scheduled for 1976.

Q: How should these facts have affected the behavior of BECo and Montaup in 1972?

A: BECo should have realized that its cost estimates, which were methodologically similar to earlier, understated estimates, were also subject to significant overruns. As the lead utility in Pilgrim 2, BECO had a moral, and perhaps a legal, responsibility to inform its potential partners of the risks they were undertaking, and to clearly identify its cost estimate as a routine nuclear plant cost estimate, subject to all the problems of that genre.[5] Similarly, assuming even the most cursory familiarity with industry publications and experience, Montaup should have been aware of the previous problems. From Mr. Gmeiner's testimony, it appears that Montaup actually believed that each estimate it received from BECo was somehow more significant and reliable than industry (or New England, or even prior BECo) experience would have suggested. If this was due to vigorous BECo representations, Montuap may have been an excessively credulous victim. If Montaup's confidence in the cost and schedule estimates were entirely due to Montaup's failure to credit current experience, Montaup was acting in an imprudent and irresponsible manner.

By the time it signed the participation agreement, Montaup should have been in a position to extract from BECo either more realistic estimate ranges, or the information necessary to estimate a reasonable Montaup contingency. Its apparent failure to do so also appears to be imprudent, unless BECo's behavior was such as to transfer the responsibility to BECo. For example, if BECo assured Montaup that the estimate

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5. Examples of these problems would include the exclusion of many potential costs, the failure to incorporate sufficient contingency for current and future regulatory changes, and the absence of an allowance for the problems of building a plant whose design is still changing.

actually included a 100% contingency, while it only included a 3% contingency, Montaup may argue that it attempted to act in a responsible manner, but was defrauded by BECo to secure Montaup's participation in the project. If, on the other hand, Montaup's reliance on the BECo/Bechtel estimates resulted entirely from the absence of any active inquiry by Montaup, that reliance must be considered negligent. In any case, the division of responsibility between the utilities may be settled elsewhere and should not affect their rates.

Q: Is it your opinion that Montaup's decision to sign the joint ownership agreement was imprudent?

A: Not necessarily. It was certainly imprudent for any utility of Montaup's size to sign such an agreement and then fail to monitor (and critically assess) developments for most of the next decade, as Montaup appears to have done. It is possible that participating in Pilgrim 2 <u>in itself</u>, coupled with a commitment to due diligence in the future, may have been a reasonable decision at the time.

Q: Considering the problems you have described, how could such a commitment be reasonable?

A: While nuclear power had serious problems, so did the other conventional generation alternatives which were perceived to be available in 1972. Oil prices were expected to rise, although not nearly as much as they actually rose later in the decade. There was considerable uncertainty regarding the extent and cost of future environmental constraints on coal combustion. Several power supply options available today were not generally considered to be on the table in 1972: Quebec was an inconceivably distant power source, New England hydro potential seemed trivial compared to the perceived need, and fostering conservation and customer-owned power generation was simply anathema to utilities in the early 1970's.[6] Thus, it is hard to say whether Montaup erred in signing the agreement, without allowing a certain amount of hindsight to influence our judgement.

Q: What then is the ultimate significance of the state of the nuclear industry in 1972, in terms of the issues in this case?

A: There are two central points which can be drawn from the facts I laid out. First, as discussed previously, Montaup's failure to acknowledge the weakness of the Pilgrim 2 cost and schedule estimate can only be attributed to irresponsible and/or incompetent behavior on the part of either Montaup or BECo. Second, even if Montaup somehow believed that BECo's projections were the best available estimates, it should at least have recognized that the projections were subject to

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6. From Mr. Gmeiner's testimony, it appears that it is still anathema to Montaup.

tremendous uncertainty. At a minimum, choosing to participate in Pilgrim 2 created a responsiblity for Montaup to monitor the progress of the project, and of its cost estimates, and to be prepared to react appropriately if the historical trends continued or accelerated. The same can be said, even more emphatically, of BECo's responsibility as the sponsor of the project.

Q: Given the nature of the participation agreement, was there any advantage for any of the minority participants in monitoring Pilgrim 2 cost estimates? Did any of the participants other than BECo have any control over the project?

A: Despite their lack of formal control, it is clear that minority owners can have significant influence over the fate of a nuclear unit. This influence is seen most clearly in the case of Seabrook 2, and the effect of the opposition by United Illuminating, Central Maine Power and other utilities. Another visible example is Dayton Power and Light's opposition to the completion of the Zimmer nuclear plant. BECo's attempt to build Pilgrim 2 was never on very secure ground, and the public opposition (or even doubt) of one of the participants might well have been fatal to the project much earlier, and hence saved all the owners millions of dollars.

In particular, intervention in the MDPU or NRC proceedings by a partner which believed (or suspected) that construction was imposssible, or excessively expensive, would have made it very difficult for those agencies to approve the plant. The same could be said for the filing of a lawsuit, even if it eventually proved to be unsuccessful. BECo presumably would have been aware of this possibility,[7] and would have cooperated with Montaup's efforts to review the cost estimates, rather than face a public confrontation. Thus, Montaup had a great deal of power, and even the facts of 1972 should have alerted Montaup to the possibility that it would have to exercise that power.

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7. If one believes that BECo really was not aware of the state of the nuclear industry throughout the 1970's, it may be conceivable that it would not have spotted its significant liabilities in the event of a public disagreement with a joint owner. If this were the case, Montaup could have pointed out BECo's vulnerability.

## 3 - NUCLEAR PROBLEMS IN THE MID-1970's

Q: You have described the problems of the nuclear industry in the early 1970's. How had the situation changed by the middle of the decade?

A: There were two kinds of important developments in this period. First, all the problems which I described above persisted and expanded. Second, the direct and indirect effects of the first oil price shock started to change the basic environment in which utilities operated.

Q: Please describe the continuing problems of the nuclear industry.

A: Table 3.1 updates to the end of 1976 the previous analyses (Tables 2.1 and 2.2) of cost and schedule slippage in completed nuclear units. To reduce the size of a rapidly growing data base, I have restricted this analysis to Bechtel units. By this time, BECo apparently expected Pilgrim 2 to receive a construction permit (CP) fairly soon, so the summary statistics are computed from the last pre-CP estimate to the actual cost (or completion date). On this basis, the average cost ratio[8] is 2.23, the average myopia factor is 20.6%, and the average duration ratio is 1.417. These results are not very different than those in the previous analysis, through 1972. If the BECo estimate for Pilgrim 2 dated 10/76 were actually the final pre-CP estimate, and if the Pilgrim 2 cost and schedule changed as much during construction as did those of the 14 units in Table 3.1, it would have cost $3.1 to $5.6 billion, and entered service in 4/87.

In Table 3.2, I repeat the analysis of the cost and schedule slippage of nuclear units under construction (see Table 2.3), updated to the end of 1976. Due to the large amount of data available, I have again limited this set to units for which Bechtel was the A/E or constructor, as it was for Pilgrim 2. If Pilgrim 2 experienced throughout its construction the average progress ratio and cost growth rate of this group, and if the 10/76 estimate for Pilgrim 2 were in fact the last pre-CP estimate, construction would have required 25 years,[9] to sometime in the twenty-first century, and the unit would have cost $90 billion.[10]

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8. Turnkey plants are excluded from the cost analysis.

9. This is BECo's estimate of 7.42 years, divided by the progress ratio of 29.2%.

10. The average cost growth rate of 17.9%, over 25 years, would increase the price by a factor of over 65 times.

Q: Was there any more New England experience by 1976?

A: Yes. Millstone 2 entered service in December 1975. Table 3.3 displays the cost estimate history of Millstone 2, which was by far the most expensive nuclear unit in the region. While neither of the utilities which are involved in this proceeding owned any portion of Millstone 2, it would be particularly difficult for them not to be aware of the history of this relatively local unit.

Q: Did the electric utility literature continue to note the persistence of these problems?

A: Yes. The Senior Editor of **Power Engineering** magazine wrote that

> The nuclear power industry continues to miss schedules, and more slippage appears to be ahead. . . Based on past performance and anticipating new impediments, it seems unlikely that [the current construction] target will be met.
>
> Low [construction] time estimates have been characteristic of both the AEC and the utility forecasts. Part has been due to tight targeting and part to external causes. Both are understandable in moderation. It taxes reason, however, to explain all the announcements of new plants in the past three years that estimated commercial operation in six to eight years . . .
>
> The great bulk of recently announced plants are now planned for 8 to 10 years, and considerable additional slippage lies ahead for these units.
>
> The AEC is still changing the important ground rules, . . . and the nuclear community seems to profit little from some pretty plain and important lessons of recent history.

> More likely, of course, the schedule [of nuclear additions in 1979-81] will not hold. . . (Olds 1973)

The next year, Olds headlined his review "Power Plant Capital Costs Going Out of Sight" (Olds 1974). In that article, he presented extensive data on nuclear cost estimates, and subsequent revisions, for the period 1965-74, and computed that estimates had been rising 26% annually since 1970:

> From the mid-1960's on, power plant capital costs have risen faster than estimators can get their numbers changed. In spite of intensive study by many experts, the skyrocket performance of plant costs has defied complete analysis. . .
>
> It is obvious . . . that as plants get closer to their completion dates, their reported costs tend to jump. It may be expected that the 1967-68 averages [for plants ordered in those years] will increase still further.

Olds also warned that

> In spite of the steep increase in estimated costs, these probably will fall far short of the actual completed plant costs unless there is a break in the influences that are forcing costs up so dramatically. . . .
>
> In general, the 26% increase rate since 1970 reflects four factors: (1) inflation in cost of labor, material, services and money; (2) increase in scope, or material content of plants. . . ; (3) recognition that base line estimates in 1965-68 were far too low; and (4) belated recognition that slippage was of major proportions. . .
>
> The influence of the regulatory arm [of the AEC] on schedules still is totally unpredictable. The branch has kept a moving target before the utilities for a long time while proclaiming standardization and schedule shortening. As of May, the record shows that the 54 plants holding construction permits have been slipping their fuel loading dates as the rate of 0.37 months per month.

Another year later, the same author reviewed the history of nuclear plant schedules and concluded

> . . . schedule slippage has been going on for a decade. . .A study of the 10 years of changes in nuclear plant status thus discloses a steady increase in estimated time to complete plants, and that these estimates have been about two years too optimistic all along . . . Slippage became worrisome in 1969 when, just in that year, an average of one plant in six slipped a year. . . The average slippage per plant, as announced, generally increased steadily through 1973. Then in 1974, 201 net plant years of slippage were announced, nearly half of the 10-year total for the 226 plants. (Olds 1975)

Things did not improve dramatically the next year, either

> While the slippage in the nuclear program in 1975 was less than it was in 1974, it was not comfortably less, and was larger than for any other year except 1974. Setbacks were spread about evenly over the whole year, and were most severe for plnats that had been ordered in the 1971-74 period. . .
>
> Costs continue to grow at a rapid rate, and the postponed plants are going to be much higher in cost as each year passes. . .
>
> [In 1970-75,] AEC's regulatory people kept promising shorter licensing, but kept taking longer. In addition, a torrent of guides and procedural changes forced additional delays on the industry. It took time to digest the changes, to retrofit the engineering, the procedures, and to retrofit in the field. The moving target exercise was a tragedy. . .
>
> These years thus were particularly difficult ones for the industry. Accurate scheduling was impossible, and costs sped upward without any possibility of control by the industry. . .
>
> When the AEC was dissolved, an important nuclear advocate was lost. (Olds 1976)

Some other examples from the nuclear literature of this period would include:

> [T]he trend of nuclear plant costs [for plants ordered in the 1960's] was more or less correctly anticipated, but the absolute magnitude seems to have been badly misestimated. For example, in 1968 the reactors were expected to cost only $180/kw. Our actual estimate of cost of reactors ordered that year is about $430/kw. . . [both in constant] 1973 dollars; i.e., there has been a systematic discrepancy of more than a factor of 2. . . [T]his difference between expected and actual costs has not been narrowing with time. Indeed it has been growing. . . [We] predict, taking the more conservative of the two [regression] estimates, that reactor cost ;will continue to increase at an average rate of $34 [constant 1973 dollars] per year, if nothing happens to change the realtive impact of the various independent variables. (Bupp, <u>et al.</u>, 1974)

> Florida Power Corporation has announced it has abandoned its plans to construct the unnamed two-unit nuclear station it had scheduled for operation in the mid-1980's. . . "We believe nuclear power still holds the promise of being the long-range answer to adequate electric supplies as well as a means of achieving national energy independence." FPC president Andrew Hines said . . . "However, we feel it is not in our customers' best interest at this time to proceed with our previously announced plans. There is too much governmental uncertainty as well as an almost unknown cost factor for construction for us to plunge ahead into the morass." . . . In 1973, the projected cost of the facility was $1.4 billion. More recent estimates had set the cost of construction as $2.6 billion, and the utility said there was strong indication that escalation would continue in the years ahead. (**Nuclear News** 1976)

> All of us know that power generation costs and prices have run rampant since 1969, but many may not realize how much they have changed. . . [P]rojected nuclear power unit investment costs . . . have increased about four times since early 1969, an average of 21% per year compounded. . . In 1969, it was assumed that a nuclear unit could be placed in service about six years after

authorization. Today the time span between authorization and the expected date of commercial serivce is slightly over nine years. (Brandfon 1976)

For nuclear plants, . . . both the derived curve and ths specific plant data suggest that the error in cost prediction was increasing rapidly through the latter half of the 1960's [from 37% overruns for plants completed in 1971 to 115% for plants completed in 1975], largely because plants begun in the mid-to-late sixties were delayed and made more costly by imposition of unanticipated environmental and safety-related requirements . . . ; unexpected inflation also played a significant role. (Blake, et al., 1976)

[W]ere it not for these [recent sharp increases in fuel costs], the long-run economic viability of nuclear reactors as a competitive generating alternative would indeed be questionable. . . All things considered, [and even assuming nuclear costs of only $883/kw in 1985, compared to BECo's estimate of $1214/kw in 1984] it appears that purely on economic grounds and ignoring capital shortage problems resulting from state regulation of electricity rates, the future of the U.S. nuclear reactor industry is less bright than recent government forecasts indicate. (Joskow and Baughman 1976)

Q: Did the series of **Electrical World** annual reviews continue in this period?

A: Yes. Nuclear surveys were published in October of 1973 through 1975. The 1976 survey was published in January of 1977. The prose portions of these documents are worth reading in their entirety, to establish the pattern of continuing concern, optimism, and dashed hopes; some highlights include:

1973: "Nuclear Survey: A Record Year"

Reactor orders soar but lead times slip.

Schedule slippage among previously committed plants is a continuing problem. Of the units committed before Sept. 15, 1972, but not yet in commercial service, 63 units were reported this year with no schedule change, 45 had been set back one year, 6 two years, and 2 three years.

1974: "Nuclear Survey: Orders and Cancellations"

Mixed bag of statistics shows commitments to new units running about as predicted, but mid-year inflationary forces caused widespread cancellations and delays in construction programs.

Unfortunately, these figures do not openly reveal the crisis in the nuclear power industry that is being caused by spiraling inflation; they appear, instead, to herald a healthy industrial posture.

The most important truths in the industry today are not to be found in growth-rate statistics, but in reports of cancellations, indefinite postponements, and scheduled construction stretchouts.

As utilities have moved to cover financial situations by paring construction budgets, changes in nuclear schedules were occurring almost daily during the late summer.

When the tabulation closed, 75 units (or about 36% of the 206 listed) had new completion dates that were at least one year later than originally planned. A few of these are plants under construction where construction has lagged schedule, but the vast majority are utility-ordered stretchouts and average about 2 years for each delayed unit.

Last year, AEC licensing delays and intervention by small groups of diehards with talented lawyers represented the major challenges to nuclear power. This year, the old problems have not gone away, but the major contention comes from pervasive financial conditions that are not exclusively nuclear.

1975: "Nuclear Survey: Cancellations and Delays"

Industry falters as uncertainties mount in the areas of financial commitments, load-growth demands, regulatory delays, fuel-cycle inadequacies, and unpredictable social and political hindrances.

The year covered by this report (Sept. 15, 1974 to Sept. 15, 1975) ended on a downward trend. Two major stations were indefinitely postponed late in the period, and this wiped out slight gains that had been posted earlier. The net result: a narrow loss . . .

Uncertainty is now the name of the game as utility executives scramble to hold on to what they see in their load-growth predictions, balanced against what they can afford.

Soaring costs have been charged with forcing seven major units off the schedules this year.

Utility executives are well aware that delays are going to be costly; nevertheless, within the period covered by this report. 84 units (90,048 Mw, or 72% of all capacity scheduled to go on line after 1975) has been delayed for periods ranging from one to seven years.

1977: "Nuclear Survey: Market Still Depressed"

About 67,000 Mw of nuclear capacity were deferred in 1975 and at least 40,000 Mw in 1976. This means that almost all future nuclear additions have been rescheduled.

Above all, potential reactor buyers now want assurance from the government that, once they have approved designs and construction permits, they can proceed with assurance that their nuclear plants will be licensed and permitted to operate effectively.

> Based on NRC's performance, the utilities are widely convinced that they cannot managed their own economic destinies in such an uncertain environment; therefore, they are being scared away from nuclear power.

Q: Taken as a whole, were these observations any different from those you described in the previous section?

A: Yes, in two respects. First, the general tenor of the comments moved perceptibly over the years, from an early sense of annoyance and puzzlement with these cost and schedule problems, to a later sense of deeper concern. Second, the continuing assurances that <u>last</u> year was the end of the trend, and that <u>next</u> year would see the industry turn around, were beginning to wear a little thin. The initial observations emphasized that the problems were a bit more complex than the industry had thought, but now they were largely under control and the "learning curve" could take over, leading the industry to faster, cheaper construction, and better cost estimation. By the mid-1970's, the regular reader of the utility magazines would have been through several cycles of bad news, followed by promises of better results in the short term, followed by more delays and overruns, and by some familiar promises. In addition, the learning curve seemed to have largely disappeared from the discussion: the problem for the foreseeable future was to stop the slippage.

Q: Are you aware of any detailed assessments by nuclear utilities of the problems they faced in this period?

A: Yes. Detroit Edison has prepared a report on the construction of its Fermi 2 nuclear power plant (Detroit Edison 1983), which presents a rather different view of nuclear regulation in the 1980's than that offered by Mr. Staszesky. Chapter 10 of that report, entitled "1978: Nuclear Design Changes", includes the following observations, written in the present tense:

> For Fermi 2 and other nuclear plants in construction, numerous additional government and industry standards leading to changes in reactor design, quality assurance practices and new equipment have a drastic effect on cost. Regulations for nuclear plants grow to 784 in 1978 from 277 in 1975. As a result, the real cost to construct nuclear power plants in the United States increases by an alarming 142 percent from the end of 1971 to the end of 1978. During this time, Fermi 2's construction costs increase nearly 150 percent in real dollars. This escalation occurs even after removing inflation in the costs of standard construction inputs - labor, materials, and equipment.
>
> Nuclear design changes, in particular, are characterized by "ripple effects" that carry beyond the immediate component or system being altered. The result is that the total impact on cost is inevitably larger than the sum of the parts. Moreover, many of the changes at Fermi 2 and other nuclear plants are mandated during construction, as new safety rules emerge. This "ratcheting" of regulations during construction greatly complicates the design and construction efforts.
>
> Fermi 2, in fact, is being built in an "environment of constant change" that makes the control or even estimation of costs extremely difficult. The result is that the construction process falls prey to logistical problems that magnify the direct impacts of increased standards. Construction contracts must be let on a "cost-plus

fixed-fee" basis, backfits during construction are common, and this often means construction workers cannot be efficiently deployed and labor productivity suffers. These problems would continue throughout the duration of the project.

Cost-plus fixed-fee contracts become unavoidable at Fermi 2. Although some construction contracts provide for a fixed price - usually tied to an agreed upon inflation index - such arrangements are not feasible when the scope of the work is subject to continuing significant changes.

Changes in quality-assurance regulations beginning in 1970 have a severe affect on Fermi 2's cost and schedule. It is truly a balancing act to control costs and, at the same time, ensure that the design is reliable, safe and meets licensing requirements. Increased engineering costs are the smallest part of the impact resulting from compliance with the new quality-assurance regulations.

As quality-assurance standards become more complex and the growth of regulations causes design changes in the mid-1970's, the impact on Fermi 2 is far-reaching, especially when construction is in progress. Previously purchased material must be replaced, usually at higher prices. Already completed construction work is torn down and reassembled according to new specifications. Valuable time is lost while construction crews wait for new equipment and materials to be delivered.

Another result of design and quality-assurance changes is the negative impact they sometimes have on labor productivity. Some construction workers lose motivation to do good work if they become frustrated by design changes that cause constant retrofitting of already completed tasks.

Q: What new problems had arisen since 1972?

A: The oil embargo and subsequent dramatic rise in oil prices had several important effects. On the one hand, it improved the economics of any technology which promised to reduce oil consumption. On the other hand, it greatly increased the cost of electricity, particularly in New England; reduced load growth to virtually unprecedented levels (often to negative growth); encouraged conservation actions and the development of conservation technologies; greatly increased the financial stress on utilities; and increased regulatory and public scrutiny of utility costs.

Q: What was the effect of reduced load growth on nuclear construction?

A: The changes in most utility load forecasts (those of BECo and Montaup are illustrated in Figures 1.1 and 1.2) had two effects. First, the reduced need for power plants made it harder to justify building any new generation, including nuclear plants, and raised the possibility that new units might not be needed for long periods after they entered service. Second, lower sales resulted in reduced internal generation of funds, which compounded the financial stress caused by the higher oil prices themselves.

Q: How did conservation affect nuclear power?

A: The reduction in load growth was largely due to conservation, of course: this demonstrated that continual increases in electricity were not inevitable. In particular, it became clear that conservation was an alternative to new power supplies, and that conservation could be encouraged by higher prices and by organized regulatory and incentive programs.

Examples of the latter would include the Federal appliance efficiency standards, higher thermal integrity standards in new building codes, and California's efforts in governmental and utility-sponsored conservation programs.

Q: How did the first oil price shock induce financial stress for utilities constructing nuclear power plants?

A: As I noted above, reduced load growth resulted in lower sales, and lower earnings, than the utilities would have expected. At the same time, the higher cost of oil, and subsequent inflation throughout the economy, greatly increased the utilities' expenses. The pinch between rising costs and falling sales limited the ability of many utilities, including BECo, to finance the construction programs they had planned in more affluent years.

Q: How did regulatory scrutiny affect nuclear power?

A: State regulators started to inquire as to the need for the construction programs, whose protection the utilities frequently presented as a major reason for rate relief. This scrutiny took many forms. In California, for example, the Sundesert nuclear plant was subjected to lengthy state hearings which eventually led to its rejection and cancelation. The Wisconsin PSC undertook similar reviews of the need for planned facilities in that state, and concluded that further nuclear investments were inappropriate, which finally resulted in the cancelation of three nuclear units in that state.[11] Investigations of this sort generally concluded after 1976, but more careful regulatory oversight was clearly emerging by the mid-70's.

The situation was rather different for Millstone 2, which was completed in 1976. The objections to that unit were not that it might be unnecessary and expensive in the future, but that it actually <u>was</u> unnecessary and expensive at the time it entered service. As I noted previously, the radical reduction in load growth had left New England utilities (including NU, the sole owner of Millstone 2) with enormous reserve margins. The construction cost of the plant was so high that even post-embargo oil prices did not make it cost-effective in the short run, and there was initially considerable concern that it might not be cheaper than oil over its life as a whole.[12] The Massachusetts Attorney General opposed the inclusion of Millstone 2 in the rate base of Western Massachusetts Electric Company (WMECo) on the

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11. The chairman of the Wisconsin commission at that time, Charles Cicchetti, later testified on cost recovery mechanisms in MDPU 906 on behalf of BECo. Prof. Cicchetti testified in some detail that he was aware, and utility managers should have been aware, in the early to mid-70's of several of the problems regarding nuclear plant cost overruns and schedule slippage, and utility financial stress discussed above.

12. This problem was solved by the Iranian revolution in 1979.

grounds that the unit's capacity was surplus to the utility's needs. This constituted a basic change from earlier years, when virtually any new capacity was welcome on most systems, and public agencies were primarily concerned with the adequacy of power supply.

Q: What other changes occurred in the mid-1970's other than those related to the increase in oil prices?

A: The cable fire at the Brown's Ferry nuclear power plant, as the most serious accident to that time at a commercial light water reactor, seems to have been a sort of watershed for the newly formed NRC in two respects. First, it alerted the agency to the possibility that significant safety problems could slip past its initial screening, and thus be present in units under construction or even in operation. Second, it must have driven home the point that those problems would not disappear if the NRC ignored them; a major design flaw could have disastrous consequences for the credibility of the agency and the industry which it was charged with regulating, however gently. Thus, nuclear safety regulation was bound to intensify, rather than relax, despite the (probably correct) perception of the industry that regulation was killing it and despite all political representations to the contrary.

4 - THE LATE 1970'S: TMI AND BEYOND

Q: What important developments occurred for Pilgrim 2 and Montaup's participation, in the period from late 1976 to the summer of 1980?

A: Four groups of events took place. First, Montaup received some important warnings regarding its nuclear construction program, including warnings about the costs of the units, their schedules, and their financial feasibility. Second, BECo received similar warnings, both from outside observers and from members of BECo's own management. Third, the TMI accident dramatically changed the nature of nuclear regulation. Fourth, the general deterioration in the economics of nuclear power continued, accompanied by a virtual torrent of plant cancelations.

Q: What warnings did Montaup receive in this period?

A: While there were several kinds of warning signals directed at Montaup, it is convenient to look at two groups: MDPU 20055, and Montaup's financial distress.

Q: What kind of warnings did Montaup receive in MDPU 20055?

A: First, in my testimony, filed on 1/23/80, I pointed out many errors, overstatements, and unsubstantiated assumptions in Montaup's load forecast. I had also reviewed Montaup's previous forecast, in my testimony for MEFSC 78-33, filed 11/27/78, and Montaup had modified certain of its approaches and methodologies as a result. Nonetheless, Montaup's techniques were still very crude in the 1979 forecast filed in MDPU 20055. If Montaup were under the illusions in 1979 that its financial forecasts and projections of capacity requirements were based on an objective and dependable forecast, those illusions should have been dispelled early in 1980.

Second, my testimony in that case also pointed out the history of nuclear power plant cost escalation, schedule slippage, and overruns. While the data base available to me at that time was considerably more limited, I was able to present cost estimate histories for six completed units[13] and four more still under construction; both groups demonstrated cost overruns and schedule delays representative of those found in the more complete data sets presented in this testimony. In addition, I presented the results of the early

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13. The utilities, including Montaup, refused to provide cost estimate histories for their own plants, Maine Yankee and Vermont Yankee. Had Montaup cooperated in gathering and examining this data, rather than proclaiming its unavailability and irrelevance, perhaps Montaup would be less exposed to the current Seabrook debacle.

regression analysis by Mooz (1978), which found that the construction costs of nuclear power plants receiving construction permits were increasing at $141/kw annually, in 1976 dollars. Again, if Montaup were somehow unaware of the trends in nuclear costs, in cost overruns, and in schedule slippage, prior to MDPU 20055, it could hardly have been unaware of them by the end of that case.

Third, Montaup's own presentation in MDPU 20055 contained some similar information, and revealed a lack of critical analysis in Montaup's construction planning. In particular, Mr. Gmeiner, testifying for Montaup, attached to his testimony a copy of the NERA study (Perl 1978), which is also Mr. Gmeiner's Exhibit #16 in this proceeding. Mr. Gmeiner adopted the NERA study, apparently because he agreed with its conclusion that nuclear power is cheaper than coal in the Northeast, but he had not really understood the study's results. NERA had, among other things, found that nuclear plant costs were increasing at an annual rate of 10% above general inflation, even including a large amount of understated forecasted costs. NERA's conclusion that nuclear power would be cheaper than coal assumed that the escalation in nuclear costs would stop abruptly. The study recognized that its "estimates are highly uncertain and hinge upon a number of speculative assumptions" and invited its readers to "substitute your judgement for" NERA's. Indeed, NERA acknowledges that "If the historic pattern continues and if the cost of coal facilities escalates at a lower rate than nuclear, eventually nuclear will become an uneconomic technology."

Montaup's reliance on the NERA study in MDPU 20055, and again in this proceeding, raises some interesting questions. It appears that Mr. Gmeiner had not looked past the study's general support for nuclear, to the disturbing results reported within, before employing it in MDPU 20055.[14] In this case, as well, Mr. Gmeiner offers this study in support of his position, when many of its results indicate that the nuclear industry was in grave difficulty in 1978, and could only be saved by dramatic improvements compared to past performance. This apparent inability of Montaup (and a corresponding problem on the part of BECo) to learn from past errors will be discussed in Section 5.

Q: Please describe the indications that Montaup's construction program was creating excessive financial stress.

A: First, while the MDPU allowed the other petitioning utilities to acquire all of the Seabrook shares they requested in MDPU

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14. This also occurred with respect to capacity factors and O & M costs within the same study.

20055, it limited Montaup to 1%, out of a requested increase of 3.1% of the project. The MDPU's decision was based upon the financial condition of Montaup, and its ability to afford the requested share. Second, Booz Allen[15] would eventually recommend that Montaup sell its interest in Millstone 3, due to the financial burden imposed by the nuclear construction program. Thus, the nuclear burden which the DPU identified as the maximum Montaup could finance, was more than Montaup's management consultant thought it could afford. Had the burden been increased by the start of construction on Pilgrim 2, Montaup's situation would have been even worse.

Q: Was Montaup's difficulty in financing its nuclear construction program in this period unique?

A: No, it was not even unusual. Delays in the in-service dates of nuclear plants, suspension of construction, and even cancelations, were often attributed to the financial condition of the constructing utility. Close to home, Northeast Utilities (NU) decided in 1977 to stretch out construction of Millstone 3, moving the scheduled in-service date back from 1982 to 1986, due to the unit's strain on NU's finances.

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15. This management review, commissioned by Montaup, concluded that Montaup would be hard-pressed to finance its nuclear commitments. Booz Allen reached that conclusion even after having assumed that Pilgrim 2 would be canceled.

Q: How did the relative size of BECo's proposed nuclear construction program compare to those which were causing financial stress for Montaup and NU?

A: Table 4.1 compares the MW commitment in nuclear plants under construction by NU and Montaup in 1980 to BECo's share of Pilgrim 2. The table also lists various measures of the size of the utilities, such as peak demand, sales, revenues, and net plant in service, and the ratios of the size measures to their nuclear commitments. The relative burden on BECo would have been much heavier than those on NU by all of these measures, and (by most of the measures) also heavier than those on Montaup, which were already causing considerable difficulty.

This comparison understates the problems for BECo, since the exposure (both to the risks of exceptional problems and to the stresses of peak construction periods) of the other utilities, particularly Montaup, would be spread over three and four units, while all of BECo's costs would follow the construction, and the problems, of Pilgrim 2. In addition, given the history of nuclear costs, it was only reasonable to assume that the cost of building Pilgrim 2 would be greater than the cost of any of the units under construction in New England at the time, even in real inflation-adjusted terms, and that the relative stress would thus be even larger for

BECo than for NU and Montaup.

Thus, the financial problems for BECo's commitment to Pilgrim 2 should have been evident as early as 1977, when NU slowed down construction of Millstone 3, and should have been confirmed when Montaup reached its financial limits in 1980.

Q: What warnings did BECo receive in the same period?

A: The external warnings came primarily in two reviews of the Pilgrim 2 construction program, MDPU 19494 (part of which was a joint hearing with MEFSC 78-12) and the hearings in NRC 50-471, which took place in the summer of 1979. In the first phase of MDPU 19494, a number of witnesses, including me, pointed out errors, overstatements, inconsistencies, and unsupported assumptions which biased the BECo load forecast upward. As a result, the MEFSC, which has a statutory responsibility to review utility forecasts, took the very unusual step of rejecting the BECo forecast filed as part of MDPU 19494. As Figure 1.2 demonstrates, BECo's forecasts have proven to be consistently overstated.

In the second phase of MDPU 19494, I produced a similar analysis of the (then new) NEPOOL forecasting methodology, and (with Susan Geller) a review of the forecasts of all the major NEPOOL participants. Our testimony discussed numerous errors in each of these forecasts, which in most cases were at least as poorly documented and as over-optimistic as BECo's forecast. Figure 4.1 demonstrates that our overall criticism was well taken, and that the NEPOOL forecast has indeed declined continually both before and since our review.

MDPU 19494, Phase 2, also reviewed the cost estimate for Pilgrim 2. Among the points brought to BECo's attention were the cost overrun of more than 100% for Pilgrim 1, and the fact that contingency figures had been manipulated to prevent new A/E estimates of base costs from increasing the total reported cost of Pilgrim 2. Before he realized that his company had engaged in the latter practice, Mr. Staszesky testified that he "resented the implication" that BECo would manipulate contingency in that way.

Q: Were these warnings repeated in NRC 50-471?

A: Yes. Again, Ms. Geller and I laid out the fallacies in the BECo and NEPOOL forecasts. In addition, I projected out the cost of Pilgrim 2 based upon the regression analysis by Mooz (1978?) and based upon the record of BECo and Bechtel in projecting the cost of Pilgrim 1. Depending on the method used, and even without any schedule slippage, the historical trends indicated that Pilgrim 2 was likely to be completed for $3.40 billion to $4.93 billion, rather than the $1.895 billion BECo was projecting at the time.

Q: Did BECo receive any new warnings in NRC 50-471?

A: Yes. Paul Levy, who had recently been (and who is again) Chairman of the MDPU, testified on the financial difficulties BECo would face if it attempted to construct Pilgrim 2. He pointed out that internal BECo studies indicated that construction of the plant would be difficult or impossible, given BECo's current and likely future financial condition, and concluded that the exceptional rate relief that BECo would require was unlikely.

Q: These were all external warnings to BECO. What were the internal warnings which you mentioned?

A: Internal studies of the feasibility of financing Pilgrim 2 actually informed BECo management that this undertaking would be extremely difficult well before the regulatory reviews of the construction program discussed above. In July of 1978, two studies were produced by BECo management and presented to the Board of Directors. One of these documents (BECo 1978a) concluded that

> ...management can no longer recommend that we continue to license and construct Pilgrim II with a 59 percent ownership share.
>
> The major constraint is financial and controls all other alternatives.

> One constraint which makes it impossible to continue with 59% ownership is the lack of CWIP in rate base in Massachusetts.
>
> [W]e tested a sell-down position . . . and found it unworkable without CWIP, and also tested a 30% ownership position . . . We believe the 30% ownership level is marginally acceptable as a financial risk without CWIP, and propose that this become the sell-down minimum level for continuing with this alternative.

The second study (BECo 1978b) included the following observations:

> [AFUDC] will represent 36% of earnings per share in 1979 and increase annually to the point where it will represent 80% of earnings per share in 1982, 92% in 1983, 93% in 1984, and 95% in 1985.
>
> ...$961 million of new external funds must be raised to complete [Pilgrim 2].
>
> [I]t does not appear that it would be easy to attract institutional buyers [of BECo stock] in the future.
>
> [T]he quality of the company's common stock would be low [due to the high AFUDC component.]
>
> [T]he company would need a substantial rate increase at the time the unit goes into operation...
>
> [To finance Pilgrim 2], the company must issue $770 million of additional first mortgage bonds or other long term debt. . . the company is going into this project with a triple B/Baa bond rating.
>
> If during the construction period the company were to suffer adverse financial experience and have its ratings lowered to . . . double B or Ba, the company would in effect be unable to sell additional debt securities, or if it did so, such securities could only be sold at a substantial increase in the cost of money.
>
> [BECo] would need a substantial rate increase at the very moment the unit goes into operation. The rate increase associated with base revenues is

> estimated to be $270 million, and it will be necessary to argue the use of six million barrels of oil annually at a net reduction to the consumer in fuel adjustment revenues of $184 million, or a net increase to the consumer of $86 million. . . The $270 million rate increase is predicated on the capital and fuel costs of the nuclear plant. Any additional capital expenditures associated with the plant will of necessity increase the required annual rate increases. . . The savings in the fuel adjustment revenues are predicated on a cost of fuel of $32 per barrel. . . [E]very change of one dollar in the cost of a barrel of fuel from that $32 figure would increase or decrease the savings in fuel clause revenues by $6 million.
>
> [T]here are a number of independent parties who have the ability to interfere with the construction of a nuclear plant and drastically affect its cost, construction time requirement and the scheduled operation date. . . Of more importance is the fact that no single party, public or private, has the ability to individually and successfully control either the timely construction, the ultimate cost, or the scheduled operation date of the unit.
>
> Building [Pilgrim 2] for peak with relatively low annual load factors [due to the excess capacity caused by Pilgrim 2] at a cost of $1,700 per kw compared to $227 per kw for Mystic 7 and $353 per kw for Pilgrim I will result in the company's continuing its relatively high rates.
>
> Because of the high cost of construction and the related necessary rate increase that must follow, the issue of a relatively low capacity factor after Pilgrim II goes into service could contribute to a delay in adding the unit to rate base. The financial implications of such a delay would obviously be disasterous.
>
> In summary, the increased cost of construction, the decreased sales forecast, the current triple B rating, the adverse regulatory and judicial climate and possible action on the part of intervenors have substantially increased the financial risks resulting from the construction on a nuclear plant. . .

These observations describe a grim future for BECo, had it succeeded in commencing construction of Pilgrim 2. The financial requirements of constructing the plant would virtually eliminate cash earnings, at a time when BECo was already having difficulty in raising capital.[16] The authors of these analyses forsaw the situation in which PSNH has placed itself, and recommended that BECo avoid that fate, if at all possible.

Q: Were the assumptions underlying these analyses reasonable?

A: There were three assumptions which were clearly not reasonable. First, the construction cost used in these studies is very close to BECo's official estimate at the time, $1895 million.[17] The authors anticipated that some cost overrun from this estimate was likely, and in fact it was essentially inevitable; this would likely trigger the "adverse financial experience" which could close off BECo's current bond market. Second, the schedule for Pilgrim 2 was quite aggressive, and was unlikely to be met; any delay in the COD would further increase the AFUDC burden on the company. Third, while an immediate rate increase at COD would be vital, it was also quite unlikely.

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16. I do not mean to suggest that BECo was facing a "locked box" when it approached the capital markets, only that BECo's financing options were restricted, and the rates it paid were increased, relative to its experience early in the Pilgrim 2 project.

17. $1700/kw is equivalent to $1955 million for the plant.

Since AFUDC would represent almost all of the company's earnings, a rate increase coinciding with the unit's in-service date (when AFUDC would cease to accrue) would be essential. Unfortunately for BECo, the MDPU, which regulates over 90% of BECo's sales, then used an average test-year rate base,[18] so only half of the cost of Pilgrim 2 could be expected to enter the rate base in the first case in which it was included. Further, the MDPU used (and still uses) an historic test year, which would prevent BECo from filing a rate case for a few months after commercial operation, while test year data was assembled. Including the six month suspension period allowed by Massachusetts law, and fully used by the MDPU in virtually all rate cases, BECo would have to expect a delay of nine months to a year between the Pilgrim 2 COD and the reflection of even half of the plant's cost in rates. This could easily result in a year of zero earnings, even if nothing else went wrong at the same time. The fact that Pilgrim 2 would tend to increase rates, and keep them high, would not make it any easier to obtain exceptionally favorable treatment from the MDPU.

Financial analysts would presumably be aware of these facts,

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18. Of course, exceptions could be made.

and the ratings and pricing of BECo's securities would reflect the financial and regulatory risks which BECo was assuming. This would tend to depress the price of BECo's stock, making equity financing less attractive, while increasing BECo's interest costs, and further increasing the AFUDC burden. If this spiral had continued long enough, BECo might well have joined PSNH and LILCo on the list of utilities foreclosed from conventional capital markets.

Q: What was happening to the nuclear industry in general in the 1977-1980 time period?

A: There were several important events or trends:

1. Nuclear units were being canceled at unprecedented rates, which actually exceeded the number of new orders.

2. The cost estimates continued to increase, and the schedules continued to slip, for those units which were not canceled.

3. The accident at Three Mile Island, and other NRC actions, dashed any hope of rapid recovery in the industry, and accelerated many of the previous adverse trends.

Q: Please describe the history of cancelations of ordered reactors within the US nuclear industry.

A: Figure 4.2 portrays the annual and cumulative cancelations, through 1980. Figure 4.3 presents the number of new orders, the number of cancelations, and the net change in orders in the same period. While some of the canceled units had construction permits, units awaiting permits were more heavily hit by the wave of cancelations. Table 4.2 lists the plants canceled in 1977-80, with the construction status of each.

Q: Did the cost estimates and schedule projections for nuclear plants improve between 1976 and 1980?

A: No. Table 4.3 presents summaries of the cost and schedule histories of plants which entered service between January 1977 and June 1980. This Table is comparable to Table 3.1; the calculated summary statistics indicate that the situation had not improved, and in fact had deteriorated considerably. Applying these results to the 6/80 estimate for Pilgrim 2 would predict a cost of \$9.9 to \$42.4 billion dollars, and an in-service date of 10/97. In other words, the plant could not possibly be completed if the average cost trends of these five plants continued. The small number of entries in Table 4.3 illustrates another problem, as well: nuclear units were simply not being completed. This is particularly true in 1979 and 1980, following the TMI accident, but the trend was evident in 1978, as well.

Table 4.4 looks at the data on plants under construction in a slightly different way than in the previous sections. Each unit is listed for which a cost and schedule estimate was available by December 1976, but which had not entered service by June 1980 (and thus was not listed in Table 4.3). This is a group which was more favorably positioned than Pilgrim 2, since most of its members had their construction permits much earlier than Pilgrim 2 could have received its, and certainly prior to the TMI accident. The cost and schedules as of both 12/76 and 6/80 are listed, along with the percentage increase in the cost estimate, and the months of slippage in the in-service date. The schedule for the average of these 21 units had slipped by 21.2 months and the cost estimate had increased 55.7%. If Pilgrim 2 were as fortunate,[19] it would have cost $40 billion and been completed in 10/99. As we have seen, even BECo's ability to complete the unit on BECo's schedule and at BECo's cost projection was highly questionable, so a continuation of recent trends would have been fatal to the plant, and possibly also to the utility.

Q: How did NRC regulation change in this period?

A: Even before the TMI accident, the NRC was demonstrating a

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19. If its schedule slipped only 21.2 months in every 42, and its cost only increased by 13.5% annually.

more cautious attitude towards potential safety problems. Where problems and solutions were identifiable, the NRC was increasingly reluctant to allow plants to operate without the solutions.[20] The best example of this trend was the order which shut down several units in 1978, after an error was found in a Stone and Webster seismic design program. Criticism of this "over-reaction" was largely ended by the TMI accident.

The accident at TMI had two kinds of effects. First, it increased the NRC's reluctance to take unnecessary risks with potential safety problems at reactors under construction or in operation. It was widely perceived that another TMI-scale accident might well be a fatal blow to commercial nuclear power development, and almost any cost imposed on individual plants was preferable to collapse of the industry. The second effect was that NRC staff attention was largely diverted to the agency's most immediate problems, and away from construction permit issuance. The first priority was to address the issues raised by the accident for existing reactors, followed by consideration of the problems of units nearing completion, and then those of units well under

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20. The NRC was less willing to address the difficult, "generic" issues which might bring into question the viability of the industry.

construction and likely to be completed. Not only would the NRC be likely to examine new units much more closely before issuing construction permits and operating licenses, but it would be conducting the examinations (especially for construction permits) with reduced staff commitments.

Q: Were the problems you described clear to observers within the nuclear industry?

A: Yes. Again, the A/E's identified the past pattern, although they were loath to admit that their current efforts were subject to the same problems:

> Over a twelve-year period in operating dates (1976-1988) estimated power plant investment requirements have increased by a factor fo approximately seven. . . . About 22 percent of the increase is due to inflation and 78 percent due [sic] to statuatory and regulatory changes. (Bennett and Kettler 1978)
>
> . . . Harold E. Vann, vice president-power, United Engineers & Constructors [said] "The 10-6 year schedule for nuclear plants is not compatible with the time period betweeen investment made and revenues received . . . The high investment cost has also complicated this problem. It is commonly known in the investment community that announcement of expansion plans adversely affects the price of a utility's equity. (**Nuclear Industry** 1977)
>
> Ebasco Services Incorporated is projecting that "there will be few domestic nuclear power plants announced by utilities in 1977. This opinion is based on the conditional nature of new construction permits, and [fuel cycle concerns.]" (ibid.)
>
> Bechtel said "it anticipates regulatory agencies will continue to change licensing criteria and it therefore seems unlikely that nuclear units will become standardized." (ibid.)

> Ebasco especially wanted to note its concern with the indicated trend of review and backfitting of operating plants to meet current guides. "We believe," it said, "that a broad policy of requiring retrofit without a demonstrated need, or benefit to the public commensurate with cost, is detrimental to the public interest at a time when public concern for energy independence should be answered with an accelerated commitment to nuclear power." (ibid.)
>
> Brown & Root's senior vice president, M. M. Finch, sees prospects for shortening [nuclear] power plant construction schedules as "unlikely." Expecting costs and shceduling to escalate in the future as they have in the past, Finch believes that this will change only with the recognition of the absolute necessity of the nuclear option. "If we are to have a viable nuclear industry," Finch warns, " there must be an absolute commitment to resolving the many significant items which have been plaguing the nuclear industry for so long." (Meanwhile, just _maintaining_ construction schedules is a more realistic hope, Finch says, because the "barriers" to shortening schedules are formidable.) (Jacobson 1977; parentheses and emphasis in original)

From Burns and Roe came the observations that:

> It is clear that nuclear power in in deep trouble. . . In the first eight months of 1979 alone, 67 plants were either deferred or cancelled, and the Nuclear Regulatory Commission has imposed a temporary moratorium on the licensing of nuclear power plants.
>
> The nuclear plant cost [projection] has a wider range [than the coal plant estimate] because it is felt that there is greater uncertainty in estimating future costs of nuclear plants than there is with coal plants.
>
> These cost projections . . . are based on . . . current known regulatory requirements. It is important to keep this in mind because actual . . . regulatory requirements experienced over the life of a project are likely to be different.
>
> Today's estimates for the 1992 plants are more than 10 times as large as the estimates that were

made in 1969 for nuclear units scheduled to start up in 1976. Although the projected costs of nuclear and coal costs are very high, the nation's options are limited, at least through the end of the century.

> This study of available cost data for U.S. power plants has indicated that costs are likely to increase significantly for all types of plants over the next few years, at least. The base cost numbers have been established, and major reasons for cost increase have been identified. Form this point, it can be said that the final costs of nuclear plants now underway are expected to be 3 to 4 times as high as the original estimates.
>
> In 1974 and 1975, . . . less than 3 million engineering man-hours were required for a single unit plant. Today, the figure is 4.5 million man-hours for the single unit plant. The earlier studies showed 11-12 craft man hours per kilowatt of capacity in the single unit plant; today, the craft man-hours exceed 15 per kilowatt.
>
> As a final point, it was noted during the course of this detailed cost study that the available actual cost data often do not reflect the ultimate total capital costs. This is true to the extent that costs are not updated to include subsequent expenditures for compliance with new regulations. (Budwani 1980)

F. C. Olds commented extensively on the growth in safety regulation:

> [H]ow safe is safe enough [for nuclear plants]? This question has been asked but never answered in terms of a limit to be placed on NRC requirements. Consequently, as long as a reviewer can conceive of a way to reduce pollution or risk, he is likely to require it.
>
> [Adding 1975 and 1976 to the regulatory picture] can best be described as ratcheting gone wild. During 1976, and average of three new requirements having significant impact on NSSS design were issued by the NRC every month. Obviously this situation has a severe adverse impact; imagine the picture by the end of the 12-year period now needed to get a plant on line.

> Where all this ratcheting will end is anybody's guess. The primary cause is the open-ended [Atomic Energy] Act that more or less directs reviewers to ratchet, and creates an ungovernable situation.
>
> Replication . . . met with some success until a regulatory ratchet was applied to the process. . . [A]n expensive change was required of [a duplicate] plant. In turn, this was whipsawed back on the original plant, which now was under construction. (Olds 1977)

Florida Power Corporation became a bit more colorful in its description of the problems which resulted in the cancelation of the South Dade units:

> . . . Robert Uhrig, vice president for nuclear and general engineering, said he didn't see how any utility "that has to defend its actions to a public service commission could justify a business decision to 'go nuclear' in the present environment. . . The nuclear licensing process has been destabilized to the point where sound business decisions cannot be exercised with respect to nuclear facilities. Sound business is dependent upon prdictable time schedules and costs, and neither is present in today's era of uncertainty. (**Nuclear Industry** 1977)

**Electrical World** continued its increasingly gloomy reviews:

1978: "1978 Nuclear Plant Survey"

> This year's nuclear survey . . .tends to reinforce the gloom of the "big four" manufacturers that was expressed last year in both trade journals and the popular press.
>
> Several dates for scheduled commercial operation of plants have been postponed - some indefinitely - and there have also been cancellations,
>
> FPL announced in mid-1977 that it would not commit itself to any future nuclear plants as of

that time. The utility cited regulatory uncertainties at both state and federal levels as its principal reason.

The Omaha Public Power District told Electrical World that its overriding reasons for canceling Ft. Calhoun 2 were (1) excessively high estimated cost per installed kw, (2) lower-than-expected load growth projected for its service area, and (3) a more than $200-million interest charge on capital before commercial operation would begin.

The number of "indefinities" [sic] has dropped over the past year from nine to seven, with an accompanying "decrease" of almost 2,000 Mw in generating capacity. But this encouraging portent could be canceled when one realizes that the chance of all - of any - of the "indefinites" being built is slim indeed.

1979: "1979 Nuclear Plant Survey"

If you were disturbed by the statistics contained in last year's nuclear-plant survey, the 1979 roundup won't help to settle your stomach. Unit cancellations, delays, and postponements are on the rise, while the total number of reactor commitments, through 1995, has dropped alarmingly.

Another very disturbing element is the large number of postponements and delays in commercial operation, ranging from one year to as long as six years, with a concomitant increase - from seven to eleven - in the number of units now in the "indefinite" column. Just as discouraging is a new listing: two units in the "work suspended" designation.

Although we usually endeavor to be upbeat and optimistic in seeking the oft-elusive silver lining in a cloudy report, this time around offers us an unprecedented challenge.

1980: "No reactors sold; More Cancellations"

> Since last year's survey, the commercial operation dates of some 80 units have been postponed, from one year to indefinitely, and nuclear commitments are down from last year's 195 units . . . to 193 units . . .

## 5 - THE SITUATION TODAY

Q: What does the testimony of Mr. Gmeiner and Mr. Staszesky tell us about the decision processes of Montaup and BECo?

A: If we take the testimony of these two men at face value, we may conclude that neither one of them yet understands that

- Nuclear cost estimates have never been reliable, either before or after the issuance of a construction permit.

- Nuclear power plant have consistently failed to meet their construction schedules.

- Pilgrim 2 could not have been built for any of the cost estimates BECo produced, or been completed on the BECo schedules, even if BECo had received a construction permit on the corresponding schedule.

- Pilgrim 2 construction would have imposed tremendous financial strain on both utilities.

- Completion of Pilgrim 2 was probably impossible by the middle of 1978, given the financial condition of the owners, the rapidly rising cost of nuclear plants, and the fact that no units which received a construction permit after January 1978 are still under construction.

- Had Pilgrim 2 been completed, it would have operated at much lower capacity factors than assumed in the utility cost-benefit analyses.

- Pilgrim 2 would have had very serious effects on the rates of both utilities, and created significant rate shock.

Thus, these two men, and their utilities, appear to still be unaware the cancelation of Pilgrim 2 was inevitable, desirable, and long past due when it finally occurred. This can only lead us to the conclusion that they are still actively resisting any knowledge of the realities of nuclear plant construction in the late 1970's and early 1980's.

Q: Are Mr. Staszesky and Mr. Gmeiner realistic in their interpretation of the NRC licensing process, even in retrospect?

A: No. Mr. Staszesky indicates that 1981 NRC regulations providing for post-construction-permit reviews of design came as a shock to the BECo:

> For the first time we were faced with the prospect of obtaining a construction permit and commencing on-site construction before we would know what the ultimate design requirements would be. We considered this to present a grave risk. (p. 17)
>
> For the first time we were confronted with the situation where resolution of design-requirements issues would not occur prior to construction permit issuance, thus significantly increasing uncertainty

as to final project form, schedule and cost. (p. 22)

Under normal circumstances, the issuance of the construction permit marks the end of a significant portion of the uncertainties associated with major projects of long duration. Under normal circumstances, the issuance of the constructioon permit means that you finally know when construction can begin, you finally have a more concrete handle on when the project should come into commercial operation, and you finally have project scope and design fairly well tied down. These factors all affect project cost, which in turn affects economic desirability, and relative certainty as to these factors means that a judgment as to the feasibility of proceeding can be made, as of the issuance of the construction permit. The change in procedures at NRC that occurred subsequent to June, 1980, meant that these certainties would not be available and it meant that the uncertainties that are characteristic of the pre-on-site construction phase would now continue after the commencement of on-site construction and after the expenditure of the costs of on-site construction. This was an important new factor in the equation. (pp. 22-23)

In fact, there was very little new in the "equation", as is demonstrated by the actual cost and schedule histories, and the quotes which I presented in the earlier sections of this testimony. The NRC may have changed the letter of its licensing procedures in 1981, but it was simply recognizing the reality: utilities have never known the scope of nuclear projects until they are completed, or actually until they are retired. The certainty to which Mr. Staszesky refers did not exist at any time during the licensing of Pilgrim 2, as shown by the experience of dozens of other plants. This fact was clear to me in 1979, and it should have been clear much earlier to BECo (which had access to data I have only recently seen, and probably much which I still have not seen).

Q: Is the same true for Mr. Gmeiner's testimony?

A: Yes. Mr. Gmeiner asserts that "once construction on those projects [Seabrook and Millstone No. 3] got underway . . . the lead participants began to provide reasonably good estimates" (Exh. MEC-400 SIII, p. 1). Since the current cost estimates for these plants are about four times as large as the first post-CP estimates, Mr. Gmeiner's definition of "reasonably good" appears to be essentially meaningless.

Mr. Gmeiner also makes the striking assertion the "The project was never 'no longer feasible' even when it was actually cancelled" (p. 7). In fact, any reasonable evaluation of the project, for some years prior to cancelation, would have found it to be both financially infeasible (in terms of the owners'ability to pay for it) and economically infeasible (in terms of its competitiveness with alternative sources of power). But more importantly, it must be clear to all competent observers, in retrospect, that it had become impossible to build Pilgrim 2 by some time in the late 1970's. Mr. Gmeiner's inability to admit this obvious fact, given his disastrous experience (along with most of New England) with Seabrook, and the stress caused by the earlier and less troubled Millstone 3 project, illustrates one of my basic observations in this case. Montaup's capacity planning has become totally frozen in time (as of the late 1960's or early 1970's) and has been totally unable to respond to the changing realities facing the utility.

Actually, Mr. Gmeiner may be a little more realistic than his testimony would suggest. While he complains about Montaup's inability to obtain more nuclear capacity, and expresses regret that Montaup lost the opportunity to bring its share of Pilgrim 2 on line, he is aware that Montaup does not actually want or need more new nuclear capacity (AGM-59 and AGM-60). Oddly, he attributes this lack of interest in greater nuclear capacity to falling Montaup demand forecasts, and to Montaup's ability to convert Somerset to coal, both of which I suggested (and Mr. Gmeiner rejected) in MDPU 20055. More peculiar still, Mr. Gmeiner is no longer concerned about the lack of firm sources of supply past 1992, nor of continued reliance on oil for about a third of Montaup's power supply. If Montaup believed Mr. Gmeiner's assertions about nuclear economics, and really regretted the loss of Pilgrim 2, it would have been buying up some of the available capacity in Millstone or Seabrook. The truth is, of course, that the best things that have happened to Montaup in terms of its capacity plans in the last decade were the cancelation of Pilgrim 2 and the MDPU's refusal to allow the purchase of further Seabrook shares.

Q: Do Mr. Staszesky and Mr. Gmeiner define the problem of financial feasibility properly?

A: Not really. Both men confuse economic feasibility with financial feasibility. Economic feasibility is desirability of the plant from a cost-benefit perspective, in terms of its costs compared to alternative sources of power. Financial feasibility is the ability "to get from here to there", to actually pay for the investment. I have presented a very strong case that Pilgrim 2 was not economically feasible as far back as 1976, which Montaup of course disputes. But even if the plant were economically feasible, compared to a hypothetical (and worse-case) alternative of burning oil over the life of the unit, it could not be built if it were financially infeasible. This is the situation that Seabrook is in now: neither unit is likely to be economically feasible, but we will never know, since they have become financially infeasible.

Mr. Staszesky asserts that if "the project was needed and was the most economic source to supply the need" then "there was every reason to believe that the project could be financed" (p. 13). WPPSS and Public Service of Indiana (and perhaps

Public Service of New Hampshire) might be suprised to hear this: my impression is that these entities essentially ran out of money. It is also my impression, from the July 1978 BECo studies, that BECo's financial officers understood this problem and attempted to save BECo from following PSI and PSNH into financial disaster, even at the cost of foregoing a potential economic benefit.

Mr. Gmeiner's testimony is less clear on this point, but he also confuses the two problems, and generally prefers to answer questions in terms of economic feasibility (for which his answers are incorrect but consistent) than in terms of financial feasibility (which, considering Montaup's financial condition historically, would be difficult to defend).

Q: Is Mr. Gmeiner realistic in his economic appraisal of nuclear and alternative generation?

A: Not generally. He relies on very old studies of solar water heating, for example, including a NEES study which compares 1975 vintage solar water heaters to electricity prices of 3 or 4 cents per kwh, not the 30 or so cents/kwh that the new nuclear plants will cost if they ever enter service. He also assumes that only very large steam users can cogenerate economically, without any economic analysis, and despite the existence of quite small cogeneration units producing hot water, as well as steam. I am not suggesting that Mr. Gmeiner's attitudes towards conservation and alternative energy sources are critical to the central issues of this case: any reasonable analysis of the economics of Pilgrim 2 would have resulted in its cancelation years earlier, regardless of the projected costs of solar water heaters. These attitudes are more important as evidence that Montaup (and particularly Mr. Gmeiner) has been unable or unwilling to learn from experience over the last ten or fifteen years.

On a similar issue, it is interesting to note that, despite extensive experience to the contrary, Mr. Gmeiner continues to project a 70% mature capacity factor for large nuclear units. If Montaup believes this rash assertion, I suggest that it agree to collect only the fuel costs which would be required at a 70% capacity factor for Millstone 3 (and Seabrook 1, if it is ever completed).

## 6 - CONCLUSIONS AND RECOMMENDATIONS

Q: What are your conclusions regarding the prudence of the major decisions to participate in, and attempt to construct, in Pilgrim 2?

A: Reviewing the preceding information and analysis, I conclude that a reasonable observer, with access to the information reasonably available to Montaup would have concluded:

1. As a general matter, participating in a nuclear power plant construction program may well have been prudent in 1972, so long as it was accompanied by a commitment to continued monitoring of developments in the industry and in the particular project, and with the knowledge that nuclear cost projections were highly unreliable.

2. Continuing the Pilgrim 2 project past 1976, in the absence of a construction permit, was extremely questionable. No further major expenditures should have been undertaken without a thorough and candid assessment of the costs, benefits, and risks of continued expenditures. Such an analysis would probably (i.e., with greater than a 50% probability) have indicated that cancelation of the plant was

have been canceled; at the very least, the rate of expenditures would have been reduced to the absolute minimum level which would have preserved the investment to that date (possibly including some licensing expenses).

By 1978, Montaup should have been publicly opposing continuation of the plant, if BECo had not halted cash expenditures or actually canceled the plant. BECo should have been carefully considering any additional expenditures, and should almost certainly have canceled the plant by that time.

By early 1980, Pilgrim 2 should have been canceled.

Q: If BECo had acted as you suggest they should have, would BECo and its customers be better off today than they are?

A: Yes. The losses suffered by both BECo's ratepayers and its shareholders would have been limited. In addition, the several other New England utilities (and their customers) which were joint owners in the Pilgrim 2 project would be better off today.

Q: How would you recommend that this Commission treat Montaup's investment in Pilgrim 2 for ratemaking purposes?

A: I would recommend that the Commission disallow any costs beyond December, 1976. This is based on my conclusion that an honest appraisal of the project at that date would probably have recommended cancelation. Since Montaup did not conduct any such inquiry (nor attempt to force BECo to conduct one), its investment beyond that date appears to be totally due to Montaup's imprudence.

My other recommendations are more conditional. First, I believe that the Commission should determine whether it wishes to disallow costs after the time at which Montaup's behavior became imprudent, or only at the time when prudent behavior would have resulted in a different substantive outcome. This is equivalent to the question of whether a driver is imprudent as soon as he falls asleep behind the wheel, or whether that behavior only becomes imprudent when the car hits someone. I have assumed the second standard in selecting the 1976 cut-off date; if the Commission chooses the first standard, then none of Montaup's investment should be recovered from ratepayers.

Second, if the Commission does allow Montaup to recover any of its costs beyond 1976, due to the uncertainty which still remained at that time, Montaup should not recover more than 50% of its costs in 1977 and 1978, more than 15% of its costs in 1979 and the first half of 1980, or any costs beyond July

1980.

Q: Do you have any opinion as to whether Montaup or BECo should bear the portion of the costs which are not recovered from Montaup's ratepayers?

A: Not really. As I noted above, this question hinges on the nature of BECo's representations and responsibilities to Montaup. I do not believe that this potential dispute between the two utilities should in any way affect the Commission's decision in this proceeding, however, since the only issue here is whether Montaup's customers should be paying these costs.

Q: Does this conclude your testimony?

A: Yes.

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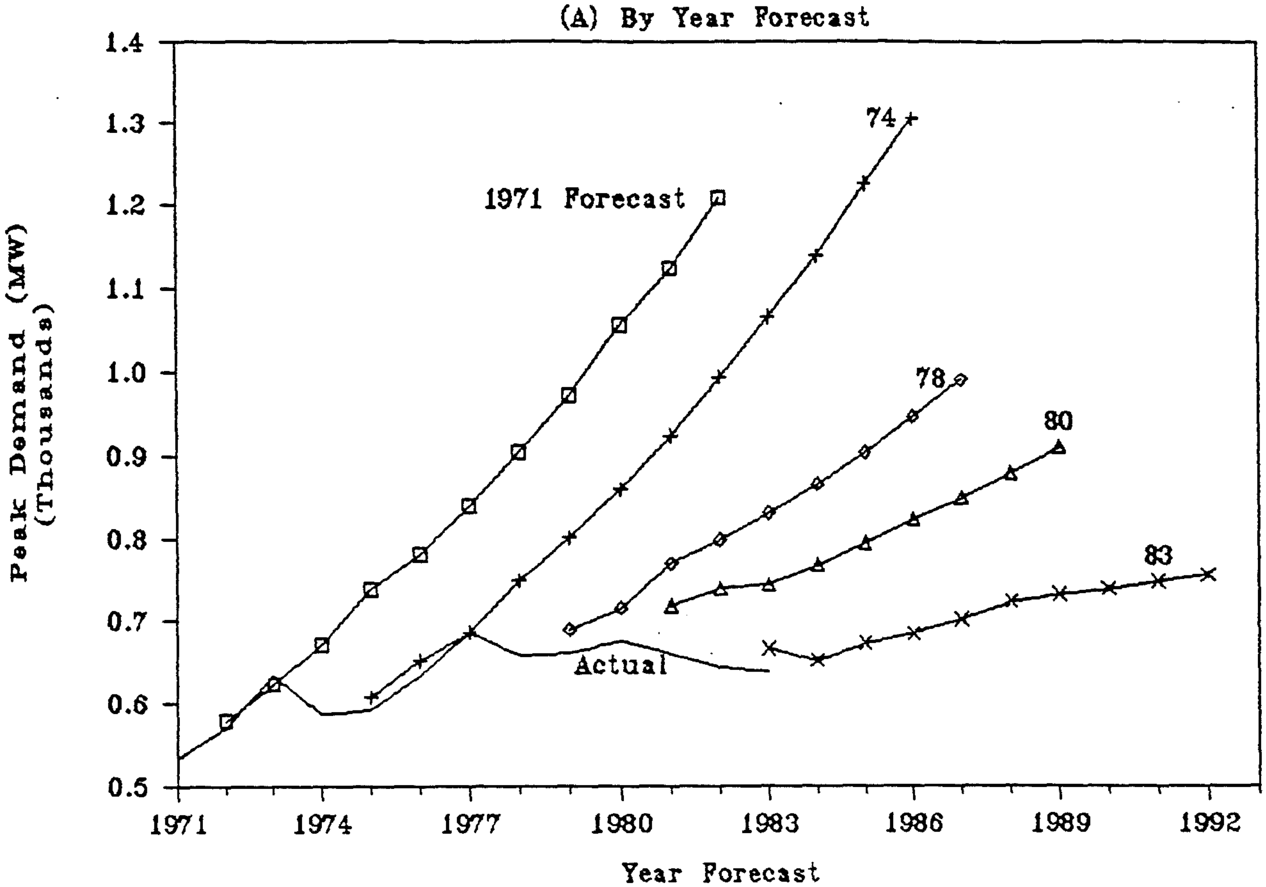
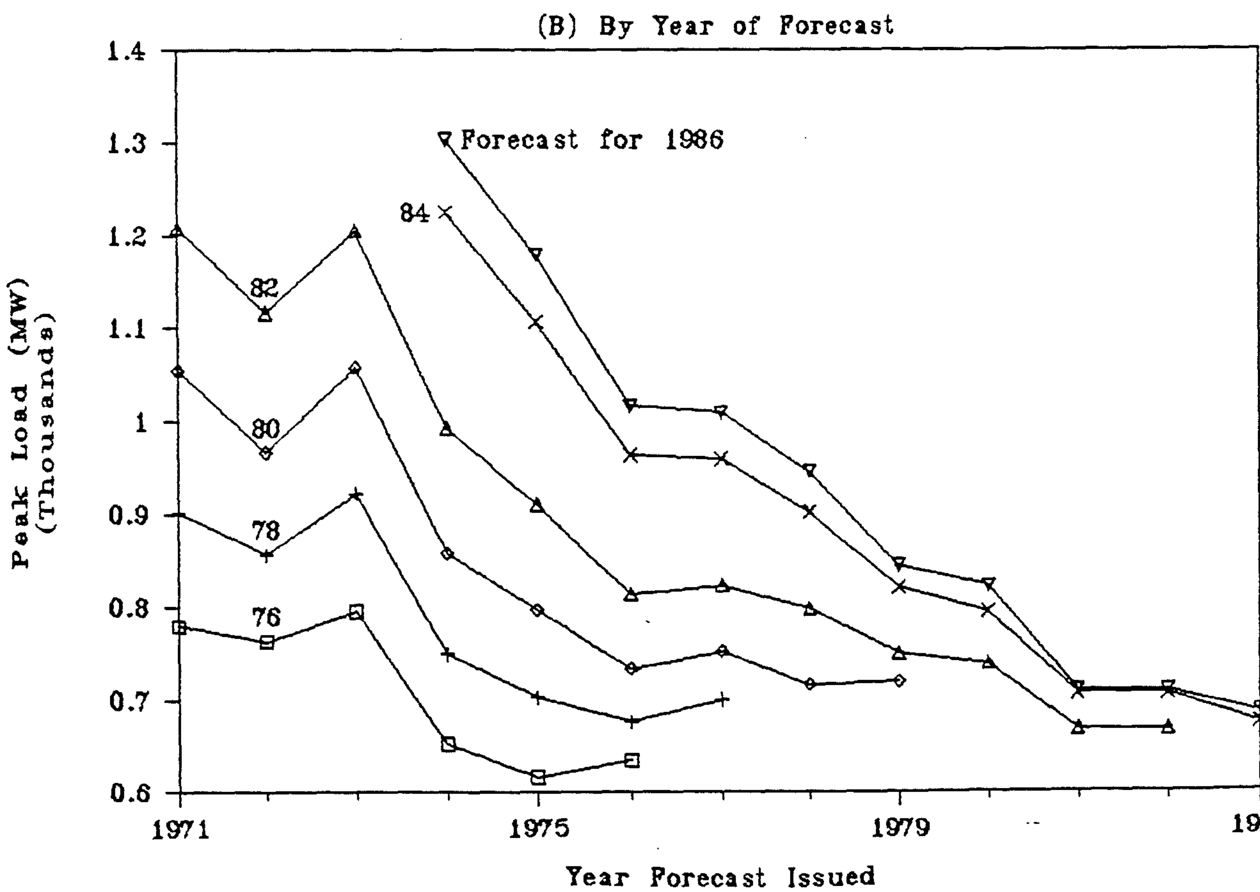
# Figure 1.1: EUA Forecast History

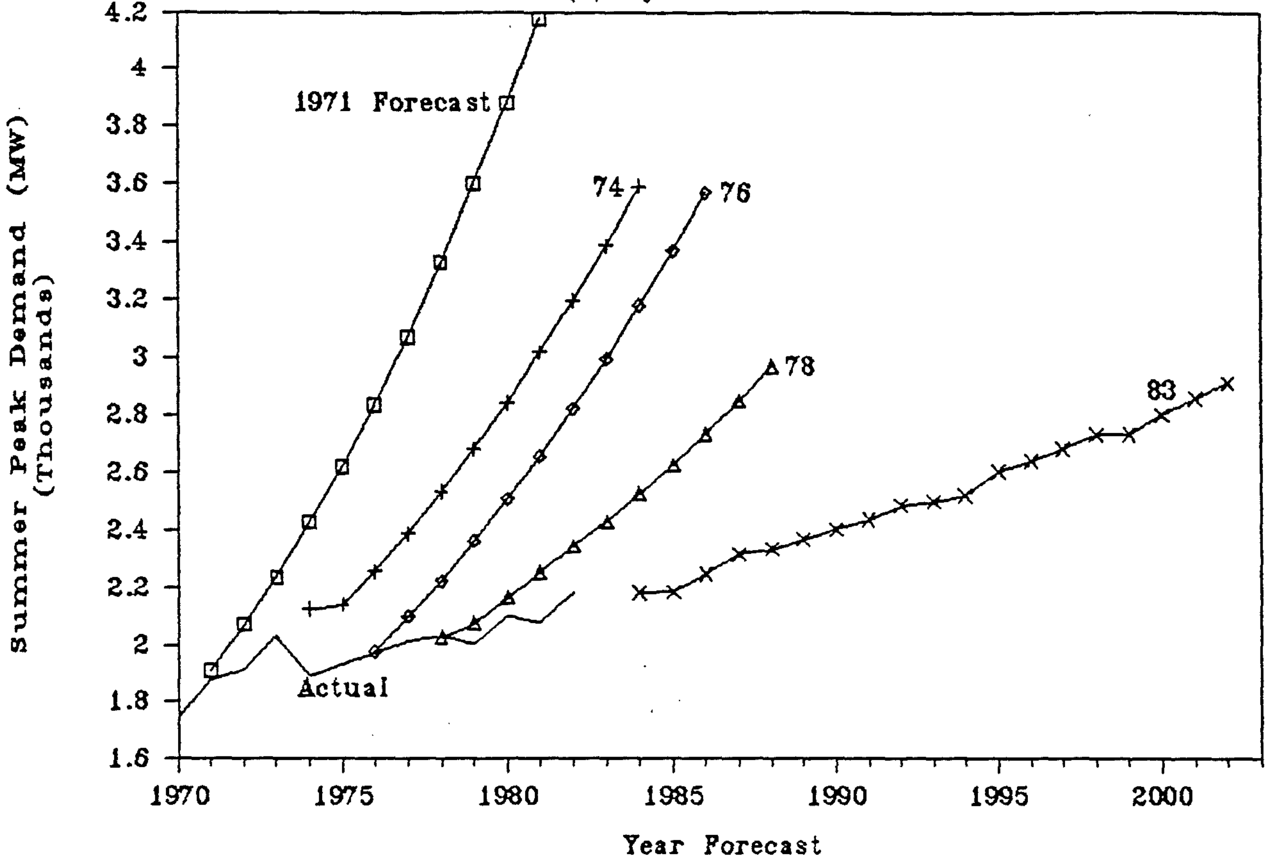




# Figure 1.2: BECo Forecast History

(A) By Year Forecast






(B) By Year of Forecast

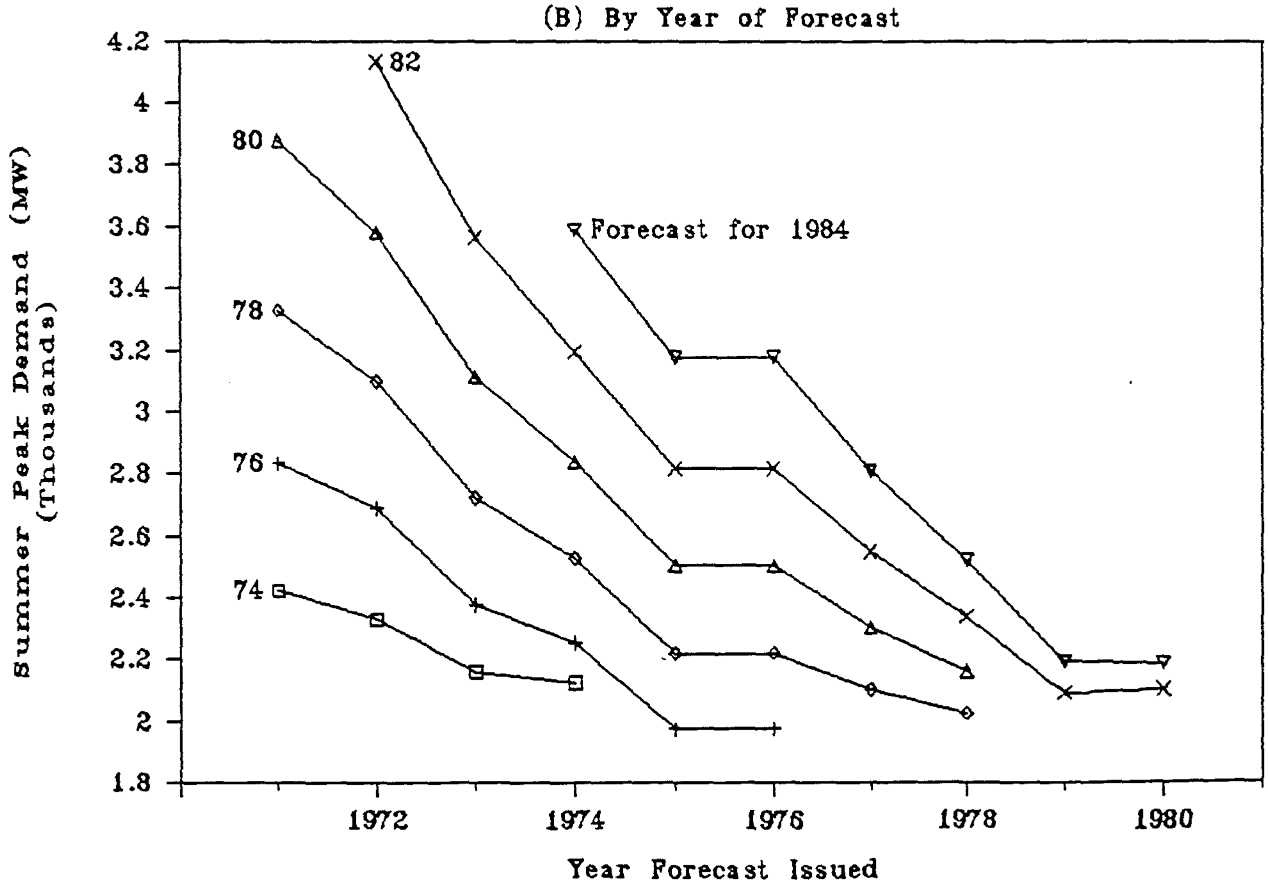
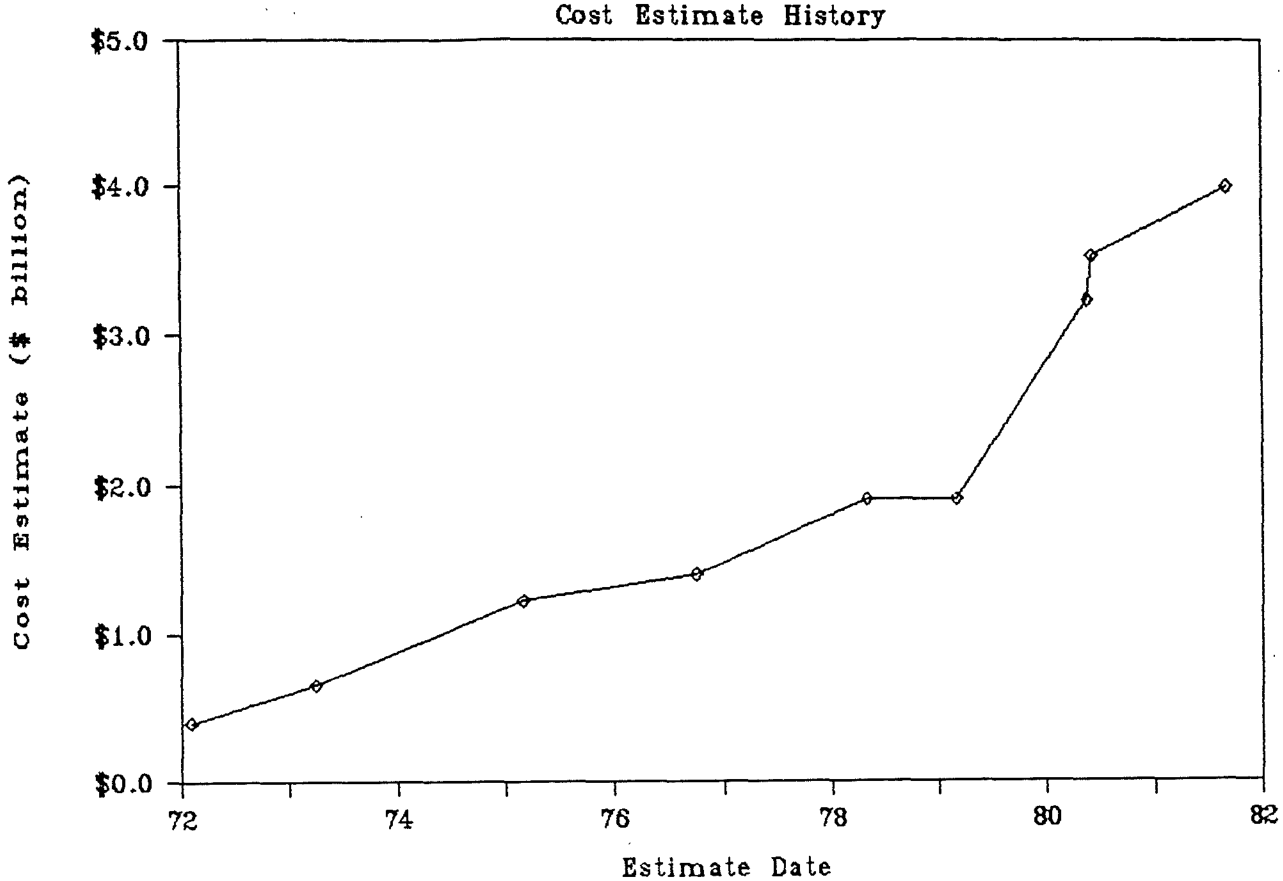


Figure 1.3: Pilgrim 2



# Figure 1.4: Pilgrim 2

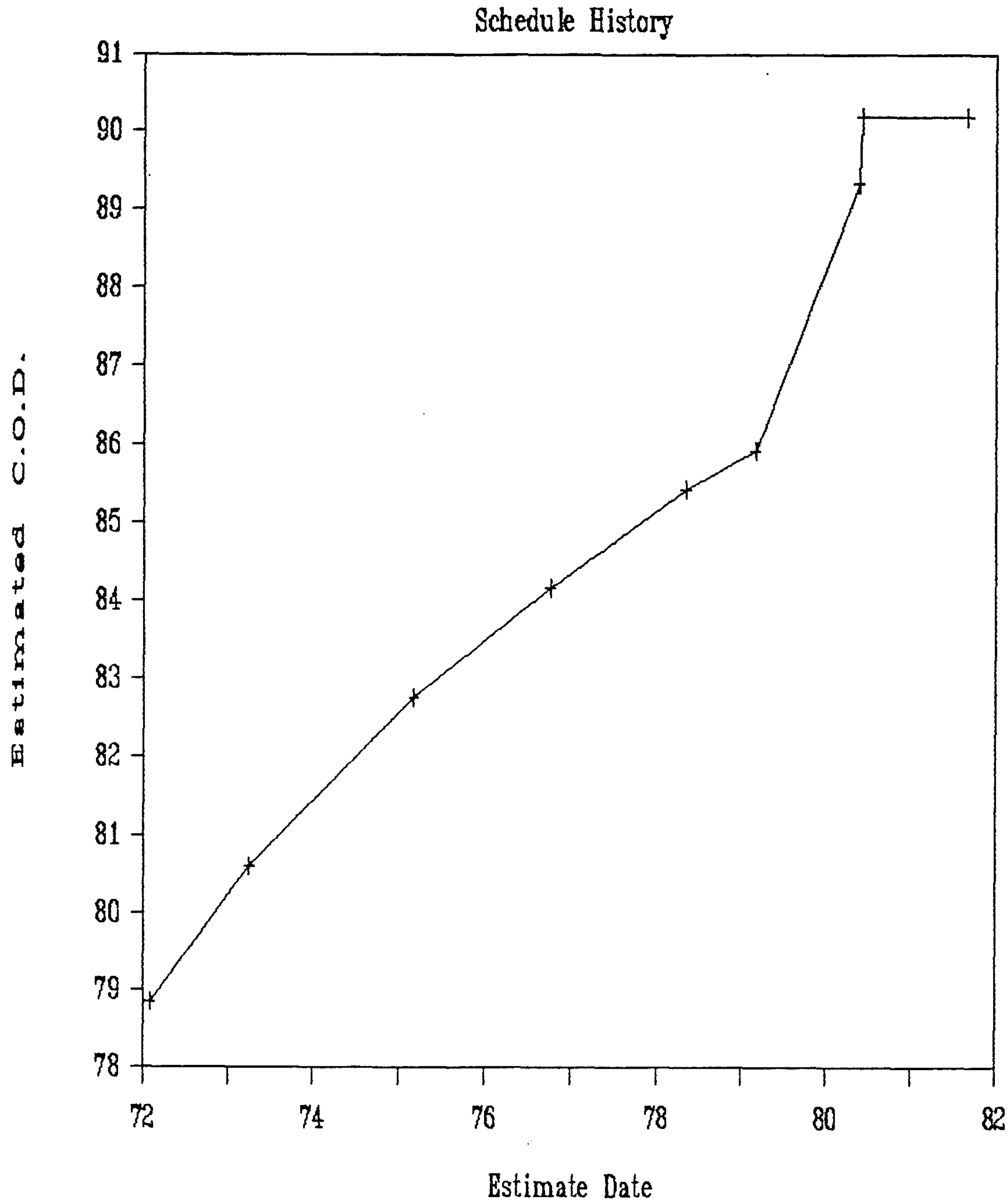


Figure 1.5:

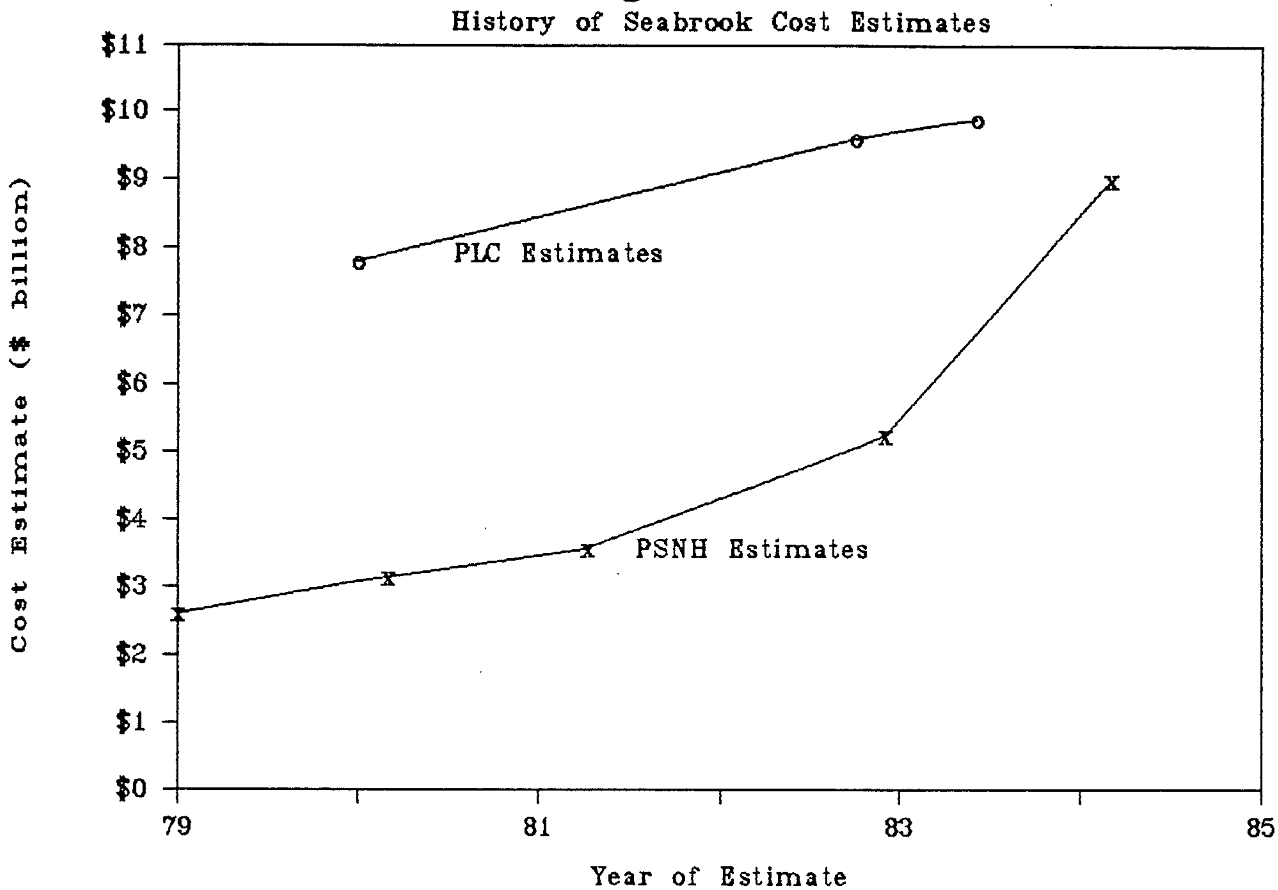

History of Seabrook Cost Estimates
$11
$10
$9
$8
$7
$6
$5
$4
$3
$2
$1
$0
Cost Estimate ($ billion)
PLC Estimates
PSNH Estimates
79
81
83
85
Year of Estimate

TABLE 2.1: COMPLETED NON-TURNKEY NUCLEAR UNITS
As of December, 1972

| Unit Name | --Actual--- Cost | COD | ------Estimates----- Date of Est. | Cost | COD | | Years to COD | Cost Ratio | Myopia | Duration Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| Palisades | 147 | Dec-71 | Mar-68 | 89 | May-70 | | 2.17 | 1.65 | 1.259 | 1.731 |
| Vermont Yankee | 184 | Nov-72 | Sep-66 | 88 | Oct-70 | | 4.08 | 2.10 | 1.199 | 1.510 |
| Pilgrim 1 | 239 | Dec-72 | Jul-65 | 70 | Jul-71 | | 6.00 | 3.42 | 1.227 | 1.236 |
| Turkey Point 3 | 109 | Dec-72 | Sep-69 | 99 | Jun-71 | [1] | 1.75 | 1.10 | 1.055 | 1.861 |
| Maine Yankee | 219 | Dec-72 | Sep-67 | 100 | May-72 | | 4.67 | 2.19 | 1.183 | 1.125 |
| Surry 1 | 247 | Dec-72 | Dec-66 | 130 | Mar-71 | | 4.25 | 1.90 | 1.163 | 1.412 |
| Average | 191 | Oct-72 | Jun-67 | 96 | Apr-71 | | 3.82 | 2.06 | 1.181 | 1.479 |
| # of Datapoints | 6 | 6 | 6 | 6 | 6 | | 6 | 6 | 6 | 6 |

Notes: [1] From AEC. Month not given, June assumed.

TABLE 2.2: COMPLETED TURNKEY AND DEMONSTRATION UNITS
As of December, 1972

| Unit Name | --Actuals--- Cost | --Actuals--- COD | ----First Available--- Estimates Date of Est. | Estimates Cost | Estimates COD | Est. Years to COD | Cost Ratio | Myopia | Duration Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Indian Point 1 [1] | 126 | Sep-62 | Jun-60 | 68 | Jan-62 | 1.58 | 1.86 | 1.478 | 1.421 |
| Humboldt [1] | 24 | Aug-63 | Jun-60 | 3 | Oct-62 | 2.33 | 8.16 | 2.458 | 1.357 |
| Nine Mile Point 1 | 162 | Dec-69 | Mar-64 | 68 | Nov-68 | 4.67 | 2.39 | 1.205 | 1.232 |
| Oyster Creek 1 | 90 | Dec-69 | Jun-64 | 59 | Oct-67 | 3.33 | 1.52 | 1.135 | 1.650 |
| Ginna | 83 | Jul-70 | Dec-65 | 64 | Jun-69 | 3.50 | 1.30 | 1.078 | 1.310 |
| Dresden 2 | 83 | Jul-70 | Mar-66 | 79 | [2]Feb-69 | 2.92 | 1.05 | 1.016 | 1.486 |
| Point Beach 1 | 74 | Dec-70 | Jun-66 | 61 | Apr-70 | 3.83 | 1.21 | 1.052 | 1.174 |
| Millstone 1 | 97 | Mar-71 | Dec-65 | 81 | [2]Aug-69 | 3.67 | 1.20 | 1.050 | 1.432 |
| Robinson 2 | 78 | Mar-71 | Jun-66 | 76 | May-70 | 3.92 | 1.02 | 1.006 | 1.213 |
| Monticello | 105 | Jun-71 | Jun-66 | 74 | [2]May-70 | 3.92 | 1.42 | 1.093 | 1.277 |
| Dresden 3 | 104 | Nov-71 | Mar-66 | 81 | [2]Feb-70 | 3.92 | 1.28 | 1.065 | 1.447 |
| Point Beach 2 | 71 | Oct-72 | Mar-67 | 54 | Apr-71 | 4.08 | 1.32 | 1.071 | 1.367 |
| ALL UNITS | | | | | | | | | |
| Average | 91 | Sep-69 | Jan-65 | 64 | Jul-68 | 3.47 | 1.98 | 1.225 | 1.364 |
| # of Datapoints | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| ALL UNITS EXCEPT Indian Pt 1 & Humboldt | | | | | | | | | |
| Average | 95 | Jan-71 | Dec-65 | 70 | Sep-69 | 3.78 | 1.37 | 1.077 | 1.359 |
| # of Datapoints | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Notes: [1] Demonstration units
[2] Cost estimate as of 9/66

TABLE 2.3: COST GROWTH IN BECHTEL PLANTS
First Estimate to December 1972

| Unit Name | Estimates: Date of Est. | Estimates: Cost | Estimates: COD | Years to COD | Years Elapsed | Cost Growth Rate | % Complete |
|---|---|---|---|---|---|---|---|
| Arkansas 1 | Dec-67 | 132 | Dec-72 | 5.00 | --- | --- | 0.0 |
| | Sep-72 | 185 | Oct-73 | 1.08 | 4.76 | 7.4% | 86.8 |
| Arkansas 2 | Dec-70 | 183 | Oct-75 | 4.83 | --- | --- | 0.0 |
| | Sep-72 | 230 | Oct-76 | 4.08 | 1.75 | 13.9% | 6.9 |
| Duane Arnold | Jun-68 | 103 | Dec-73 | 5.50 | --- | --- | 0.0 |
| | Sep-72 | 192 | Jan-74 | 1.33 | 4.25 | 15.8% | 69.0 |
| Calvert Cliffs 1 | Jun-67 | 118 | Jan-73 | 5.58 | --- | --- | 0.0 |
| | Sep-72 | 250 | Feb-74 | 1.42 | 5.26 | 15.3% | 72.0 |
| Calvert Cliffs 2 | Jun-67 | 105 | Jan-74 | 6.58 | --- | --- | 0.0 |
| | Sep-72 | 204 | Jan-75 | 2.33 | 5.26 | 13.5% | 56.0 |
| Davis-Besse 1 | Dec-68 | 180 | Dec-74 | 6.00 | --- | --- | 0.0 |
| | Dec-72 | 349 | May-75 | 2.42 | 4.00 | 18.0% | 40.0 |
| Farley 1 | Sep-69 | 164 | Apr-75 | 5.58 | --- | --- | 0.0 |
| | Sep-71 | 259 | Apr-75 | 3.58 | 2.00 | 25.7% | 6.0 |
| Farley 2 | Sep-70 | 183 | Apr-77 | 6.58 | --- | --- | 0.0 |
| | Sep-71 | 233 | Apr-77 | 5.58 | 1.00 | 27.3% | 0.0 |
| Hatch 1 | Mar-69 | 151 | Jun-73 | 4.25 | --- | --- | 1.5 |
| | Dec-72 | 282 | Apr-74 | 1.33 | 3.76 | 18.1% | 69.0 |
| Hatch 2 | Jun-70 | 189 | NA | NA | --- | --- | NA |
| | Dec-72 | 330 | Apr-78 | 5.33 | 2.50 | 24.9% | 11.0 |
| Millstone 2 | Dec-67 | 150 | Apr-74 | 6.33 | --- | --- | 0.0 |
| | Sep-72 | 282 | Apr-74 | 1.58 | 4.76 | 14.2% | 49.0 |
| Oconee 1 | Sep-70 | 109 | Jul-71 | 0.83 | --- | --- | 80.0 |
| | Dec-72 | 137 | Jun-73 | 0.50 | 2.25 | 10.7% | 99.5 |
| Oconee 2 | Sep-70 | 109 | Jul-72 | 1.83 | --- | --- | 50.0 |
| | Sep-71 | 137 | Feb-73 | 1.42 | 1.00 | 25.7% | 71.0 |
| Oconee 3 | Sep-70 | 109 | Jul-73 | 2.83 | --- | --- | 25.0 |
| | Sep-71 | 137 | Nov-73 | 2.17 | 1.00 | 25.7% | 43.0 |
| Peach Bottom 2 | Dec-66 | 138 | NA | NA | --- | --- | 0.0 |
| | Jun-72 | 352 | Sep-73 | 1.25 | 5.50 | 18.5% | 72.0 |
| Peach Bottom 3 | Dec-66 | 125 | NA | NA | --- | --- | NA |
| | Jun-72 | 316 | Sep-74 | 2.25 | 5.50 | 18.4% | 50.0 |

( continued )

TABLE 2.3: COST GROWTH IN BECHTEL PLANTS
First Estimate to December 1972

| Unit Name | -----Estimates------ Date of Est. | Cost | COD | Years to COD | Years Elapsed | Cost Growth Rate | % Complete |
|---|---|---|---|---|---|---|---|
| Rancho Seco | Dec-67 | 134 | May-73 | 5.42 | --- | --- | 0.0 |
| | Sep-72 | 300 | Feb-74 | 1.42 | 4.76 | 18.5% | 78.0 |
| San Onofre 2 | Mar-70 | 189 | Jun-76 | 6.25 | --- | --- | 0.0 |
| | Dec-71 | 409 | NA | NA | 1.75 | 55.3% | 0.0 |
| Trojan | Dec-68 | 196 | Sep-74 | 5.75 | --- | --- | 0.0 |
| | Dec-72 | 284 | Jul-75 | 2.58 | 4.00 | 9.7% | 57.0 |
| Turkey Point 4 | Mar-70 | 80 | NA | NA | --- | --- | 66.7 |
| | Dec-72 | 106 | Jul-73 | 0.58 | 2.76 | 10.7% | 99.0 |
| Grand Gulf 1 | Jun-72 | 600 | Dec-78 | 6.50 | --- | --- | 0 |
| | Dec-72 | 656 | Jun-79 | 6.50 | 0.50 | 19.5% | 0 |
| Hope Creek 1 | Mar-70 | 574 | Mar-75 | 5.00 | --- | --- | 0 |
| | Dec-72 | 1139 | May-79 | 6.42 | 2.76 | 28.2% | 0 |
| Limerick 1 | Mar-70 | 252 | Mar-75 | 5.00 | --- | --- | 0 |
| | Dec-72 | 694 | Aug-78 | 5.67 | 2.76 | 44.4% | 1 |
| Limerick 2 | Mar-70 | 223 | Mar-77 | 7.00 | --- | --- | 0 |
| | Dec-72 | 512 | Jan-80 | 7.08 | 2.76 | 35.2% | 1 |
| Midland 1 | Dec-71 | 277 | May-77 | 5.42 | --- | --- | 2 |
| | Dec-72 | 383 | Feb-79 | 6.17 | 1.00 | 38.1% | 2 |
| Midland 2 | Dec-71 | 277 | May-78 | 6.42 | --- | --- | 2 |
| | Dec-72 | 383 | Feb-80 | 7.17 | 1.00 | 38.1% | 2 |
| San Onofre 3 | Mar-70 | 189 | Jun-76 | 6.25 | --- | --- | 0 |
| | Dec-71 | 409 | NA | NA | 1.75 | 55.3% | 0 |
| Vogtle 1 | Sep-71 | NA | Apr-78 | 6.58 | --- | --- | 0 |
| | Dec-72 | 570 | Apr-80 | 7.33 | 1.25 | NA | 0 |
| Vogtle 2 | Sep-71 | NA | Apr-79 | 7.58 | --- | --- | 0 |
| | Dec-72 | NA | Apr-81 | 8.33 | 1.25 | NA | 0 |
| Averages: | | | | | | | |
| Simple | | | | | 2.86 | 23.9% | |
| Weighted by Years | | | | | --- | 20.8% | |
| # of Datapoints | | | | | 29 | 27 | |

TABLE 2.4: SCHEDULE SLIPPAGE IN BECHTEL PLANTS
First Estimate to December 1972

| Unit Name | Date of Estimate | Estimated Cost | Estimated COD | Years to COD | Years Elapsed | Progress Ratio | % Complete |
|---|---|---|---|---|---|---|---|
| Arkansas 1 | Dec-67 | 132 | Dec-72 | 5.00 | --- | --- | 0.0 |
| | Sep-72 | 185 | Oct-73 | 1.08 | 4.76 | 82.5% | 86.8 |
| Arkansas 2 | Dec-70 | 183 | Oct-75 | 4.83 | --- | --- | 0.0 |
| | Sep-72 | 230 | Oct-76 | 4.08 | 1.75 | 42.8% | 6.9 |
| Duane Arnold | Jun-68 | 103 | Dec-73 | 5.50 | --- | --- | 0.0 |
| | Sep-72 | 192 | Jan-74 | 1.33 | 4.25 | 98.0% | 69.0 |
| Calvert Cliffs 1 | Jun-67 | 118 | Jan-73 | 5.58 | --- | --- | 0.0 |
| | Sep-72 | 250 | Feb-74 | 1.42 | 5.26 | 79.4% | 72.0 |
| Calvert Cliffs 2 | Jun-67 | 105 | Jan-74 | 6.58 | --- | --- | 0.0 |
| | Sep-72 | 204 | Jan-75 | 2.33 | 5.26 | 81.0% | 56.0 |
| Davis-Besse 1 | Dec-68 | 180 | Dec-74 | 6.00 | --- | --- | 0.0 |
| | Dec-72 | 349 | May-75 | 2.42 | 4.00 | 89.7% | 40.0 |
| Farley 1 | Sep-69 | 164 | Apr-75 | 5.58 | --- | --- | 0.0 |
| | Sep-71 | 259 | Apr-75 | 3.58 | 2.00 | 100.0% | 6.0 |
| Farley 2 | Sep-70 | 183 | Apr-77 | 6.58 | --- | --- | 0.0 |
| | Sep-71 | 233 | Apr-77 | 5.58 | 1.00 | 100.0% | 0.0 |
| Hatch 1 | Jun-68 | NA | Jun-73 | 5.00 | --- | --- | 0.0 |
| | Dec-72 | 282 | Apr-74 | 1.33 | 4.50 | 81.5% | 69.0 |
| Hatch 2 | Sep-72 | 189 | Apr-76 | 3.58 | --- | --- | NA |
| | Dec-72 | 330 | Apr-78 | 5.33 | 0.25 | -702.2% | 11.0 |
| Millstone 2 | Dec-67 | 150 | Apr-74 | 6.33 | --- | --- | 0.0 |
| | Sep-72 | 282 | Apr-74 | 1.58 | 4.76 | 100.0% | 49.0 |
| Oconee 1 | Sep-70 | 109 | Jul-71 | 0.83 | --- | --- | 80.0 |
| | Dec-72 | 137 | Jun-73 | 0.50 | 2.25 | 14.7% | 99.5 |
| Oconee 2 | Sep-70 | 109 | Jul-72 | 1.83 | --- | --- | 50.0 |
| | Sep-71 | 137 | Feb-73 | 1.42 | 1.00 | 41.1% | 71.0 |
| Oconee 3 | Sep-70 | 109 | Jul-73 | 2.83 | --- | --- | 25.0 |
| | Sep-71 | 137 | Nov-73 | 2.17 | 1.00 | 66.3% | 43.0 |
| Peach Bottom 2 | Mar-68 | 163 | Mar-71 | 3.00 | --- | --- | 4.4 |
| | Jun-72 | 352 | Sep-73 | 1.25 | 4.25 | 41.1% | 72.0 |
| Peach Bottom 3 | Mar-68 | 145 | Jan-73 | 4.83 | --- | --- | 1.6 |
| | Jun-72 | 316 | Sep-74 | 2.25 | 4.25 | 60.8% | 50.0 |

( continued )

TABLE 2.4: SCHEDULE SLIPPAGE IN BECHTEL PLANTS
First Estimate to December 1972

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | Years Elapsed | Progress Ratio | % Complete |
|---|---|---|---|---|---|---|---|
| Rancho Seco | Dec-67 | 134 | May-73 | 5.42 | --- | --- | 0.0 |
| | Sep-72 | 300 | Feb-74 | 1.42 | 4.76 | 84.1% | 78.0 |
| San Onofre 2 | Mar-70 | 189 | Jun-76 | 6.25 | --- | --- | 0.0 |
| | Sep-72 | NA | Apr-78 | 5.58 | 2.51 | 26.9% | |
| Trojan | Dec-68 | 196 | Sep-74 | 5.75 | --- | --- | 0.0 |
| | Dec-72 | 284 | Jul-75 | 2.58 | 4.00 | 79.3% | 57.0 |
| Turkey Point 4 | Sep-71 | 96 | Jul-72 | 0.83 | --- | --- | 75.5 |
| | Dec-72 | 106 | Jul-73 | 0.58 | 1.25 | 20.1% | 99.0 |
| Grand Gulf 1 | Jun-72 | 600 | Dec-78 | 6.50 | --- | --- | 0 |
| | Dec-72 | 656 | Jun-79 | 6.50 | 0.50 | 0.5% | 0 |
| Hope Creek 1 | Mar-70 | 574 | Mar-75 | 5.00 | --- | --- | 0 |
| | Dec-72 | 1139 | May-79 | 6.42 | 2.76 | -51.3% | 0 |
| Limerick 1 | Mar-70 | 252 | Mar-75 | 5.00 | --- | --- | 0 |
| | Dec-72 | 694 | Aug-78 | 5.67 | 2.76 | -24.2% | 1 |
| Limerick 2 | Mar-70 | 223 | Mar-77 | 7.00 | --- | --- | 0 |
| | Dec-72 | 512 | Jan-80 | 7.08 | 2.76 | -3.0% | 1 |
| Midland 1 | Jun-68 | NA | Feb-74 | 5.67 | --- | --- | 0 |
| | Dec-72 | 383 | Feb-79 | 6.17 | 4.50 | -11.1% | 2 |
| Midland 2 | Mar-68 | NA | Feb-75 | 6.92 | --- | --- | 0 |
| | Dec-72 | 383 | Feb-80 | 7.17 | 4.76 | -5.2% | 2 |
| San Onofre 3 | Mar-70 | 189 | Jun-76 | 6.25 | --- | --- | 0 |
| | Sep-72 | NA | Apr-79 | 6.58 | 2.51 | -13.0% | |
| Vogtle 1 | Sep-71 | NA | Apr-78 | 6.58 | --- | --- | 0 |
| | Dec-72 | 570 | Apr-80 | 7.33 | 1.25 | -60.0% | 0 |
| Vogtle 2 | Sep-71 | NA | Apr-79 | 7.58 | --- | --- | 0 |
| | Dec-72 | NA | Apr-81 | 8.33 | 1.25 | -60.0% | 0 |
| Averages: | | | | | | | |
| Simple | | | | | 2.97 | 12.4% | |
| Weighted by Years | | | | | --- | 46.0% | |
| # of Datapoints | | | | | 29 | 29 | |

TABLE 2.5: COST ESTIMATE HISTORIES
New England Nuclear Units to December, 1972

| Unit Name | Date of Estimate | Estimates Cost | Estimates COD |
|---|---|---|---|
| Connecticut Yankee | 1962 | 86 | 1967 |
| | 1963 | 99 | 1967 |
| | 1967 | 104 | 1967 |
| | Actual | 104 | Jan-68 |
| Millstone 1 | Dec-65 | | Aug-69 |
| | Mar-67 | 81 | Aug-69 |
| | Sep-67 | 84 | Aug-69 |
| | Dec-68 | 90 | Jan-70 |
| | Mar-69 | 90 | Mar-70 |
| | Sep-69 | 92 | Oct-70 |
| | Jun-70 | 92 | Nov-70 |
| | Sep-70 | 92 | Dec-70 |
| | Dec-70 | 92 | Feb-71 |
| | Actual | 97 | Mar-71 |
| Vermont Yankee | Sep-66 | 88 | Oct-70 |
| | Sep-69 | 120 | Jul-71 |
| | Mar-70 | 133 | Jul-71 |
| | Feb-71 | | Oct-71 |
| | Jul-70 | 154 | Mar-72 |
| | Dec-71 | | Sep-72 |
| | Actual | 184 | Nov-72 |
| Pilgrim 1 | Mar-64 | | Oct-71 |
| | Jul-65 | 70 | Jul-71 |
| | Feb-67 | 105 | Jul-71 |
| | Jun-68 | 122 | Sep-71 |
| | Jan-70 | 153 | Sep-71 |
| | Jun-70 | | Dec-71 |
| | Mar-71 | | Nov-71 |
| | Mar-71 | | Apr-72 |
| | Sep-72 | | Nov-72 |
| | Actual | 239 | Dec-72 |
| Maine Yankee | Sep-67 | 100 | May-72 |
| | Sep-68 | 131 | May-72 |
| | Mar-70 | 181 | May-72 |
| | Actual | 219 | Dec-72 |

TABLE 3.1: COMPLETED BECHTEL NUCLEAR UNITS
As of December, 1976

| | --Actuals-- | | ---Last Pre-C.P.--- Estimates | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Unit Name | Cost | COD | Date of Est. | Cost | COD | Years to COD | Cost Ratio | Myopia | Duration Ratio |
| Arkansas 1 | 239 | Dec-74 | Dec-67 | 132 | Dec-72 | 5.00 | 1.81 | 1.126 | 1.400 |
| Calvert Cliffs 1 | 431 | May-75 | Mar-69 | 124 | Jan-73 | 3.83 | 3.47 | 1.384 | 1.609 |
| Duane Arnold | 280 | Feb-75 | Dec-69 | 138 | Dec-73 | 4.00 | 2.03 | 1.193 | 1.292 |
| Ginna | [1] | Jul-70 | Mar-66 | | Jun-69 | 3.25 | | | 1.333 |
| Hatch 1 | 390 | Dec-75 | Mar-69 | 151 | Jun-73 | 4.25 | 2.59 | 1.250 | 1.588 |
| Millstone 2 | 426 | Dec-75 | Dec-69 | 183 | Apr-74 | 4.33 | 2.33 | 1.215 | 1.385 |
| Monticello | [1] | Jun-71 | Jun-66 | | May-70 | 3.92 | | | 1.277 |
| Palisades | 147 | Dec-71 | Sep-66 | 75 | May-70 | 3.67 | 1.96 | 1.201 | 1.433 |
| Peach Bottom 2 | 531 | Jul-74 | Sep-67 | 163 | Jun-71 [2] | 3.75 | 3.26 | 1.370 | 1.822 |
| Peach Bottom 3 | 223 | Dec-74 | Sep-67 | 145 | Jun-73 [2] | 5.75 | 1.54 | 1.078 | 1.261 |
| Pilgrim 1 | 239 | Dec-72 | Jun-68 | 122 | Sep-71 | 3.25 | 1.96 | 1.229 | 1.385 |
| Point Beach 1 | [1] | Dec-70 | Sep-66 | | Apr-70 | 3.58 | | | 1.186 |
| Point Beach 2 | [1] | Oct-72 | Mar-67 | | Apr-71 | 4.08 | | | 1.367 |
| Rancho Seco | 344 | Apr-75 | Dec-67 | 134 | May-73 | 5.42 | 2.56 | 1.190 | 1.354 |
| Trojan | 452 | Dec-75 | Dec-69 | 227 | Sep-74 | 4.75 | 1.99 | 1.156 | 1.263 |
| Turkey Point | 109 | Dec-72 | Sep-66 | 70 | Jun-70 | 3.75 | 1.55 | 1.125 | 1.668 |
| Turkey Point | 127 | Sep-73 | Sep-66 | 63 | Jun-71 | 4.75 | 2.01 | 1.159 | 1.475 |
| Average | 303 | Nov-73 | Dec-67 | 133 | Feb-72 | 4.20 | 2.23 | 1.206 | 1.417 |
| # of Datapoints | 13 | 17 | 17 | 13 | 17 | 17 | 13 | 13 | 17 |

Notes: [1] Turnkey Plant: no cost analysis performed
[2] Month assumed

TABLE 3.2: BECHTEL PLANTS UNDER CONSTRUCTION
Experience From Last Estimate Before Construction Permit
To December 1976

| Unit Name | Date of Est. | Cost | COD | Years to COD | Years Elapsed | Cost Growth Rate | Progress Ratio | % Complete |
|---|---|---|---|---|---|---|---|---|
| Arkansas 2 | Sep-72 | 230 | Oct-76 | 4.08 | --- | --- | --- | 6.9 |
| | Dec-75 | 393 | Mar-78 | 2.25 | 3.25 | 17.9% | 56.5% | 56.4 |
| Calvert Cliffs 2 | Mar-69 | 105 | Jan-74 | 4.83 | --- | --- | --- | 2.0 |
| | Dec-76 | 251 | Apr-77 | 0.33 | 7.76 | 11.9% | 58.1% | 100.0 |
| Davis-Besse 1 | Sep-70 | 266 | Dec-74 | 4.25 | --- | --- | --- | 2.0 |
| | Dec-76 | 566 | Jul-77 | 0.58 | 6.25 | 12.8% | 58.7% | 99.0 |
| Farley 1 | Sep-71 | 259 | Apr-75 | 3.58 | --- | --- | --- | 6.0 |
| | Dec-76 | 666 | Sep-77 | 0.75 | 5.25 | 19.7% | 53.9% | 97.0 |
| Farley 2 | Sep-71 | 233 | Apr-77 | 5.58 | --- | --- | --- | 0.0 |
| | Dec-76 | 572 | Apr-79 | 2.33 | 5.25 | 18.6% | 61.9% | 42.0 |
| Hatch 2 | Sep-72 | 189 | Apr-76 | 3.58 | --- | --- | --- | NA |
| | Jun-76 | 512 | Apr-79 | 2.83 | 3.75 | 30.4% | 20.0% | 57.0 |
| San Onofre 2 | Jun-73 | 655 | Apr-78 | 4.84 | --- | --- | --- | 0.0 |
| | Jun-76 | 1210 | Oct-81 | 5.33 | 3.00 | 22.7% | -16.7% | 23.0 |
| Callaway 1 | Mar-76 | 780 | Oct-81 | 5.58 | --- | --- | --- | 1 |
| | Dec-76 | 1088 | Jun-82 | 5.50 | 0.75 | 55.5% | 11.6% | 2.7 |
| Grand Gulf 1 | Sep-73 | 656 | Sep-79 | 6.00 | --- | --- | --- | 0 |
| | Sep-76 | 935 | Jun-80 | 3.75 | 3.00 | 12.5% | 75.0% | 32.5 |
| Grand Gulf 2 | Sep-73 | 571 | Sep-81 | 8.00 | --- | --- | --- | NA |
| | Sep-76 | 775 | Sep-83 | 7.00 | 3.00 | 10.7% | 33.4% | 6.5 |
| Hope Creek 1 | Sep-74 | 1972 | Dec-81 | 7.25 | --- | --- | --- | 0 |
| | Sep-76 | 2580 | May-84 | 7.67 | 2.00 | 14.4% | -20.7% | 2 |
| Limerick 1 | Mar-74 | 694 | Oct-79 | 5.58 | --- | --- | --- | 1 |
| | Jun-76 | 1212 | Apr-83 | 6.83 | 2.25 | 28.1% | -55.3% | 28.6 |
| Limerick 2 | Mar-74 | 539 | Apr-82 | 8.08 | --- | --- | --- | 4 |
| | Jun-76 | 539 | Apr-85 | 8.83 | 2.25 | 0.0% | -33.2% | 15.3 |
| Midland 1 | Dec-72 | 383 | Feb-79 | 6.17 | --- | --- | --- | 2 |
| | Jun-76 | 700 | Mar-82 | 5.75 | 3.50 | 18.8% | 12.1% | 13 |
| Midland 2 | Dec-72 | 383 | Feb-80 | 7.17 | --- | --- | --- | 2 |
| | Jun-76 | 700 | Mar-81 | 4.75 | 3.50 | 18.8% | 69.2% | 16 |

( continued )

TABLE 3.2: BECHTEL PLANTS UNDER CONSTRUCTION
Experience From Last Estimate Before Construction Permit
To December 1976

| Unit Name | -----Estimates------ Date of Est. | Cost | COD | Years to COD | Years Elapsed | Cost Growth Rate | Progress Ratio | % Complete |
|---|---|---|---|---|---|---|---|---|
| Palo Verde 3 | Dec-75 | 950 | May-86 | 10.42 | --- | --- | --- | 0 |
| | Dec-76 | 950 | Jun-86 | 9.50 | 1.00 | 0.0% | 91.5% | 0 |
| San Onofre 3 | Jun-73 | 655 | Apr-79 | 5.84 | --- | --- | --- | 0 |
| | Dec-76 | 996 | Jan-83 | 6.08 | 3.50 | 12.7% | -7.2% | 20 |
| Callaway 2 | Mar-76 | 739 | Apr-83 | 7.08 | --- | --- | --- | 0.2 |
| | Dec-76 | 1297 | Apr-87 | 10.33 | 0.75 | 111.0% | -431.3% | 0.4 |
| Averages: | | | | | | | | |
| Simple | | | | | 3.34 | 23.1% | 2.1% | |
| Weighted by Years | | | | | --- | 17.9% | 29.2% | |
| # of Datapoints | | | | | 18 | 18 | 18 | |

TABLE 3.3: MILLSTONE 2 COST ESTIMATE HISTORY

| Unit Name | Date of Estimate | ----Estimates---- Cost | COD |
| --- | --- | --- | --- |
| Millstone 2 | Dec-67 | 150 | Apr-74 |
| | Mar-68 | 146 | Apr-74 |
| | Dec-68 | 179 | Apr-74 |
| | Dec-69 | 183 | Apr-74 |
| | Dec-70 | 239 | Apr-74 |
| | Sep-71 | 252 | Apr-74 |
| | Sep-72 | 282 | Apr-74 |
| | Mar-73 | 341 | Dec-74 |
| | Dec-73 | 380 | May-75 |
| | Sep-74 | 399 | Aug-75 |
| | Jun-75 | 399 | Oct-75 |
| | Sep-75 | 416 | Nov-75 |
| | Dec-75 | 416 | Dec-75 |
| | Actual | 426 | Dec-75 |

TABLE 4.1: COMPARISON OF FINANCIAL INDICATORS TO NUCLEAR COMMITMENT

| INDICATOR [for 1980] | UTILITY MONTAUP/EUA | NORTHEAST | BECO |
|---|---|---|---|
| Peak Load (MW) | 695 | 4,050 | 2,373 |
| Sales (GWH) | 4,333 | 20,567 | 11,868 |
| Revenues ($MM) | $244.6 | $1,179.2 | $886.4 |
| Net Income ($MM) | $9.0 | $88.8 | $66.8 |
| Net Plant in Service ($MM) | $232.0 | $2,294.3 | $1,199.9 |
| Book Common Equity ($MM) | $95.4 | $917.2 | $488.5 |
| MW Nuclear Commitment | 138.0 | 782.0 | 678.5 |
| **RATIO OF INDICATORS TO NUCLEAR COMMITMENT** | | | |
| Peak Load | 5.0 | 5.2 | 3.5 |
| Sales | 31.4 | 26.3 | 17.5 |
| Revenues | 1.8 | 1.5 | 1.3 |
| Net Income | 0.07 | 0.11 | 0.10 |
| Net Plant in Service | 1.7 | 2.9 | 1.8 |
| Common Equity | 0.69 | 1.17 | 0.72 |

TABLE 4.2: PLANT CANCELATIONS: 1977-1980

| Unit Name | Year of Cancelation | Construction Status | % Complete |
|---|---|---|---|
| Alan Barton 1 | 1977 | order | |
| Alan Barton 2 | | order | |
| Douglas Point 1 | | order | |
| Ft. Calhoun 2 | | order | |
| South Dade 1 | | order | |
| South Dade 2 | | order | |
| Surry 3 | | C.P. | 0% |
| Surry 4 | | C.P. | 0% |
| CMO Co. unit 1 | | order | |
| Atlantic 1 | 1978 | order | |
| Atlantic 2 | | order | |
| Blue Hills 1 | | order | |
| Blue Hills 2 | | order | |
| Haven 2 | | order | |
| Islote | | order | |
| S.R. 1 | | order | |
| S.R. 2 | | order | |
| Sundesert 1 | | order | |
| Sundesert 2 | | order | |
| PSE&G Co. unit 1 | | order | |
| PSE&G Co. unit 2 | | order | |
| Wm. H. Zimmer 2 | | order | |
| Greene County | 1979 | order | |
| NEP-1 | | order | |
| NEP-2 | | order | |
| Palo Verde 4 | | order | |
| Palo Verde 5 | | order | |
| Tyrone 1 | | C.P. | 0% |
| Davis-Besse 2 | 1980 | limited work auth. | 0% |
| Davis-Besse 3 | | limited work auth. | 0% |
| Erie 1 | | order | |
| Erie 2 | | order | |
| Forked River 1 | | C.P. | 5% |
| Greenwood 2 | | order | |
| Greenwood 3 | | order | |
| Haven 1 | | order | |
| Jamesport 1 | | C.P. | 0% |
| Jamesport 2 | | C.P. | 0% |
| Montague 1 | | order | |
| Montague 2 | | order | |
| New Haven 1 | | order | |
| New Haven 2 | | order | |
| North Anna 4 | | C.P. | 4% |
| Sterling | | C.P. | 0% |

TABLE 4.3: BECHTEL PLANTS COMPLETED
1977 to June 1980

| Unit Name | --Actual--- Cost | COD | ------Estimates----- Date of Est. | Cost | COD | Years to COD | Cost Ratio | Myopia |
|---|---|---|---|---|---|---|---|---|
| Arkansas 2 | 640 | Mar-80 | Sep-72 | 230 | Oct-76 | 4.08 | 2.78 | 1.285 |
| Calvert Cliffs 2 | 335 | Apr-77 | Mar-69 | 105 | Jan-74 | 4.83 | 3.19 | 1.272 |
| Davis Besse 1 | 672 | Nov-77 | Sep-70 | 266 | Dec-74 | 4.25 | 2.53 | 1.244 |
| Farley 1 | 727 | Dec-77 | Sep-71 | 259 | Apr-75 | 3.58 | 2.81 | 1.334 |
| Hatch 2 | 515 | Sep-79 | Sep-72 | 189 | Apr-76 | 3.58 | 2.72 | 1.323 |
| Average | 578 | Aug-78 | May-71 | 210 | Jun-75 | 4.07 | 2.81 | 1.291 |
| # of Datapoints: | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

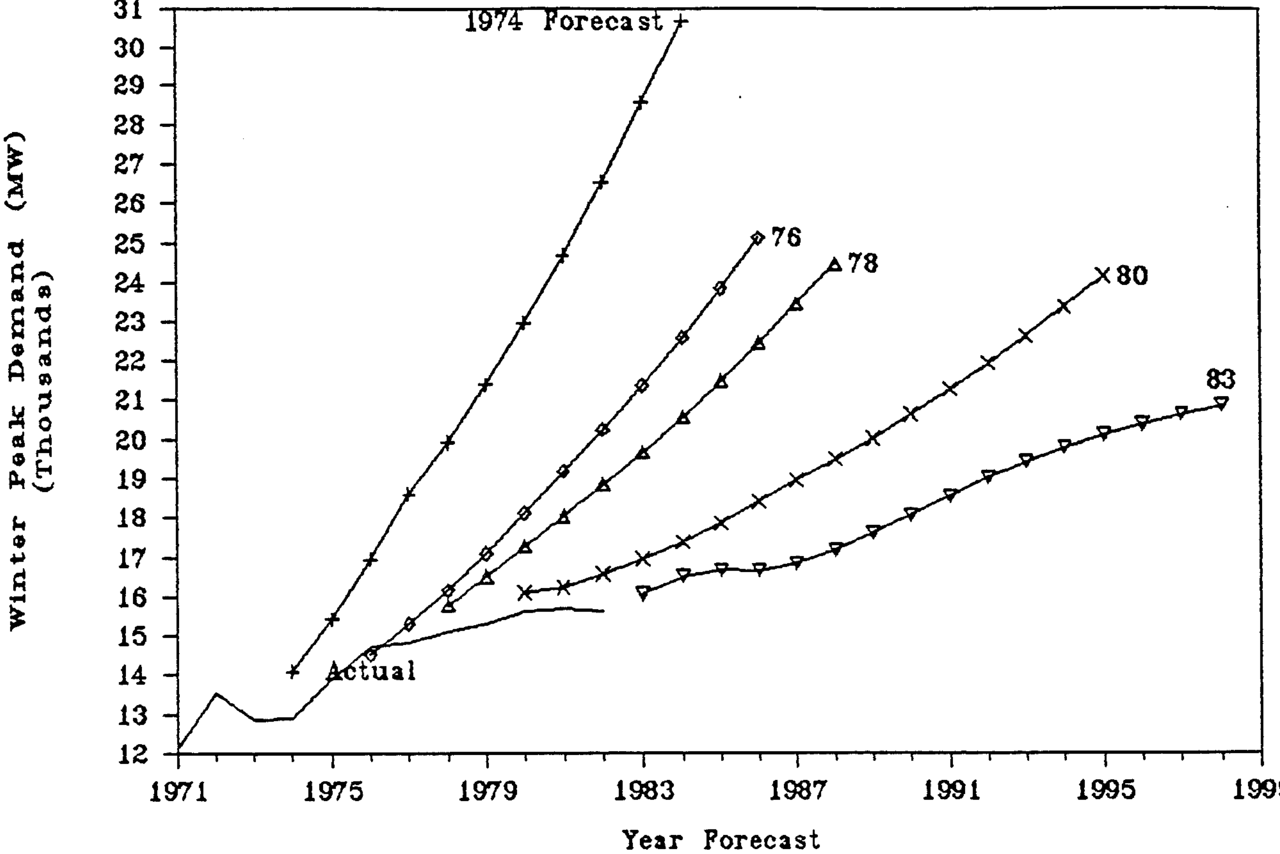
Notes: 1. Cost: $ Million

TABLE 4.4: COST OVERRUNS AND SCHEDULE SLIPPAGE

| Unit Name | Dec-1976 Estimated Cost | Dec-1976 Estimated COD | Jun-1980 Estimated Cost | Jun-1980 Estimated COD | Cost % Increase | Schedule Slippage (months) |
|---|---|---|---|---|---|---|
| Farley 2 | 572 | Apr-79 | 707 | Feb-80 | 23.6% | 10 |
| San Onofre 2 | 1210 | Oct-81 | 1824 | Dec-81 | 50.7% | 2 |
| Callaway 1 | 1088 | Jun-82 | 1261 | Oct-82 | 15.9% | 4 |
| Grand Gulf 1 | 935 | Jun-80 | 1203 | Apr-82 | 28.7% | 22 |
| Grand Gulf 2 | 775 | Sep-83 | 878 | Apr-86 | 13.3% | 31 |
| Hope Creek 1 | 2580 | May-84 | 4310 | Dec-86 | 67.1% | 31 |
| Limerick 1 | 1212 | Apr-83 | 1695 | Apr-83 | 39.9% | 0 |
| Limerick 2 | 539 | Apr-85 | 909 | Apr-85 | 68.6% | 0 |
| Midland 1 | 700 | Mar-82 | 1550 | Mar-85 | 121.4% | 36 |
| Midland 2 | 700 | Mar-81 | 1550 | Sep-84 | 121.4% | 42 |
| Palo Verde 1 | 975 | May-82 | 1429 | May-83 | 46.6% | 12 |
| Palo Verde 2 | 845 | May-84 | 820 | May-84 | -3.0% | 0 |
| Palo Verde 3 | 950 | Jun-86 | 1125 | Jun-86 | 18.4% | 0 |
| San Onofre 3 | 996 | Jan-83 | 1216 | Jan-83 | 22.1% | 0 |
| South Texas 1 | 676 | Oct-80 | 1208 | Feb-84 | 78.7% | 40 |
| South Texas 2 | 676 | Mar-82 | 1208 | Feb-86 | 78.7% | 47 |
| Susquehanna 2 | 706 | May-82 | 1082 | Aug-82 | 53.3% | 3 |
| Vogtle 1 | 629 | Apr-80 | 1746 | May-85 | 177.6% | 61 |
| Vogtle 2 | 534 | Apr-81 | 988 | Nov-87 | 85.0% | 79 |
| Wolf Creek | 940 | Apr-82 | 1296 | Apr-83 | 37.9% | 12 |
| Callaway 2 | 1297 | Apr-87 | 1609 | Jun-88 | 24.1% | 14 |
| AVERAGE | | | | | 55.7% | 21 |

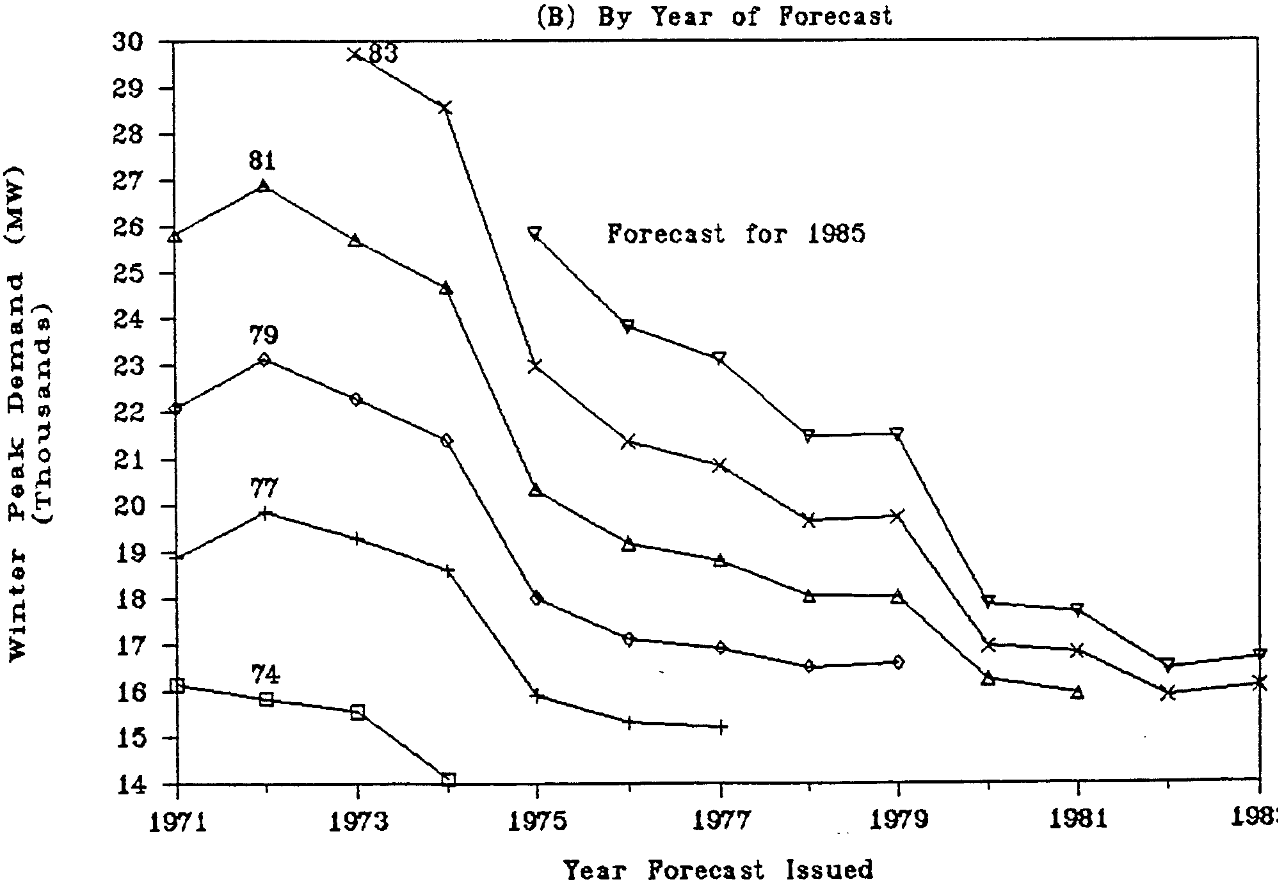
Figure 7.1. NEPOOL Forecast History

(A) By Year Forecast



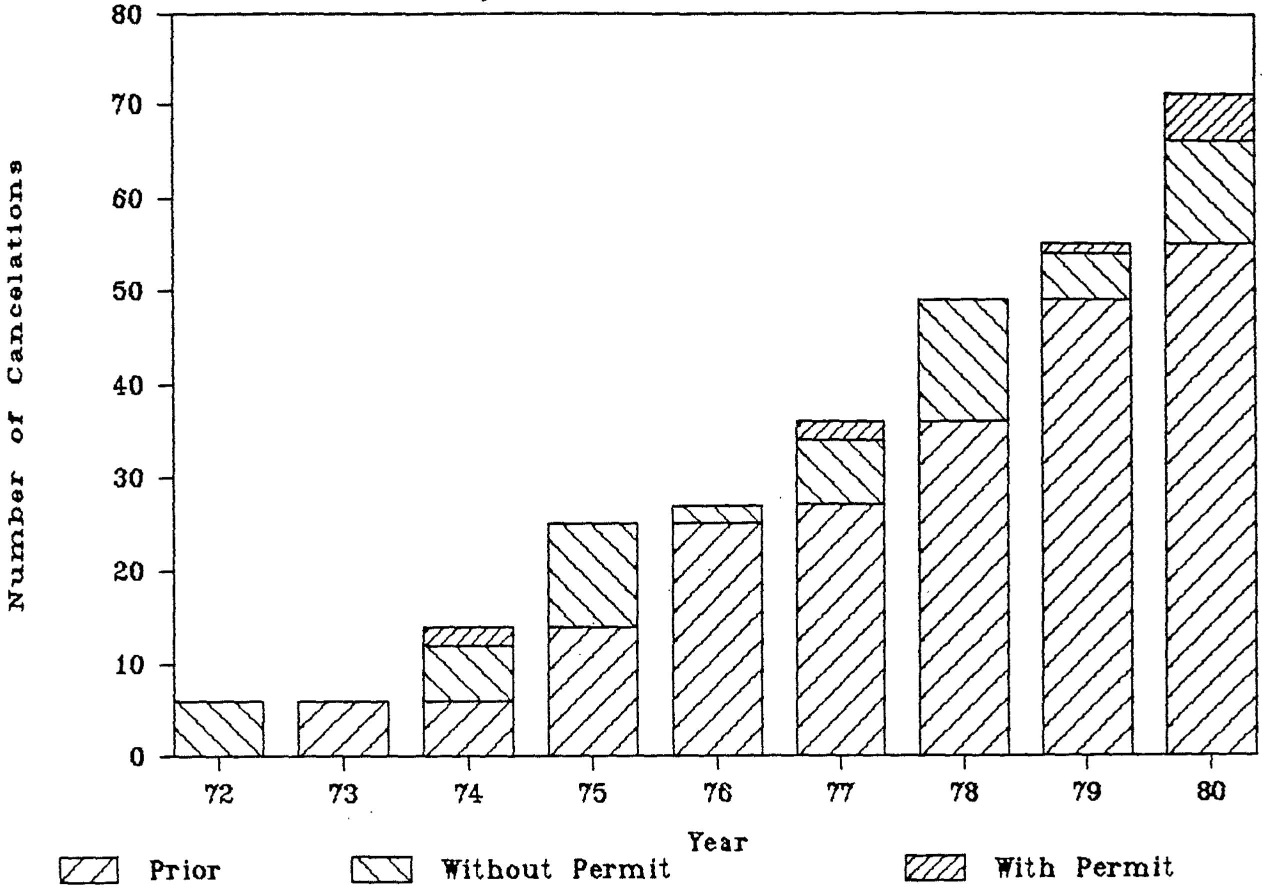



(B) By Year of Forecast

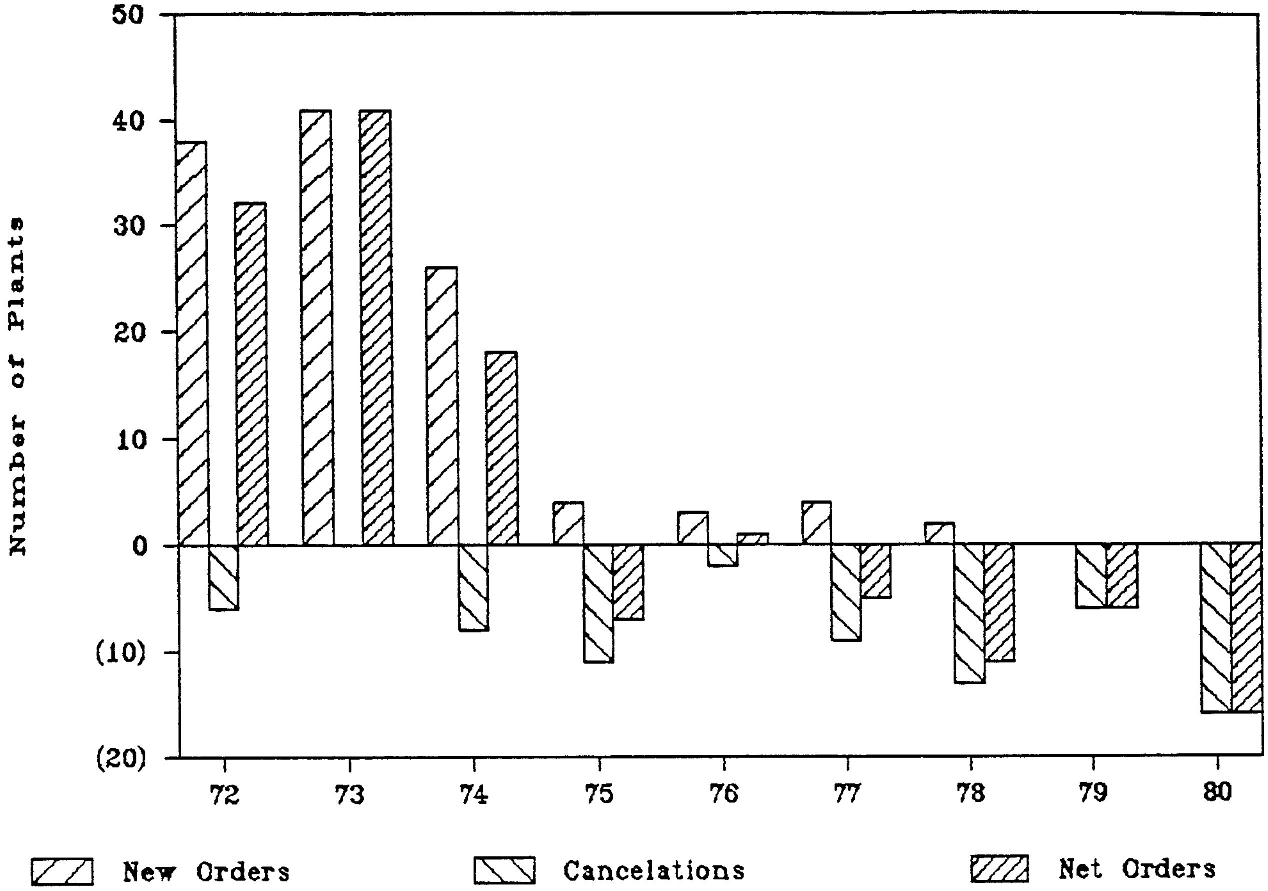


# Figure 4.2: Plant Cancelations:

With, and Without Construction Permit



# Figure 4.3: NET NUCLEAR ORDERS



Appendix A:

Resume of Paul Chernick

PAUL L. CHERNICK

Analysis and Inference, Inc.
10 Post Office Square
Boston, Massachusetts 02109
(617) 542-0611

## PROFESSIONAL EXPERIENCE

Research Associate, Analysis and Inference, Inc.
May, 1981 - present (Consultant, 1980-1981)

Research, consulting and testimony in various aspects of utility and insurance regulation. Designed self-insurance pool for nuclear decommissioning; estimated probability and cost of insurable events, and rate levels; assessed alternative rate designs. Projected nuclear power plant construction, operation, and decommissioning costs.

Consulted on utility rate design issues including small power producer rates; retail natural gas rates; public agency electric rates; and comprehensive electric rate design for a regional power agency. Developed electricity cost allocations between customer classes.

Reviewed district heating system efficiency. Proposed power plant performance standards. Analyzed auto insurance profit requirements. Designed utility-financed, decentralized conservation program. Reviewed cost-effectiveness analyses for transmission lines.

Utility Rate Analyst, Massachusetts Attorney General
December, 1977 - May, 1981

Analyzed utility filings and prepared alternative proposals. Participated in rate negotiations, discovery, cross-examination, and briefing. Provided extensive expert testimony before various regulatory agencies.

Topics included: demand forecasting, rate design, marginal costs, time-of-use rates, reliability issues, power pool operations, nuclear power cost projections, power plant cost-benefit analysis, energy conservation and alternative energy development.

EDUCATION

S.M., Technology and Policy Program, Massachusetts Institute of Technology, February, 1978

S.B., Civil Engineering Department, Massachusetts Institute of Technology, June, 1974

HONORARY SOCIETIES

Chi Epsilon (Civil Engineering)
Tau Beta Pi (Engineering)
Sigma Xi (Research)

OTHER HONORS

Institute Award, Institute of Public Utilities, 1981

PUBLICATIONS

Fairley, W., Meyer, M., and Chernick, P., "Insurance Market Assessment of Technological Risks," presented at the Session on Monitoring for Risk Management, Annual meeting of the American Association for the Advancement of Science, Detroit, Michigan, May 27, 1983.

Chernick, P., "Revenue Stability Target Ratemaking," Public Utilities Fortnightly, February 17, 1983 ,pp. 35-39.

Chernick, P., and Meyer, M., "An Improved Methodology for Making Capacity/Energy Allocations for Generation and Transmission Plant," in Award Papers in Public Utility Economics and Regulation, Institute for Public Utilities, Michigan State University, 1982.

Chernick, P., Fairley, W., Meyer, M., and Scharff,L., Design, Costs and Acceptability of an Electric Utility Self-Insurance Pool for Assuring the Adequacy of Funds for Nuclear Power Plant Decommissioning Expense (NUREG/CR-2370), U.S. Nuclear Regulatory Commission, December, 1981.

Chernick, P., Optimal Pricing for Peak Loads and Joint Production: Theory and Applications to Diverse Conditions (Report 77-1), Technology and Policy Program, Massachusetts Institute of Technology, September, 1977.

EXPERT TESTIMONY

In each entry, the following information is presented in order: jurisdiction and docket number; title of case; client; date testimony filed; and subject matter covered. Abbreviations of jurisdictions include: MDPU (Massachusetts Department of Public Utilities); MEFSC (Massachusetts Energy Facilities Siting Council); PUC (Public Utilities Commission); and PSC (Public Service Commission).

1. MEFSC 78-12/MDPU 19494, Phase I; Boston Edison 1978 forecast; Mass. Attorney General; June 12, 1978.

   Appliance penetration projections, price elasticity, econometric commercial forecast, peak demand forecast. Joint testimony with S.C. Geller.

2. MEFSC 78-17; Northeast Utilities 1978 forecast; Mass. Attorney General; September 29, 1978.

   Specification of economic/demographic and industrial models, appliance efficiency, commercial model structure and estimation.

3. MEFSC 78-33; Eastern Utilities Associates 1978 forecast; Mass. Attorney General; November 27, 1978.

   Household size, appliance efficiency, appliance penetration, price elasticity, commercial forecast, industrial trending, peak demand forecast.

4. MDPU 19494, Phase II; Boston Edison Company Construction Program; Mass. Attorney General; April 1, 1979.

   Review of numerous aspects of the 1978 demand forecasts of nine New England electric utilities, constituting 92% of projected regional demand growth, and of the NEPOOL demand forecast. Joint testimony with S.C. Geller.

5. MDPU 19494, Phase II; Boston Edison Company Construction Program; Mass. Attorney General; April 1, 1979.

   Reliability, capacity planning, capability responsibility allocation, customer generation, co-generation rates, reserve margins, operating reserve allocation. Joint testimony with S. Finger.

6. Atomic Safety and Licensing Board, Nuclear Regulatory Commission 50-471; Pilgrim Unit 2, Boston Edison Company; Commonwealth of Massachusetts; June 29, 1979.

   Review of the Oak Ridge National Laboratory and the NEPOOL demand forecast models; cost-effectiveness of oil displacement; nuclear economics. Joint testimony with S.C. Geller.

7. MDPU 19845; Boston Edison Time-of-Use Rate Case; Mass. Attorney General; December 4, 1979.

   Critique of utility marginal cost study and proposed rates; principles of marginal cost principles, cost derivation, and rate design; options for reconciling costs and revenues. Joint testimony with S.C. Geller. Testimony eventually withdrawn due to delay in case.

8. MDPU 20055; Petition of Eastern Utilities Associates, New Bedford G. & E., and Fitchburg G. & E. to purchase additional shares of Seabrook Nuclear Plant; Mass. Attorney General; January 23, 1980.

   Review of demand forecasts of three utilities purchasing Seabrook shares, Seabrook power costs, including construction cost, completion date, capacity factor, O & M expenses, interim replacements, reserves and uncertainties; alternative energy sources, including conservation, cogeneration, rate reform, solar, wood and coal conversion.

9. MDPU 20248; Petition of Massachusetts Municipal Wholesale Electric Company to Purchase Additional Share of Seabrook Nuclear Plant; Mass. Attorney General; June 2, 1980.

   Nuclear power costs; update and extension of MDPU 20055 testimony.

10. MDPU 200; Massachusetts Electric Company Rate Case; Mass. Attorney General; June 16, 1980.

    Rate design; declining blocks, promotional rates, alternative energy, demand charges, demand ratchets; conservation: master metering, storage heating, efficiency standards, restricting resistance heating.

11. MEFSC 79-33; Eastern Utilities Associates 1979 Forecast; Mass. Attorney General; July 16, 1980.

    Customer projections, consistency issues, appliance efficiency, new appliance types, commercial specifications, industrial data manipulation and trending, sales and resale.

12. MDPU 243; Eastern Edison Company Rate Case; Mass. Attorney General; August 19, 1980.

    Rate design: declining blocks, promotional rates, alternative energy, master metering.

13. PUCT 3298; Gulf States Utilities Rate Case; East Texas Legal Services; August 25, 1980.

    Inter-class revenue allocations, including production plant in service, O & M, CWIP, nuclear fuel in progress, amortization of cancelled plant residential rate design; interruptible rates; off-peak rates. Joint testimony with M.B. Meyer.

14. MEFSC 79-1; Massachusetts Municipal Wholesale Electric Company Forecast; Mass. Attorney General; November 5, 1980.

    Cost comparison methodology; nuclear cost estimates; cost of conservation, cogeneration, and solar.

15. MDPU 472; Recovery of Residential Conservation Service Expenses; Mass. Attorney General; December 12, 1980.

    Conservation as an energy source; advantages of per-kwh allocation over per-customer month allocation.

16. MDPU 535; Regulations to Carry Out §210 of PURPA; Mass. Attorney General; January 26, 1981 and February 13, 1981.

    Filing requirements, certification, qualifying facility (QF) status, extent of coverage, review of contracts; energy rates; capacity rates; extra benefits of QF's in specific areas; wheeling; standardization of fees and charges.

17. MEFSC 80-17; Northeast Utilities 1980 Forecast; Mass. Attorney General; March 12, 1981 (not presented).

    Specification process, employment, electric heating promotion and penetration, commercial sales model, industrial model specification, documentation of price forecast and wholesale forecast.

18. MDPU 558; Western Massachusetts Electric Company Rate Case; Mass. Attorney General; May, 1981.

    Rate design; declining blocks, marginal cost, conservation impacts, promotional rates; conservation: terms and conditions limiting renewables, cogeneration, small power production; scope of current conservation program; efficient insulation levels; additional conservation opportunities.

19. MDPU 1048; Boston Edison Plant Performance Standards; Mass. Attorney General; May 7, 1982.

    Critique of company approach, data, and statistical analysis; description of comparative and absolute approaches to standard-setting; proposals for standards and reporting requirements.

20. District of Columbia PSC FC785; Potomac Electric Power Rate Case: DC People's Counsel; July 29, 1982.

    Inter-class revenue allocations, including generation, transmission, and distribution plant classification; fuel and O & M classification; distribution and service allocators. Marginal cost estimation, including losses.

21. New Hampshire PUC DE81-312; Public Service of New Hampshire - Supply and Demand; Conservation Law Foundation, et al., October 8, 1982.

    Conservation program design, ratemaking, and effectiveness. Cost of nuclear power, including construction cost and duration, capacity factor, O&M, replacements, insurance, and decommissioning.

22. Massachusetts Division of Insurance; Hearing to Fix and Establish 1983 Automobile Insurance Rates; Massachusetts Attorney General; October, 1982.

    Profit margin calculations, including methodology, interest rates, surplus flow, tax flows, tax rates, and risk premium.

23. Illinois Commerce Commission 82-0026; Commonwealth Edison Rate Case; Illinois Attorney General; October 15, 1982.

    Review of Cost-Benefit Analysis for nuclear plant. Nuclear cost parameters (construction cost, O & M, capital additions, useful life, capacity factor), risks, discount rates, evaluation techniques.

24. New Mexico Public Service Commission 1794; Public Service of New Mexico Application for Certification; New Mexico Attorney General; May 10, 1983.

    Review of Cost-Benefit Analysis for transmission line. Review of electricity price forecast, nuclear capacity factors, load forecast. Critique of company ratemaking proposals; development of alternative ratemaking.

25. Connecticut Public Utility Control Authority 830301; United Illuminating Rate Case; Connecticut Consumers Counsel; June 17, 1983.

    Cost of Seabrook nuclear power plants, including construction cost and duration, capacity factor, O & M, replacements, insurance, and decommissioning.

26. MDPU 1509; Boston Edison Plant Performance Standards; Massachusetts Attorney General; July 15, 1983.

    Critique of company approach and statistical analysis; regression model of nuclear capacity factor; proposals for standards and for standard-setting methodologies.

27. Massachusetts Division of Insurance; Hearing to Fix and Establish 1983 Automobile Insurance Rates; Massachusetts Attorney General; October, 1983.

    Profit margin calculations, including methodology, interest rates, surplus flow, tax rates, and recognition of risk.

28. Connecticut Public Utility Control Authority 83-07-15; Connecticut Light and Power Rate Case; Alloy Foundry; October 3, 1983.

    Industrial rate design. Marginal and embedded costs; classification of generation, transmission, and distribution expenses; relative importance of demand and energy charges.

29. MEFSC 83-24; New England Electric System Forecast of Electric Resources and Requirements; Massachusetts Attorney General; November 14, 1983.

    Need for transmission line. Status of supply plan, especially Seabrook 2. Review of interconnection requirements. Analysis of cost-effectiveness for power transfer.

30. Michigan PSC U-7775; Detroit Edison Fuel Cost Recovery Plan; Public Interest Research Group in Michigan; January 13, 1984.

    Review of proposed performance target for new nuclear power plant. Formulation of alternative proposals.

Appendix B:

Myopia Data

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| Arkansas 1 | Dec-67 | 132 | Dec-72 | 5.00 | 0.0 |
| | Mar-69 | 138 | Dec-72 | 3.75 | 1.0 |
| | Jun-69 | 132 | Dec-72 | 3.50 | 1.6 |
| | Mar-72 | 175 | Sep-73 | 1.50 | 76.0 |
| | Sep-72 | 185 | Oct-73 | 1.08 | 86.8 |
| | Mar-73 | 200 | Mar-74 | 1.00 | 96.3 |
| | Sep-73 | 200 | May-74 | 0.67 | 98.8 |
| | Dec-73 | 198 | Jul-74 | 0.58 | 99.8 |
| | Mar-74 | 214 | Sep-74 | 0.50 | 99.0 |
| | Jun-74 | 218 | Sep-74 | 0.25 | 100.0 |
| | Dec-74 | 245 | Dec-74 | 0.00 | 100.0 |
| | Mar-75 | 234 | Dec-74 | -0.25 | 100.0 |
| | Actual | 239 | Dec-74 | | |
| Arkansas 2 | Dec-70 | 183 | Oct-75 | 4.83 | 0.0 |
| | Jun-71 | 190 | Oct-75 | 4.33 | 0.0 |
| | Dec-71 | 200 | Oct-75 | 3.83 | 2.1 |
| | Sep-72 | 230 | Oct-76 | 4.08 | 6.9 |
| | Jun-73 | 275 | Oct-76 | 3.33 | 13.6 |
| | Sep-73 | 275 | Dec-76 | 3.25 | 16.9 |
| | Dec-73 | 273 | Dec-76 | 3.00 | 18.0 |
| | Mar-74 | 273 | Feb-77 | 2.92 | 25.0 |
| | Jun-74 | 318 | Feb-77 | 2.67 | 33.5 |
| | Sep-74 | 318 | Jun-77 | 2.75 | 39.8 |
| | Mar-75 | 339 | Jun-77 | 2.25 | 42.7 |
| | Jun-75 | 339 | Oct-77 | 2.33 | 46.1 |
| | Sep-75 | 369 | Jan-78 | 2.33 | 50.4 |
| | Dec-75 | 393 | Mar-78 | 2.25 | 56.4 |
| | Actual | 640 | Mar-80 | | |
| Calvert Cliffs 1 | Jun-67 | 118 | Jan-73 | 5.58 | 0.0 |
| | Dec-67 | 123 | Jan-73 | 5.08 | 0.0 |
| | Mar-68 | 125 | Jan-73 | 4.83 | 0.0 |
| | Mar-69 | 124 | Jan-73 | 3.83 | 3.0 |
| | Sep-70 | 170 | Jan-73 | 2.33 | 24.0 |
| | Dec-71 | 210 | Jun-73 | 1.50 | 58.0 |
| | Mar-72 | 210 | Oct-73 | 1.58 | 63.0 |
| | Jun-72 | 250 | Oct-73 | 1.33 | 70.0 |
| | Sep-72 | 250 | Feb-74 | 1.42 | 72.0 |
| | Sep-73 | 280 | Jul-74 | 0.83 | 89.0 |
| | Dec-73 | 280 | Sep-74 | 0.75 | 95.0 |
| | Mar-74 | 300 | Oct-74 | 0.58 | 92.0 |
| | Jun-74 | 300 | Dec-74 | 0.50 | 96.0 |
| | Sep-74 | 341 | Dec-74 | 0.25 | 98.7 |
| | Dec-74 | 341 | Mar-75 | 0.25 | 99.4 |
| | Mar-75 | 346 | May-75 | 0.17 | 99.6 |
| | Sep-75 | 350 | May-75 | -0.33 | 100.0 |
| | Actual | 431 | May-75 | | |
| Calvert Cliffs 2 | Jun-67 | 105 | Jan-74 | 6.58 | 0.0 |
| | Dec-67 | 107 | Jan-74 | 6.08 | 0.0 |
| | Mar-68 | 106 | Jan-74 | 5.83 | 0.0 |
| | Mar-69 | 105 | Jan-74 | 4.83 | 2.0 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Sep-70 | 128 | Jan-74 | 3.33 | 21.0 |
| | Dec-71 | 168 | Jan-74 | 2.08 | 46.0 |
| | Mar-72 | 168 | Jun-74 | 2.25 | 47.0 |
| | Jun-72 | 204 | Jun-74 | 2.00 | 54.0 |
| | Sep-72 | 204 | Jan-75 | 2.33 | 56.0 |
| | Mar-73 | 204 | Feb-75 | 1.92 | 67.0 |
| | Sep-73 | 243 | Jun-75 | 1.75 | 73.0 |
| | Dec-73 | 243 | Aug-75 | 1.67 | 79.0 |
| | Mar-74 | 273 | Sep-75 | 1.50 | 75.0 |
| | Jun-74 | 273 | Dec-75 | 1.50 | 73.0 |
| | Sep-74 | 256 | Jan-77 | 2.33 | 71.9 |
| | Mar-75 | 253 | Jan-77 | 1.83 | 80.6 |
| | Dec-75 | 251 | Jan-77 | 1.08 | 92.1 |
| | Sep-76 | 251 | Feb-77 | 0.42 | 99.9 |
| | Dec-76 | 251 | Apr-77 | 0.33 | 100.0 |
| | Actual | 335 | Apr-77 | | |
| Davis-Besse 1 | Dec-68 | 180 | Dec-74 | 6.00 | 0.0 |
| | Sep-69 | 201 | Dec-74 | 5.25 | 0.0 |
| | Sep-70 | 266 | Dec-74 | 4.25 | 2.0 |
| | Jun-72 | 304 | Dec-74 | 2.50 | 22.0 |
| | Dec-72 | 349 | May-75 | 2.42 | 40.0 |
| | Sep-73 | 409 | Feb-76 | 2.42 | 59.0 |
| | Sep-74 | 434 | Jun-76 | 1.75 | 72.5 |
| | Mar-75 | 434 | Sep-76 | 1.50 | 82.3 |
| | Jun-75 | 461 | Sep-76 | 1.25 | 88.2 |
| | Dec-75 | 533 | Mar-77 | 1.25 | 95.0 |
| | Jun-76 | 533 | Apr-77 | 0.83 | 94.9 |
| | Sep-76 | 566 | Jun-77 | 0.75 | 98.8 |
| | Dec-76 | 566 | Jul-77 | 0.58 | 99.0 |
| | Mar-77 | 590 | Jul-77 | 0.33 | 99.5 |
| | Jun-77 | 630 | Oct-77 | 0.33 | 99.8 |
| | Sep-77 | 649 | Dec-77 | 0.25 | 99.9 |
| | Actual | 672 | Nov-77 | | |
| Duane Arnold | Jun-68 | 103 | Dec-73 | 5.50 | 0.0 |
| | Dec-68 | 107 | Dec-73 | 5.00 | 0.0 |
| | Jun-69 | 133 | Dec-73 | 4.50 | 0.0 |
| | Dec-69 | 138 | Dec-73 | 4.00 | 0.0 |
| | Dec-70 | 148 | Dec-73 | 3.00 | 10.0 |
| | Mar-72 | 177 | Dec-73 | 1.75 | 50.0 |
| | Sep-72 | 192 | Jan-74 | 1.33 | 69.0 |
| | Jun-73 | 211 | Jan-74 | 0.58 | 92.0 |
| | Sep-73 | 211 | Mar-74 | 0.50 | 94.0 |
| | Dec-73 | 211 | May-74 | 0.42 | 98.0 |
| | Mar-74 | 277 | Jan-75 | 0.83 | 100.0 |
| | Actual | 280 | Feb-75 | | |
| Farley 1 | Sep-69 | 164 | Apr-75 | 5.58 | 0.0 |
| | Jun-70 | 203 | Apr-75 | 4.83 | 0.0 |
| | Sep-71 | 259 | Apr-75 | 3.58 | 6.0 |
| | Mar-73 | 294 | Apr-75 | 2.08 | 35.5 |
| | Jun-73 | 294 | Dec-75 | 2.50 | 42.3 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Dec-73 | 395 | Dec-75 | 2.00 | 62.7 |
| | Jun-74 | 415 | Feb-76 | 1.67 | 75.0 |
| | Sep-74 | 456 | Feb-76 | 1.42 | 79.2 |
| | Dec-74 | 456 | Jul-76 | 1.58 | 81.0 |
| | Jun-75 | 487 | Oct-76 | 1.33 | 86.0 |
| | Dec-75 | 589 | Jun-77 | 1.50 | 90.0 |
| | Jun-76 | 614 | Jun-77 | 1.00 | 91.0 |
| | Sep-76 | 615 | Jun-77 | 0.75 | 92.0 |
| | Dec-76 | 666 | Sep-77 | 0.75 | 97.0 |
| | Jun-77 | 666 | Oct-77 | 0.33 | 97.0 |
| | Actual | 727 | Dec-77 | | |
| Farley 2 | Sep-70 | 183 | Apr-77 | 6.58 | 0.0 |
| | Sep-71 | 233 | Apr-77 | 5.58 | 0.0 |
| | Mar-73 | 268 | Apr-77 | 4.08 | 5.3 |
| | Jun-73 | 268 | Jan-77 | 3.58 | 10.8 |
| | Dec-73 | 329 | Jan-77 | 3.08 | 17.0 |
| | Jun-74 | 338 | Jan-77 | 2.58 | 27.8 |
| | Sep-74 | 363 | Jan-77 | 2.33 | 34.5 |
| | Dec-74 | 363 | Jun-77 | 2.50 | 41.6 |
| | Jun-75 | 365 | Sep-77 | 2.25 | 42.5 |
| | Dec-75 | 477 | Apr-79 | 3.33 | 41.0 |
| | Sep-76 | 499 | Apr-79 | 2.58 | 42.0 |
| | Dec-76 | 572 | Apr-79 | 2.33 | 42.0 |
| | Mar-77 | 689 | Apr-79 | 2.08 | 42.0 |
| | Jun-77 | 689 | Apr-80 | 2.83 | 45.0 |
| | Dec-77 | 662 | Apr-80 | 2.33 | 53.2 |
| | Mar-78 | 635 | Apr-80 | 2.08 | 57.0 |
| | Sep-78 | 652 | Apr-80 | 1.58 | 72.4 |
| | Jun-79 | 687 | Sep-80 | 1.25 | 82.3 |
| | Sep-79 | 684 | Sep-80 | 1.00 | 83.7 |
| | Jun-80 | 707 | Feb-80 | -0.33 | 92.1 |
| | Sep-80 | 755 | Apr-81 | 0.58 | 95.0 |
| | Dec-80 | 755 | Jul-81 | 0.58 | 95.6 |
| | Mar-81 | 803 | Jul-81 | 0.33 | 96.8 |
| | Actual | 750 | Jul-81 | | |
| Ginna | Dec-65 | 64 | Jun-69 | 3.50 | 0.0 |
| | Mar-66 | 65 | Jun-69 | 3.25 | 0.0 |
| | Sep-68 | 65 | Oct-69 | 1.08 | 80.0 |
| | Jun-69 | 65 | Nov-69 | 0.42 | 98.0 |
| | Sep-69 | 65 | Jun-70 | 0.75 | 99.8 |
| | Jun-70 | 65 | Jun-70 | 0.00 | 100.0 |
| | Actual | 83 | Jul-70 | | |
| Hatch 1 | Jun-68 | NA | Jun-73 | 5.00 | 0.0 |
| | Mar-69 | 151 | Jun-73 | 4.25 | 1.5 |
| | Mar-70 | 185 | Jun-73 | 3.25 | 5.0 |
| | Jun-70 | 184 | Jun-73 | 3.00 | 7.5 |
| | Sep-70 | 184 | Apr-73 | 2.58 | 10.0 |
| | Sep-72 | 184 | Mar-74 | 1.50 | 63.0 |
| | Dec-72 | 282 | Apr-74 | 1.33 | 69.0 |
| | Jun-73 | 254 | Apr-74 | 0.83 | 88.0 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Sep-73 | 325 | Apr-74 | 0.58 | 89.0 |
| | Dec-73 | 325 | Oct-74 | 0.83 | 93.0 |
| | Jun-74 | 359 | Oct-74 | 0.33 | 99.0 |
| | Sep-74 | 366 | Dec-74 | 0.25 | 99.0 |
| | Dec-74 | 377 | May-75 | 0.42 | 100.0 |
| | Actual | 390 | Dec-75 | | |
| Hatch 2 | Jun-70 | 189 | NA | NA | NA |
| | Sep-72 | 189 | Apr-76 | 3.58 | NA |
| | Dec-72 | 330 | Apr-78 | 5.33 | 11.0 |
| | Sep-73 | 404 | Apr-78 | 4.58 | 15.0 |
| | Sep-74 | 513 | Apr-78 | 3.58 | 23.0 |
| | Sep-75 | 513 | Apr-79 | 3.58 | 32.0 |
| | Jun-76 | 512 | Apr-79 | 2.83 | 57.0 |
| | Dec-77 | 512 | Nov-78 | 0.92 | 98.5 |
| | Actual | 515 | Sep-79 | | |
| Humboldt | Jun-60 | 3 | Oct-62 | 2.33 | 0.0 |
| | Sep-60 | 3 | Oct-62 | 2.08 | 0.0 |
| | Dec-60 | 4 | Oct-62 | 1.83 | 1.0 |
| | Mar-61 | 6 | Oct-62 | 1.58 | 7.5 |
| | Jun-61 | 8 | Oct-62 | 1.33 | 19.0 |
| | Sep-61 | 10 | Nov-62 | 1.17 | 31.0 |
| | Dec-61 | 14 | Nov-62 | 0.92 | 52.0 |
| | Mar-62 | 16 | Nov-62 | 0.67 | 74.0 |
| | Jun-62 | 18 | Jan-63 | 0.58 | 84.0 |
| | Sep-62 | 19 | Jan-63 | 0.33 | 96.5 |
| | Dec-62 | 22 | Apr-63 | 0.33 | 96.5 |
| | Mar-63 | 23 | Apr-63 | 0.08 | 99.9 |
| | Jun-63 | 24 | May-63 | -0.08 | 100.0 |
| | Actual | 24 | Aug-63 | | |
| Millstone 2 | Dec-67 | 150 | Apr-74 | 6.33 | 0.0 |
| | Mar-68 | 146 | Apr-74 | 6.08 | 0.0 |
| | Dec-68 | 179 | Apr-74 | 5.33 | 0.0 |
| | Dec-69 | 183 | Apr-74 | 4.33 | 0.0 |
| | Dec-70 | 239 | Apr-74 | 3.33 | 10.0 |
| | Sep-71 | 252 | Apr-74 | 2.58 | 24.0 |
| | Sep-72 | 282 | Apr-74 | 1.58 | 49.0 |
| | Mar-73 | 341 | Dec-74 | 1.75 | 60.0 |
| | Dec-73 | 380 | May-75 | 1.42 | 69.0 |
| | Sep-74 | 399 | Aug-75 | 0.92 | 81.0 |
| | Jun-75 | 399 | Oct-75 | 0.33 | 94.0 |
| | Sep-75 | 416 | Nov-75 | 0.17 | 96.0 |
| | Dec-75 | 416 | Dec-75 | 0.00 | 100.0 |
| | Actual | 426 | Dec-75 | | |
| Monticello | Jun-66 | NA | May-70 | 3.92 | 0.0 |
| | Mar-69 | 74 | May-70 | 1.17 | 61.0 |
| | Jun-69 | 89 | May-70 | 0.92 | 68.0 |
| | Mar-70 | 89 | Jul-70 | 0.33 | 98.0 |
| | Sep-70 | 89 | Dec-70 | 0.25 | 99.0 |
| | Mar-71 | 89 | Jun-71 | 0.25 | 99.9 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Dec-71 | 89 | May-71 | -0.58 | 99.9 |
| | Actual | 105 | Jun-71 | | |
| Oconee 1 | Sep-70 | 109 | Jul-71 | 0.83 | 80.0 |
| | Dec-70 | 109 | Sep-71 | 0.75 | 92.0 |
| | Mar-71 | 109 | Dec-71 | 0.75 | 96.0 |
| | Jun-71 | 109 | Mar-72 | 0.75 | 97.0 |
| | Sep-71 | 137 | Mar-72 | 0.50 | 98.0 |
| | Dec-71 | 137 | Jun-72 | 0.50 | 99.0 |
| | Dec-72 | 137 | Jun-73 | 0.50 | 99.5 |
| | Jun-73 | 137 | Aug-73 | 0.17 | 100.0 |
| | Sep-73 | 137 | Sep-73 | 0.00 | 100.0 |
| | Dec-73 | 160 | Jul-73 | -0.42 | 100.0 |
| | Actual | 156 | Jul-73 | | |
| Oconee 2 | Sep-70 | 109 | Jul-72 | 1.83 | 50.0 |
| | Mar-71 | 109 | Dec-72 | 1.75 | 68.0 |
| | Sep-71 | 137 | Feb-73 | 1.42 | 71.0 |
| | Mar-73 | 137 | Nov-73 | 0.67 | 98.5 |
| | Jun-73 | 137 | Dec-73 | 0.50 | 99.0 |
| | Dec-73 | 160 | Feb-74 | 0.17 | 100.0 |
| | Mar-74 | 160 | Jun-74 | 0.25 | 99.5 |
| | Actual | 160 | Sep-74 | | |
| Oconee 3 | Sep-70 | 109 | Jul-73 | 2.83 | 25.0 |
| | Sep-71 | 137 | Nov-73 | 2.17 | 43.0 |
| | Mar-73 | 137 | Jun-74 | 1.25 | 87.5 |
| | Dec-73 | 160 | Jun-74 | 0.50 | 97.3 |
| | Jun-74 | 160 | Oct-74 | 0.33 | 98.9 |
| | Sep-74 | 166 | Nov-74 | 0.17 | 99.3 |
| | Dec-74 | 166 | Dec-74 | 0.00 | 99.6 |
| | Actual | 160 | Dec-74 | | |
| Palisades | Mar-68 | 89 | May-70 | 2.17 | 31.0 |
| | Mar-69 | 110 | Aug-70 | 1.42 | 70.0 |
| | Jun-69 | 110 | May-70 | 0.92 | 85.0 |
| | Dec-69 | 110 | Aug-70 | 0.67 | 97.0 |
| | Mar-70 | 118 | Aug-70 | 0.42 | 99.0 |
| | Jun-70 | 118 | Nov-70 | 0.42 | 99.0 |
| | Actual | 147 | Dec-71 | | |
| Peach Bottom 2 | Dec-66 | 138 | NA | NA | 0.0 |
| | Sep-67 | 163 | NA | NA | 1.0 |
| | Mar-68 | 163 | Mar-71 | 3.00 | 4.4 |
| | Sep-69 | 206 | Mar-72 | 2.50 | 35.0 |
| | Dec-69 | 218 | Mar-72 | 2.25 | 43.0 |
| | Mar-70 | 230 | May-72 | 2.17 | 48.0 |
| | Dec-70 | 230 | Dec-72 | 2.00 | 70.0 |
| | Mar-71 | 277 | Mar-73 | 2.00 | 77.0 |
| | Jun-71 | 288 | Mar-73 | 1.75 | 80.0 |
| | Jun-72 | 352 | Sep-73 | 1.25 | 72.0 |
| | Mar-73 | 352 | Nov-73 | 0.67 | 100.0 |
| | Jun-73 | 352 | Dec-73 | 0.50 | 100.0 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Sep-73 | 352 | Jan-74 | 0.33 | 100.0 |
| | Dec-73 | 483 | Apr-74 | 0.33 | 100.0 |
| | Jun-74 | 483 | Jun-74 | 0.00 | 100.0 |
| | Sep-74 | 527 | Jul-74 | -0.17 | 100.0 |
| | Dec-74 | 537 | Jul-74 | -0.42 | 100.0 |
| | Actual | 531 | Jul-74 | | |
| Peach Bottom 3 | Dec-66 | 125 | NA | NA | NA |
| | Sep-67 | 145 | NA | NA | NA |
| | Mar-68 | 145 | Jan-73 | 4.83 | 1.6 |
| | Sep-68 | 145 | Mar-73 | 4.50 | 4.5 |
| | Sep-69 | 193 | Mar-73 | 3.50 | 12.0 |
| | Dec-69 | 203 | Mar-73 | 3.25 | 13.0 |
| | Mar-70 | 221 | Mar-73 | 3.00 | 13.0 |
| | Dec-70 | 221 | Oct-73 | 2.83 | 30.0 |
| | Mar-71 | 263 | Apr-74 | 3.08 | 37.0 |
| | Jun-72 | 316 | Sep-74 | 2.25 | 50.0 |
| | Sep-73 | 316 | Dec-74 | 1.25 | 91.0 |
| | Dec-73 | 284 | Dec-74 | 1.00 | 94.0 |
| | Sep-74 | 226 | Dec-74 | 0.25 | 100.0 |
| | Dec-74 | 226 | Dec-74 | 0.00 | 100.0 |
| | Actual | 223 | Dec-74 | | |
| Pilgrim 1 | Mar-64 | | Oct-71 | 7.58 | |
| | Jul-65 | 70 | Jul-71 | 6.00 | |
| | Feb-67 | 105 | Jul-71 | 4.42 | |
| | Jun-68 | 122 | Sep-71 | 3.25 | |
| | Jan-70 | 153 | Sep-71 | 1.67 | |
| | Jun-70 | | Dec-71 | 1.50 | 65.0 |
| | Mar-71 | NA | Nov-71 | 0.67 | |
| | Mar-71 | | Apr-72 | 1.08 | 89.0 |
| | Sep-72 | NA | Nov-72 | 0.17 | 100.0 |
| | Dec-72 | NA | Dec-72 | 0.00 | 100.0 |
| | Dec-75 | 120 | Dec-72 | -3.00 | 100.0 |
| | Actual | 239 | Dec-72 | | |
| Point Beach 1 | Jun-66 | 61 | Apr-70 | 3.83 | 0.0 |
| | Sep-66 | 61 | Apr-70 | 3.58 | 0.0 |
| | Mar-69 | 61 | Aug-70 | 1.42 | 53.2 |
| | Dec-69 | 61 | Dec-70 | 1.00 | 71.8 |
| | Actual | 74 | Dec-70 | | |
| Point Beach 2 | Mar-67 | 54 | Apr-71 | 4.08 | 0.0 |
| | Sep-69 | 54 | Aug-71 | 1.92 | 25.4 |
| | Dec-69 | 54 | Dec-71 | 2.00 | 29.7 |
| | Mar-70 | 54 | Aug-71 | 1.42 | 35.2 |
| | Sep-70 | 54 | Sep-71 | 1.00 | 56.1 |
| | Dec-71 | 54 | Sep-72 | 0.75 | 100.0 |
| | Actual | 71 | Oct-72 | | |
| Rancho Seco | Dec-67 | 134 | May-73 | 5.42 | 0.0 |
| | Jun-71 | 215 | May-73 | 1.92 | 43.0 |
| | Mar-72 | 215 | Oct-73 | 1.58 | 65.0 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Jun-72 | 264 | Oct-73 | 1.33 | 75.0 |
| | Sep-72 | 300 | Feb-74 | 1.42 | 78.0 |
| | Mar-73 | 327 | Jun-74 | 1.25 | 80.5 |
| | Sep-73 | 328 | Oct-74 | 1.08 | 92.0 |
| | Jun-74 | 335 | Mar-75 | 0.75 | 98.2 |
| | Mar-75 | 341 | Apr-75 | 0.08 | 100.0 |
| | Dec-75 | 338 | Apr-75 | -0.67 | 100.0 |
| | Actual | 344 | Apr-75 | | |
| San Onofre 2 | Mar-70 | 189 | Jun-76 | 6.25 | 0.0 |
| | Jun-70 | 213 | Jun-76 | 6.00 | 0.0 |
| | Sep-71 | 363 | NA | NA | 0.0 |
| | Dec-71 | 409 | NA | NA | 0.0 |
| | Jun-73 | 655 | NA | NA | 0.0 |
| | Mar-74 | 655 | Jun-79 | 5.25 | 0.0 |
| | Dec-74 | 893 | Jul-81 | 6.58 | 0.0 |
| | Mar-75 | 1142 | Jul-81 | 6.33 | 3.0 |
| | Sep-75 | 1142 | Oct-81 | 6.08 | 10.0 |
| | Jun-76 | 1210 | Oct-81 | 5.33 | 23.0 |
| | Jun-77 | 1320 | Oct-81 | 4.33 | 44.0 |
| | Dec-79 | 1740 | Oct-81 | 1.83 | 86.0 |
| | Mar-80 | 1824 | Dec-81 | 1.75 | 86.0 |
| | Mar-81 | 2010 | Jun-82 | 1.25 | 98.0 |
| | Mar-82 | 2122 | Aug-82 | 0.42 | 95.0 |
| | Jun-82 | 2216 | Jan-83 | 0.58 | 95.0 |
| | Sep-82 | 2502 | Apr-83 | 0.58 | 95.0 |
| | Dec-82 | 2502 | Oct-83 | 0.83 | 92.0 |
| | Mar-83 | 2502 | Jul-83 | 0.33 | 97.0 |
| | Actual | 2502 | Aug-83 | | |
| Trojan | Dec-68 | 196 | Sep-74 | 5.75 | 0.0 |
| | Mar-69 | 197 | Sep-74 | 5.50 | 0.0 |
| | Dec-69 | 227 | Sep-74 | 4.75 | 0.0 |
| | Mar-71 | 228 | Sep-74 | 3.50 | 3.6 |
| | Mar-72 | 233 | Sep-74 | 2.50 | 30.0 |
| | Sep-72 | 243 | Sep-74 | 2.00 | 52.0 |
| | Dec-72 | 284 | Jul-75 | 2.58 | 57.0 |
| | Sep-73 | 334 | Jul-75 | 1.83 | 72.0 |
| | Sep-74 | 366 | Oct-75 | 1.08 | 84.0 |
| | Mar-75 | 395 | Jan-76 | 0.83 | 90.0 |
| | Jun-75 | 395 | Dec-75 | 0.50 | 96.0 |
| | Mar-76 | 448 | Dec-75 | -0.25 | 100.0 |
| | Actual | 452 | Dec-75 | | |
| Turkey Point 3 | Sep-69 | 99 | NA | NA | 52.2 |
| | Mar-70 | 111 | NA | NA | 66.7 |
| | Dec-70 | 73 | NA | NA | 84.4 |
| | Mar-71 | 75 | NA | NA | 88.9 |
| | Jun-71 | 89 | NA | NA | 94.0 |
| | Dec-71 | 94 | NA | NA | 99.8 |
| | Mar-72 | 98 | Jun-72 | 0.25 | 99.9 |
| | Jun-72 | 102 | Oct-72 | 0.33 | 99.9 |
| | Sep-72 | 110 | Dec-72 | 0.25 | 99.9 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Actual | 109 | Dec-72 | | |
| Turkey Point 4 | Sep-69 | NA | NA | NA | 52.2 |
| | Mar-70 | 80 | NA | NA | 66.7 |
| | Dec-70 | 81 | NA | NA | 65.4 |
| | Mar-71 | 83 | NA | NA | 68.0 |
| | Jun-71 | 96 | NA | NA | 72.0 |
| | Sep-71 | 96 | Jul-72 | 0.83 | 75.5 |
| | Dec-71 | 126 | Dec-72 | 1.00 | 84.0 |
| | Mar-72 | 130 | Dec-72 | 0.75 | 76.8 |
| | Jun-72 | 130 | Apr-73 | 0.83 | 96.0 |
| | Sep-72 | 106 | Jun-73 | 0.75 | 98.0 |
| | Dec-72 | 106 | Jul-73 | 0.58 | 99.0 |
| | Sep-73 | 106 | Sep-73 | 0.00 | 100.0 |
| | Actual | 127 | Sep-73 | | |
| Callaway 1 | Jun-74 | 839 | Oct-81 | 7.33 | 0 |
| | Dec-74 | 895 | Oct-81 | 6.83 | 0 |
| | Mar-76 | 780 | Oct-81 | 5.58 | 1 |
| | Dec-76 | 1088 | Jun-82 | 5.50 | 2.7 |
| | Jun-77 | 1088 | Oct-82 | 5.33 | 6.9 |
| | Dec-77 | 1122 | Oct-82 | 4.83 | 11.2 |
| | Mar-80 | 1261 | Oct-82 | 2.58 | 64 |
| | Dec-80 | 1533 | Apr-83 | 2.33 | 74.6 |
| | Sep-81 | 2100 | Jan-84 | 2.33 | 75.5 |
| | Sep-82 | 2850 | Dec-84 | 2.25 | 84.5 |
| | Dec-82 | 2850 | Jun-85 | 2.50 | 86 |
| Grand Gulf 1 | Jun-72 | 600 | Dec-78 | 6.50 | 0 |
| | Dec-72 | 656 | Jun-79 | 6.50 | 0 |
| | Mar-73 | 656 | Sep-79 | 6.50 | 0 |
| | Jun-73 | 656 | Jun-79 | 6.00 | 0 |
| | Sep-73 | 656 | Sep-79 | 6.00 | 0 |
| | Sep-75 | 689 | Sep-79 | 4.00 | 11 |
| | Jun-76 | 689 | Jun-80 | 4.00 | 25.9 |
| | Sep-76 | 935 | Jun-80 | 3.75 | 32.5 |
| | Jun-77 | 935 | Apr-81 | 3.83 | 48 |
| | Dec-77 | 1174 | Apr-81 | 3.33 | 57.9 |
| | Mar-79 | 1203 | Apr-81 | 2.08 | 77.4 |
| | Dec-79 | 1203 | Apr-82 | 2.33 | 80 |
| | Dec-81 | 2391 | Feb-83 | 1.17 | 96 |
| | Jun-82 | 2859 | NA | NA | 99 |
| | Sep-82 | 2859 | Dec-83 | 1.25 | 99 |
| Grand Gulf 2 | Sep-73 | 571 | Sep-81 | 8.00 | NA |
| | Sep-75 | NA | Sep-83 | 8.00 | 1.6 |
| | Dec-75 | 699 | Sep-83 | 7.75 | 6.5 |
| | Sep-76 | 775 | Sep-83 | 7.00 | 6.5 |
| | Jun-77 | 775 | Jan-84 | 6.58 | 1.7 |
| | Dec-77 | 954 | Jan-84 | 6.08 | 2.4 |
| | Jun-79 | 878 | Jan-84 | 4.58 | 11.6 |
| | Dec-79 | 878 | Apr-85 | 5.33 | 23 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Jun-80 | 878 | Apr-86 | 5.83 | 23 |
| Hope Creek 1 | Mar-70 | 574 | Mar-75 | 5.00 | 0 |
| | Dec-71 | 1039 | May-78 | 6.42 | 0 |
| | Dec-72 | 1139 | May-79 | 6.42 | 0 |
| | Jun-73 | 1139 | May-81 | 7.92 | 0 |
| | Dec-73 | 1461 | May-81 | 7.42 | 0 |
| | Sep-74 | 1972 | Dec-81 | 7.25 | 0 |
| | Mar-75 | 1972 | Dec-82 | 7.75 | 0 |
| | Jun-75 | 2435 | Jun-83 | 8.00 | 0 |
| | Sep-75 | 1972 | Dec-82 | 7.25 | 0 |
| | Dec-75 | 2435 | Dec-82 | 7.00 | 0 |
| | Sep-76 | 2580 | May-84 | 7.67 | 2 |
| | Mar-78 | 2580 | May-84 | 6.17 | 6 |
| | Jun-78 | 2890 | May-84 | 5.92 | 8.5 |
| | Sep-79 | 3585 | May-85 | 5.67 | 18.5 |
| | Jun-80 | 4310 | Dec-86 | 6.50 | 23.5 |
| | Sep-80 | 4595 | Dec-86 | 6.25 | 24 |
| | Jun-81 | 5465 | Dec-86 | 5.50 | 30.5 |
| | Sep-81 | 5512 | Dec-86 | 5.25 | 33.3 |
| | Mar-82 | 3518 | Dec-86 | 4.75 | 46 |
| | Sep-82 | 3521 | Dec-86 | 4.25 | 55.6 |
| | Dec-82 | 3780 | Dec-86 | 4.00 | 60.6 |
| Limerick 1 | Mar-70 | 252 | Mar-75 | 5.00 | 0 |
| | Dec-70 | 414 | Mar-75 | 4.25 | 1 |
| | Jun-71 | 414 | Sep-75 | 4.25 | 1 |
| | Dec-71 | 414 | Nov-76 | 4.92 | 1 |
| | Sep-72 | 414 | Aug-78 | 5.92 | 1 |
| | Dec-72 | 694 | Aug-78 | 5.67 | 1 |
| | Jun-73 | 694 | Apr-79 | 5.83 | 1 |
| | Mar-74 | 694 | Oct-79 | 5.58 | 1 |
| | Sep-74 | 1212 | Apr-81 | 6.58 | 2 |
| | Dec-75 | 1212 | Feb-81 | 5.17 | 18.5 |
| | Jun-76 | 1212 | Apr-83 | 6.83 | 28.6 |
| | Jun-77 | 1635 | Apr-83 | 5.83 | 32 |
| | Jun-79 | 1695 | Apr-83 | 3.83 | 52 |
| | Dec-80 | 2515 | Apr-85 | 4.33 | 57.6 |
| | Jun-81 | 2566 | Apr-85 | 3.83 | 65 |
| | Sep-82 | 2566 | Jan-84 | 1.33 | 93.9 |
| | Dec-82 | 2657 | Apr-85 | 2.33 | 83.1 |
| Limerick 2 | Mar-70 | 223 | Mar-77 | 7.00 | 0 |
| | Dec-70 | 303 | Mar-77 | 6.25 | 0 |
| | Dec-71 | 303 | Nov-77 | 5.92 | 1 |
| | Sep-72 | 303 | Jan-80 | 7.33 | 1 |
| | Dec-72 | 512 | Jan-80 | 7.08 | 1 |
| | Jun-73 | 512 | Jun-80 | 7.00 | 1 |
| | Mar-73 | 512 | Mar-81 | 8.00 | 1 |
| | Sep-73 | 539 | Apr-82 | 8.58 | 1 |
| | Mar-74 | 539 | Apr-82 | 8.08 | 4 |
| | Dec-74 | 539 | Jul-82 | 7.58 | 8 |
| | Jun-76 | 539 | Apr-85 | 8.83 | 15.3 |

| Unit Name | Date of Estimate | Estimated Cost | Estimated COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Jun-77 | 949 | Apr-85 | 7.83 | 22 |
| | Jun-79 | 909 | Apr-85 | 5.83 | 35 |
| | Dec-80 | 1581 | Oct-87 | 6.83 | 26.6 |
| | Jun-81 | 1626 | Oct-87 | 6.33 | 28.4 |
| | Dec-82 | 3126 | Oct-88 | 5.83 | 30 |
| Midland 1 | Jun-68 | NA | Feb-74 | 5.67 | 0 |
| | Sep-70 | NA | Nov-74 | 4.17 | 1 |
| | Dec-70 | NA | Mar-76 | 5.25 | 2 |
| | Jun-71 | NA | Sep-76 | 5.25 | 2 |
| | Sep-71 | NA | May-77 | 5.67 | 2 |
| | Dec-71 | 277 | May-77 | 5.42 | 2 |
| | Dec-72 | 383 | Feb-79 | 6.17 | 2 |
| | Jun-73 | 385 | Mar-80 | 6.75 | 2 |
| | Dec-73 | 470 | Mar-80 | 6.25 | 2.6 |
| | Dec-74 | 470 | Mar-82 | 7.25 | 9.1 |
| | Mar-75 | 700 | Mar-82 | 7.00 | 9.1 |
| | Jun-76 | 700 | Mar-82 | 5.75 | 13 |
| | Mar-82 | 1695 | Jul-84 | 2.33 | 74 |
| Midland 2 | Mar-68 | NA | Feb-75 | 6.92 | 0 |
| | Sep-70 | NA | Nov-75 | 5.17 | 0.5 |
| | Dec-70 | NA | Mar-77 | 6.25 | 2 |
| | Jun-71 | NA | Sep-77 | 6.25 | 2 |
| | Sep-71 | NA | May-78 | 6.67 | 2 |
| | Dec-71 | 277 | May-78 | 6.42 | 2 |
| | Dec-72 | 383 | Feb-80 | 7.17 | 2 |
| | Jun-73 | 385 | Mar-79 | 5.75 | 2 |
| | Dec-73 | 470 | Mar-79 | 5.25 | 2.6 |
| | Dec-74 | 470 | Mar-81 | 6.25 | 9.1 |
| | Mar-75 | 700 | Mar-81 | 6.00 | 9.1 |
| | Jun-76 | 700 | Mar-81 | 4.75 | 16 |
| | Sep-82 | 1695 | Dec-83 | 1.25 | 84 |
| Palo Verde 1 | Jun-74 | 606 | May-81 | 6.92 | 0 |
| | Sep-74 | 613 | May-81 | 6.67 | 0 |
| | Mar-75 | 1000 | May-82 | 7.17 | 0 |
| | Dec-75 | 975 | May-82 | 6.42 | 0 |
| | Dec-77 | 989 | May-82 | 4.42 | 21.9 |
| | Mar-78 | 1263 | May-82 | 4.17 | 24.6 |
| | Sep-78 | 760 | May-82 | 3.67 | 28.5 |
| | Mar-79 | 911 | May-83 | 4.17 | 43 |
| | Dec-79 | 938 | May-83 | 3.42 | 55.7 |
| | Mar-80 | 1354 | May-83 | 3.17 | 62.3 |
| | Jun-80 | 1429 | May-83 | 2.92 | 68.3 |
| | Sep-80 | 1457 | May-83 | 2.67 | 74.3 |
| | Mar-81 | 1453 | May-83 | 2.17 | 83.8 |
| | Dec-81 | 1579 | May-83 | 1.42 | 92.8 |
| | Mar-82 | 1670 | May-83 | 1.17 | 96.5 |
| | Mar-83 | 1671 | May-84 | 1.17 | 99.3 |
| Palo Verde 2 | Sep-74 | 586 | Nov-82 | 8.17 | 0 |
| | Mar-75 | 827 | May-84 | 9.17 | 0 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Dec-75 | 845 | May-84 | 8.42 | 0 |
| | Mar-78 | 769 | May-84 | 6.17 | 7.3 |
| | Sep-78 | 598 | May-84 | 5.67 | 7.8 |
| | Jun-79 | 710 | May-84 | 4.92 | 17.6 |
| | Dec-79 | 571 | May-84 | 4.42 | 26.1 |
| | Mar-80 | 827 | May-84 | 4.17 | 31.6 |
| | Jun-80 | 820 | May-84 | 3.92 | 37.7 |
| | Sep-80 | 948 | May-84 | 3.67 | 43.9 |
| | Mar-81 | 1016 | May-84 | 3.17 | 55.5 |
| | Sep-81 | 1075 | May-84 | 2.67 | 68.5 |
| | Mar-82 | 1136 | May-84 | 2.17 | 82.6 |
| | Mar-83 | 1136 | Feb-85 | 1.92 | 96.9 |
| | Jun-83 | 1136 | Sep-85 | 2.25 | 97.9 |
| Palo Verde 3 | Sep-74 | 605 | May-84 | 9.67 | 0 |
| | Mar-75 | 941 | May-86 | 11.17 | 0 |
| | Dec-75 | 950 | May-86 | 10.42 | 0 |
| | Dec-76 | 950 | Jun-86 | 9.50 | 0 |
| | Mar-78 | 834 | Jun-86 | 8.25 | 0.9 |
| | Sep-78 | 702 | Jun-86 | 7.75 | 0.5 |
| | Jun-79 | 833 | Jun-86 | 7.00 | 1.5 |
| | Dec-79 | 746 | Jun-86 | 6.50 | 4.5 |
| | Mar-80 | 1088 | May-86 | 6.17 | 7.6 |
| | Jun-80 | 1125 | Jun-86 | 6.00 | 10.8 |
| | Sep-80 | 1212 | Jun-86 | 5.75 | 12.9 |
| | Mar-81 | 1255 | Jun-86 | 5.25 | 18.6 |
| | Sep-81 | 1227 | Jun-86 | 4.75 | 26 |
| | Mar-82 | 1487 | May-86 | 4.17 | 36.7 |
| | Dec-82 | 2474 | May-86 | 3.42 | 52.5 |
| | Mar-83 | 1487 | May-86 | 3.17 | 61.7 |
| | Jun-83 | 1487 | Dec-86 | 3.50 | 70.8 |
| San Onofre 3 | Mar-70 | 189 | Jun-76 | 6.25 | 0 |
| | Jun-70 | 213 | Jun-76 | 6.00 | 0 |
| | Dec-71 | 409 | NA | NA | 0 |
| | Jun-73 | 655 | NA | NA | 0 |
| | Mar-74 | 655 | Jun-80 | 6.25 | 0 |
| | Sep-74 | 655 | Jun-81 | 6.75 | 0 |
| | Dec-74 | 812 | Oct-82 | 7.83 | 0 |
| | Jun-75 | 934 | Oct-82 | 7.33 | 1 |
| | Sep-75 | 934 | Jan-83 | 7.33 | 3 |
| | Jun-76 | 990 | Jan-83 | 6.58 | 17 |
| | Dec-76 | 996 | Jan-83 | 6.08 | 20 |
| | Mar-77 | 990 | Jan-83 | 5.83 | 24 |
| | Jun-77 | 1080 | Jan-83 | 5.58 | 30 |
| | Dec-79 | 1160 | Jan-83 | 3.08 | 63 |
| | Mar-80 | 1216 | Jan-83 | 2.83 | 60 |
| | Sep-80 | 1216 | Feb-83 | 2.42 | 66 |
| | Mar-81 | 1340 | Jul-83 | 2.33 | 74 |
| | Mar-82 | 1415 | Jul-83 | 1.33 | 86 |
| | Jun-82 | 1477 | Sep-83 | 1.25 | 89 |
| | Sep-82 | 1668 | Sep-83 | 1.00 | 91 |
| | Dec-82 | 1668 | May-83 | 0.42 | 97 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Mar-83 | 1668 | Jan-84 | 0.83 | 92 |
| Skagit 1 | Mar-74 | 900 | Jul-81 | 7.33 | 0 |
| | Dec-74 | 900 | Jul-82 | 7.58 | 0 |
| | Mar-75 | 668 | Jul-82 | 7.33 | 0 |
| | Jun-75 | 984 | Jul-82 | 7.08 | 0 |
| | Dec-75 | 984 | Jul-83 | 7.58 | 0 |
| | Dec-76 | 1238 | Jul-84 | 7.58 | 0 |
| | Sep-77 | 1601 | Mar-85 | 7.50 | 0 |
| | Sep-78 | 1793 | Sep-86 | 8.00 | 0 |
| | Dec-78 | 1896 | Sep-86 | 7.75 | 0 |
| | Jun-79 | 2072 | Jan-87 | 7.58 | 0 |
| | Mar-81 | 4249 | Jan-91 | 9.83 | 0 |
| Skagit 2 | Mar-75 | 561 | Jul-85 | 10.33 | 0 |
| | Jun-75 | 714 | Jul-85 | 10.08 | 0 |
| | Mar-76 | 714 | Jul-86 | 10.33 | 0 |
| | Sep-76 | 870 | Jul-86 | 9.83 | 0 |
| | Dec-77 | 1323 | Mar-87 | 9.25 | 0 |
| | Jun-78 | 1418 | Sep-88 | 10.25 | 0 |
| | Dec-78 | 1617 | Sep-88 | 9.75 | 0 |
| | Jun-79 | 1755 | Jan-89 | 9.58 | 0 |
| | Mar-81 | 3560 | Jan-93 | 11.83 | 0 |
| South Texas 1 | Jun-75 | 574 | Oct-80 | 5.33 | NA |
| | Sep-75 | 676 | Oct-80 | 5.08 | 0 |
| | Mar-79 | 1004 | Apr-82 | 3.08 | 44 |
| | Sep-79 | 1208 | Feb-84 | 4.42 | 48.3 |
| | Dec-81 | 1786 | Feb-84 | 2.17 | 50 |
| South Texas 2 | Jun-75 | 574 | Mar-82 | 6.75 | NA |
| | Sep-75 | 676 | Mar-82 | 6.50 | 0 |
| | Mar-79 | 1004 | Apr-83 | 4.08 | 12 |
| | Sep-79 | 1208 | Feb-86 | 6.42 | 15 |
| | Dec-81 | 1717 | Feb-86 | 4.17 | 18 |
| Susquehanna 2 | Mar-74 | 575 | Jun-81 | 7.25 | 1 |
| | Sep-74 | 575 | Jun-82 | 7.75 | 1 |
| | Dec-74 | 602 | May-82 | 7.42 | 6 |
| | Mar-75 | 662 | May-82 | 7.17 | 1.8 |
| | Jun-75 | 700 | May-82 | 6.92 | 2 |
| | Dec-75 | 689 | May-82 | 6.42 | 6 |
| | Mar-76 | 678 | May-82 | 6.17 | 7 |
| | Sep-76 | 706 | May-82 | 5.67 | 21.2 |
| | Mar-77 | 713 | May-82 | 5.17 | 30 |
| | Sep-77 | 710 | May-82 | 4.67 | 35.9 |
| | Mar-78 | 735 | May-82 | 4.17 | 44.2 |
| | Sep-78 | 787 | May-82 | 3.67 | 51.7 |
| | Jun-79 | 843 | May-82 | 2.92 | 53.6 |
| | Sep-79 | 1081 | Jan-83 | 3.33 | 45 |
| | Dec-79 | 1082 | Jan-83 | 3.08 | 46 |
| | Jun-80 | 1082 | Aug-82 | 2.17 | 53 |
| | Sep-80 | 1153 | Aug-82 | 1.92 | 55 |

| Unit Name | Date of Estimate | Estimated Cost | Estimated COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Mar-81 | 1217 | May-84 | 3.17 | 59 |
| | Dec-81 | 1578 | Nov-84 | 2.92 | 65 |
| | Jun-82 | 1598 | Nov-84 | 2.42 | 68 |
| Vogtle 1 | Sep-71 | NA | Apr-78 | 6.58 | 0 |
| | Jun-72 | NA | Apr-79 | 6.83 | 0 |
| | Sep-72 | NA | Oct-79 | 7.08 | 0 |
| | Dec-72 | 570 | Apr-80 | 7.33 | 0 |
| | Sep-73 | 630 | Apr-80 | 6.58 | 0 |
| | Mar-74 | 631 | Apr-80 | 6.08 | 0 |
| | Jun-74 | 629 | Apr-80 | 5.83 | 0 |
| | Mar-77 | 629 | Jun-83 | 6.25 | 0 |
| | Sep-77 | NA | Nov-84 | 7.17 | 5 |
| | Dec-77 | 1537 | Nov-84 | 6.92 | 5 |
| | Mar-79 | 1586 | Nov-84 | 5.67 | 5 |
| | Dec-79 | 1567 | Nov-84 | 4.92 | 5 |
| | Jun-80 | 1746 | May-85 | 4.92 | 10 |
| | Jun-82 | 4085 | Mar-87 | 4.75 | 25 |
| | Sep-82 | 4613 | Mar-87 | 4.50 | 40.4 |
| | Dec-82 | 3722 | Mar-87 | 4.25 | 45 |
| Vogtle 2 | Sep-71 | NA | Apr-79 | 7.58 | 0 |
| | Jun-72 | NA | Feb-80 | 7.67 | 0 |
| | Dec-72 | NA | Apr-81 | 8.33 | 0 |
| | Mar-73 | 495 | Apr-81 | 8.08 | 0 |
| | Sep-73 | 543 | Apr-81 | 7.58 | 0 |
| | Jun-74 | 534 | Apr-81 | 6.83 | 0 |
| | Dec-77 | 1075 | Nov-85 | 7.92 | 3 |
| | Sep-78 | 1075 | Nov-87 | 9.17 | 3 |
| | Dec-78 | 1297 | Nov-87 | 8.92 | 3 |
| | Dec-79 | 924 | Nov-87 | 7.92 | 3 |
| | Jun-80 | 988 | Nov-87 | 7.42 | 4 |
| | Jun-82 | 1415 | Sep-88 | 6.25 | 10 |
| | Sep-82 | 1653 | Sep-88 | 6.00 | 12.3 |
| | Dec-82 | 1476 | Sep-88 | 5.75 | 15 |
| WNP 1 | Sep-73 | 626 | Sep-80 | 7.00 | 0 |
| | Mar-75 | 990 | Sep-80 | 5.50 | 0 |
| | Dec-75 | 990 | Mar-81 | 5.25 | 0.7 |
| | Jun-76 | 1147 | Mar-81 | 4.75 | 1.2 |
| | Sep-76 | 1147 | Sep-81 | 5.00 | 1.6 |
| | Dec-76 | 1057 | Sep-81 | 4.75 | 1.8 |
| | Mar-77 | 1087 | Sep-81 | 4.50 | 2.6 |
| | Sep-77 | 1087 | Dec-82 | 5.25 | 5.8 |
| | Mar-78 | 1164 | Dec-82 | 4.75 | 9.3 |
| | Mar-79 | 1772 | Dec-83 | 4.75 | 22.2 |
| | Sep-79 | 2114 | Dec-83 | 4.25 | 31.4 |
| | Jun-80 | 2498 | Jun-85 | 5.00 | 41.1 |
| | Sep-80 | 2369 | Jun-85 | 4.75 | 41.1 |
| | Jun-81 | 3460 | Jun-86 | 5.00 | 51 |
| WNP 2 | Mar-71 | 187 | Sep-77 | 6.50 | 0 |
| | Mar-72 | 193 | Sep-77 | 5.50 | 0 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Jun-72 | 227 | Sep-77 | 5.25 | 0 |
| | Sep-72 | 374 | Sep-77 | 5.00 | NA |
| | Sep-73 | 472 | Sep-77 | 4.00 | 2 |
| | Dec-74 | 562 | Sep-77 | 2.75 | 13 |
| | Mar-75 | 608 | Jun-78 | 3.25 | 15.8 |
| | Sep-75 | 608 | Sep-78 | 3.00 | 24.8 |
| | Dec-75 | 608 | Jul-79 | 3.58 | 27.8 |
| | Mar-76 | 794 | Jul-79 | 3.33 | 29.6 |
| | Jun-76 | 794 | Dec-79 | 3.50 | 29.7 |
| | Sep-76 | 794 | Jun-80 | 3.75 | 32 |
| | Dec-76 | 901 | Sep-80 | 3.75 | 35.8 |
| | Mar-77 | 905 | Sep-80 | 3.50 | 39.6 |
| | Mar-78 | 1001 | Sep-80 | 2.50 | 60.7 |
| | Mar-79 | 1663 | Sep-81 | 2.50 | 66.8 |
| | Sep-79 | 1757 | Sep-81 | 2.00 | 77.6 |
| | Jun-80 | 2392 | Jan-83 | 2.58 | 85.2 |
| | Sep-80 | 2306 | Jan-83 | 2.33 | 85.3 |
| | Jun-81 | 2784 | Feb-84 | 2.67 | 85.9 |
| Wolf Creek | Dec-74 | 940 | Apr-82 | 7.33 | 0 |
| | Mar-77 | 1029 | Apr-83 | 6.08 | 1 |
| | Dec-79 | 1296 | Apr-83 | 3.33 | 47.9 |
| | Sep-80 | 1653 | Apr-84 | 3.58 | 68 |
| | Dec-81 | 1927 | May-84 | 2.42 | 79 |
| | Sep-82 | 2440 | Apr-85 | 2.58 | 80 |
| | Dec-82 | 2420 | Apr-85 | 2.33 | 83.3 |
| Callaway 2 | Jun-74 | 805 | Apr-83 | 8.83 | 0 |
| | Dec-74 | 863 | Apr-83 | 8.33 | 0 |
| | Mar-76 | 739 | Apr-83 | 7.08 | 0.2 |
| | Dec-76 | 1297 | Apr-87 | 10.33 | 0.4 |
| | Jun-77 | 1297 | Apr-87 | 9.83 | 0.4 |
| | Dec-77 | 1288 | Apr-87 | 9.33 | 0.4 |
| | Sep-78 | 1306 | Apr-87 | 8.58 | 0.4 |
| | Mar-80 | 1609 | Apr-87 | 7.08 | 0.7 |
| | Jun-80 | 1609 | Jun-88 | 8.00 | 0.7 |
| | Dec-80 | 1688 | Apr-88 | 7.33 | 0.7 |
| | Mar-81 | 1688 | Apr-90 | 9.08 | 0.7 |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| Dresden 2 | Mar-66 | NA | Feb-69 | 2.92 | 6.0 |
| | Sep-67 | NA | Apr-69 | 1.58 | 59.0 |
| | Dec-68 | NA | Jan-70 | 1.08 | 84.0 |
| | Mar-69 | 84 | Jan-70 | 0.83 | 92.0 |
| | Sep-69 | 84 | Mar-70 | 0.50 | 96.0 |
| | Mar-70 | 94 | May-70 | 0.17 | 99.8 |
| | Jun-70 | 95 | Oct-70 | 0.33 | 99.9 |
| | Sep-70 | 95 | Dec-70 | 0.25 | 100.0 |
| | Dec-70 | 95 | Aug-70 | -0.33 | 100.0 |
| | Jun-71 | 99 | Aug-70 | -0.83 | 100.0 |
| | Jun-72 | 102 | Aug-70 | -1.83 | 100.0 |
| | Sep-72 | 100 | Aug-70 | -2.08 | 100.0 |
| | Dec-72 | 101 | Aug-70 | -2.33 | 100.0 |
| | Actual | 83 | Jul-70 | | |
| Dresden 3 | Mar-66 | NA | Feb-70 | 3.92 | 2.0 |
| | Dec-68 | NA | Aug-70 | 1.67 | 54.0 |
| | Mar-69 | 81 | Aug-70 | 1.42 | 57.0 |
| | Jun-69 | 81 | Dec-70 | 1.50 | 66.0 |
| | Mar-70 | 95 | Jun-71 | 1.25 | 80.0 |
| | Jun-70 | 119 | Apr-71 | 0.83 | 89.0 |
| | Sep-70 | 121 | May-71 | 0.67 | 96.0 |
| | Mar-71 | 121 | Jul-71 | 0.33 | 99.7 |
| | Jun-71 | 125 | Sep-71 | 0.25 | 100.0 |
| | Sep-71 | 128 | Nov-71 | 0.17 | 100.0 |
| | Dec-71 | 128 | Mar-72 | 0.25 | 100.0 |
| | Mar-72 | 128 | May-72 | 0.17 | 100.0 |
| | Jun-72 | 131 | Aug-72 | 0.17 | 100.0 |
| | Sep-72 | 130 | Dec-72 | 0.25 | 100.0 |
| | Dec-72 | 131 | Dec-72 | 0.00 | 100.0 |
| | Actual | 104 | Nov-71 | | |
| Indian Point 1 | Jun-60 | 68 | Jan-62 | 1.58 | 78 |
| | Sep-60 | 77 | Jan-62 | 1.33 | 86 |
| | Dec-60 | 89 | Jan-62 | 1.08 | 90 |
| | Mar-61 | 93 | Apr-62 | 1.08 | 92 |
| | Jun-61 | 101 | Apr-62 | 0.83 | 95 |
| | Sep-61 | 111 | Jun-62 | 0.75 | 99 |
| | Dec-61 | 116 | Aug-62 | 0.67 | 99.5 |
| | Mar-62 | 121 | Sep-62 | 0.50 | 99.5 |
| | Jun-62 | 125 | Oct-62 | 0.33 | 100 |
| | Actual | 126 | Sep-62 | | |
| Maine Yankee | Sep-67 | 100 | May-72 | 4.67 | |
| | Sep-68 | 131 | May-72 | 3.67 | |
| | Mar-70 | 181 | May-72 | 2.17 | |
| | Actual | 219 | Dec-72 | | |
| Millstone 1 | Dec-65 | NA | Aug-69 | 3.67 | 0.0 |
| | Mar-67 | 81 | Aug-69 | 2.42 | 21.7 |

| Unit Name | Date of Estimate | Estimated Cost | Estimated COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| | Sep-67 | 84 | Aug-69 | 1.92 | 35.0 |
| | Dec-68 | 90 | Jan-70 | 1.08 | 72.4 |
| | Mar-69 | 90 | Mar-70 | 1.00 | 78.3 |
| | Sep-69 | 92 | Oct-70 | 1.08 | 86.0 |
| | Jun-70 | 92 | Nov-70 | 0.42 | 99.0 |
| | Sep-70 | 92 | Dec-70 | 0.25 | 99.7 |
| | Dec-70 | 92 | Feb-71 | 0.17 | 100.0 |
| | Actual | 97 | Mar-71 | | |
| Nine Mile Point | Mar-64 | 68 | Nov-68 | 4.67 | 0.0 |
| | Sep-64 | 68 | Jul-68 | 3.83 | 0.0 |
| | Jun-66 | 88 | Nov-68 | 2.42 | 34.0 |
| | Dec-67 | 134 | Jan-69 | 1.08 | 75.0 |
| | Mar-68 | 134 | Feb-69 | 0.92 | 83.0 |
| | Jun-68 | 134 | Jun-69 | 1.00 | 88.0 |
| | Dec-68 | 134 | Dec-69 | 1.00 | 94.0 |
| | Mar-69 | 151 | Dec-69 | 0.75 | 97.0 |
| | Actual | 162 | Dec-69 | | |
| Oyster Creek 1 | Jun-64 | 59 | Oct-67 | 3.33 | 0.0 |
| | Sep-65 | 59 | Nov-67 | 2.17 | 18.0 |
| | Mar-66 | 59 | Dec-67 | 1.75 | 30.0 |
| | Jun-66 | 67 | Dec-67 | 1.50 | 33.0 |
| | Sep-66 | 67 | Jan-68 | 1.33 | 41.0 |
| | Mar-67 | 67 | Apr-68 | 1.08 | 66.4 |
| | Dec-67 | 83 | NA | NA | 94.0 |
| | Jun-70 | 91 | Dec-69 | -0.50 | 100.0 |
| | Actual | 90 | Dec-69 | | |
| Robinson 2 | Jun-66 | 76 | May-70 | 3.92 | 0.0 |
| | Dec-69 | 76 | Oct-70 | 0.83 | 76.0 |
| | Mar-70 | 76 | Nov-70 | 0.67 | 91.0 |
| | Dec-70 | 76 | Jan-71 | 0.08 | 100.0 |
| | Actual | 78 | Mar-71 | | |
| Surry 1 | Dec-66 | 130 | Mar-71 | 4.25 | 0.1 |
| | Dec-67 | 144 | Mar-71 | 3.25 | 4.3 |
| | Dec-68 | 165 | Mar-71 | 2.25 | 15.2 |
| | Jun-69 | 165 | Apr-71 | 1.83 | 33.7 |
| | Sep-69 | 165 | Jun-71 | 1.75 | 45.7 |
| | Dec-69 | 189 | Jun-71 | 1.50 | 45.6 |
| | Jun-70 | 189 | Oct-71 | 1.33 | 79.5 |
| | Dec-70 | 189 | Feb-72 | 1.17 | 88.6 |
| | Jun-71 | 203 | Feb-72 | 0.67 | 91.2 |
| | Sep-71 | 222 | Jun-72 | 0.75 | 93.6 |
| | Dec-71 | 235 | Aug-72 | 0.67 | 96.5 |
| | Sep-72 | 244 | Nov-72 | 0.17 | 100.0 |
| | Dec-72 | 251 | Dec-72 | 0.00 | 100.0 |
| | Actual | 247 | Dec-72 | | |

| Unit Name | Date of Estimate | Estimated Cost | COD | Years to COD | % Comp |
|---|---|---|---|---|---|
| Vermont Yankee | Sep-66 | 88 | Oct-70 | 4.08 | 0 |
| | Sep-69 | 120 | Jul-71 | 1.83 | |
| | Mar-70 | 133 | Jul-71 | 1.33 | |
| | Feb-71 | NA | Oct-71 | 0.67 | |
| | Jul-70 | 154 | Mar-72 | 1.67 | |
| | Dec-71 | NA | Sep-72 | 0.75 | |
| | Actual | 184 | Nov-72 | | |