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STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

RE: THE APPLICATION OF THE CONSUMERS POWER COMPANY FOR AUTHORITY TO IMPLEMENT A POWER SUPPLY COST RECOVERY PLAN FOR 1984	Case No. U-7785

TESTIMONY OF PAUL CHERNICK

ON BEHALF OF THE

PUBLIC INTEREST RESEARCH GROUP

IN MICHIGAN

April 16, 1984

I. QUALIFICATIONS

Q: Mr. Chernick, would you please state your name, position, and office address.

A: My name is Paul L. Chernick. I am employed by Analysis and Inference, Inc., as a Research Associate. My office address is 10 Post Office Square, Suite 970, Boston, Massachusetts 02109.

Q: Please describe briefly your professional education and experience.

A: I received a S.B. degree from the Civil Engineering Department of the Massachusetts Institute of Technology in June, 1974, and a S.M. degree from the same school in February, 1978 in Technology and Policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, to membership in the engineering honorary society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi. I am the author of several publications, which are listed in my resume, attached as Appendix A.

My professional experience includes over three years as a Utility Rate Analyst for the Utilities Division of the Massachusetts Attorney General. In this capacity, I was involved in review and analysis of utility proposals on a number of topics, particularly load forecasting, capacity planning, and rate design. One of my first major projects for the Attorney General was an investigation of the extended 1977-78 maintenance outages and associated derating of the Pilgrim power plant.

My current position with Analysis and Inference, Inc. has involved a number of utility-related projects. These include a study of nuclear decommissioning insurance for the Nuclear Regulatory Commission, analyses of gas and electric rate designs, nuclear power cost estimation, design of conservation programs, and several other topics.

Q: Have you testified previously as an expert witness?

A: Yes. I have testified more than twenty-five times before the Massachusetts Department of Public Utilities, the Massachusetts Energy Facilities Siting Council, the Massachusetts Division of Insurance, the Atomic Safety and Licensing Board of the Nuclear Regulatory Commission, and before the utility commissions of Texas, New Mexico, Illinois, New Hampshire, Connecticut, and the District of

Columbia. My resume lists my previous testimony.

I testified in Massachusetts Department of Public Utilities (MDPU) docket numbers 1048 and 1509, the first two reviews of Boston Edison's proposed power plant performance standards, under the new fuel clause statute, M.G.L. c. 164, section 94G (effective August 6, 1981). That statute eliminated the essentially automatic recovery of fuel costs, and required that the fuel adjustment charge be based on "the efficient and cost-effective operation of individual generating units". I have also submitted testimony before this Commission in Case No. U-7775, Detroit Edison's 1984 Power Supply Cost Recovery proceedings.

In addition to power plant performance cases, I have also testified on nuclear capacity factors in a number of planning and ratemaking proceedings, including MDPU 20055, MDPU 20248, NHPUC DE 81-312, Illinois Commerce Commission 82-0026, CPUCA 83-03-01, and NMPSC 1794, among others. This testimony is also listed in my resume.

II. Introduction

Q: Please describe the subject matter and purpose of your testimony.

A: My testimony discusses the capacity factors for Consumers Power's nuclear generating units -- Big Rock Point, Palisades, Midland 1, and Midland 2 -- to be used in this proceeding and in subsequent proceedings. Section III describes the principles and concepts upon which power plant performance targets may be based. Section IV discusses the standards proposed by Consumers Power Company (CPCo), and in particular, CPCo's failure to describe the derivation of its standards, and explains why CPCo's approach is inappropriate to the purpose of this proceeding. In Section V, I suggest capacity factor performance standards and methodologies for each of CPCo's nuclear units. For Big Rock Point, I derive a target based on the historical performance of that unique unit. For Palisades, I analyze the capacity factors of other commercial-size PWR reactors, and suggest a range of comparative standards. For Midland, I first discuss the rate effects of expensive new nuclear plants, and the inequities and distortions which can result from applying traditional ratemaking techniques in those situations. Finally, I propose a method for insuring that CPCo customers will not pay more for the Midland plant than it will save them, at least until such time as the Commission determines that the additional costs are reasonable and prudent. This approach also matches the timing of the plant's benefits to its costs, and should encourage CPCo to make responsible decisions about Midland's future, and to forecast the cost and reliability of the plant more accurately.

Q: Why is it appropriate to set standards for power plant performance, rather than simply allowing CPCo to recover its actual fuel costs, regardless of how well, or how poorly, its units perform?

A: In establishing the power supply cost recovery clause (1982 PA 304), the Legislature repeatedly refers to the "reasonable and prudent" decisions, policies, and practices on the part of the utility. In order to determine whether the power supply costs were reasonable and prudent, the Commission must determine whether the prices paid for fuel and purchase power were appropriate, whether the efficiency (heat rate) of plants which burn large dollar amounts of fuel are adequate, and whether the units with the lowest running costs were available and utilized sufficiently.

Q: What is the fundamental goal of the standard-setting process?

A: In setting power plant performance standards, the objective is to develop _normative_ or _prescriptive_ goals, specifying how the plants _should_ behave. This is a very different concept from _positive_ or _descriptive_ projections, which predict how the plants _will_ behave. These two types of analyses have very different purposes and may yield very different results. For example, if a utility breaks a plant in 1983, an accurate positive analysis might project a 1984 capacity factor of zero. It may be appropriate to base 1984 power supply cost recovery on the "reasonable and prudent" costs which should have been incurred if the plant had not been broken. Thus, the normative standard may be different from both the actual performance, and from the best estimate of future performance.

III. Principles of Power Plant Performance Standard-Setting

Q: What basic approaches can be taken to establishing standards for power plant performance?

A: There are three basic types of alternative approaches. First, each unit's performance standard can be determined by a <u>self-referent</u> standard, based on the unit's past performance. Self-referent standards may be set at various levels of stringency, such as:

- The unit will perform at least as well as its best past performance.

- The unit will perform at least as well as its average past performance.

- The unit will perform at least as well as its worst past performance.

Any of these standards may be calculated from any time period (e.g., last year, or the plant's entire life) and for a variety of intervals (monthly data, annual data).

Q: Do these self-referent methods generally produce fair and even-handed standards?

A: Not usually. Self-referent standards are inherently stricter for those units with good performance histories than for those with poor past performance. This is hardly a fitting reward for those utilities which have historically taken the greatest care in plant operation. In fact, it penalizes the best past performers and rewards the worst. There is generally no compelling reason for believing that the unit's history is representative of an appropriate level of performance (neither extraordinary nor inadequate), so self-referent standards are not likely to be useful in identifying efficient and cost-effective operations.

Q: What is the next category in your taxonomy of standard-setting approaches?

A: In the second group of options, standards are based on comparative analyses, which aggregate the experience of other units. This approach would include such standards as:

- The unit will perform as well as the average comparable unit.

- The unit will perform as well as the average competently run unit.

- The unit will perform better than half (or any other percentage) of the comparable units.

Q: How may comparative targets be derived?

A: The comparisons may simply average data from a set of units which share some common characteristics, or they may involve more complex statistical analyses, such as regression. Simple comparisons are generally performed on a set of very similar units, as it is difficult to justify direct comparisons between units which are known to vary in any relevant manner. The differences which are relevant are those which can be expected to affect performance: vintage, age, operating pressure, size, fuel type, and so on. The resulting data sets tend to be small, and the comparability of the units is always subject to some dispute. Various statistical techniques may mitigate these limitations. In multiple regressions, for example, several descriptive variables may be incorporated simultaneously, facilitating the merging of data from a greater variety of units. Statistical tests can also be useful in determining whether particular units belong in a comparison group.

Q: You have stated that the purpose of analyzing power plant performance is to establish normative standards. Is this consistent with the use of actual operating data in these first two types of approaches?

A: Yes, it is consistent. Positive models describe the way things are (or have been), leading to such conclusions as "In their second year of operation, 800-MW PWR's have an average capacity factor of 55%." This sort of statement is not a performance standard; it only becomes a standard when a presciption is added, such as "Therefore, Midland 2 should have a 55% capacity factor in its second year." The way things are may be the basis for determining the way things should be, but this relationship is not automatic.

Q: What is the third group of standard-setting approaches?

A: Finally, standards may be based on absolute measures of proper performance, such as:

- The unit will perform as was promised, or expected.

- The unit will perform as well as the utility has assumed for other purposes, such as rate design, setting small power producer rates, and capacity planning.

- The unit will perform well enough to justify its fixed costs.

None of these various absolute standards depend on actual performance data, either for the subject plant or for other plants. The first example suggests that, when the utility (and hence, the ratepayers) buy a generating unit, it should get what it (and they) expected. The second example suggests the standards applied in a plant performance standard review, where over-optimistic projections cause problems for the utility, should be the same as those used in proceedings where over-optimistic projections cause problems for rate-payers, such as capacity planning and rate design. The last example suggests that, regardless of what the utility expected, or predicted, or should have expected for the unit, the real issue is whether the unit is paying its own way.

Q: Is one particular approach to standard-setting preferable in all applications?

A: No. The various kinds of standards are appropriate for different situations. As noted above, self-referent standards raise major equity issues. If applied on a rolling basis (e.g., if the standard in any year is determined by performance in the preceding three years), serious and perverse incentive problems may be created. Self-referent standards are also inherently inapplicable to new units. There are special circumstances in which self-referent standards are useful, particularly when no other basis for standard-setting exists; these are the exceptions, rather than the rule.

Comparative standards are appealing wherever a reasonable comparison group exists. They are not applicable for experimental units and other unique designs[1]. Comparative analyses establish business-as-usual standards, which simply ask utilities to keep up with general industry performance levels.

Absolute standard-setting approaches rely on other concepts of fairness, which may be applicable even where business is far from usual. For example, using pre-operational expectations to set performance standards is intrinsically appealing: if a utility sets out to build a plant which will operate in a particular manner, it should be able to explain why the actual plant is significantly different than the expected one. Similarly, utilities should not be allowed to change their stories to suit their positions in different proceedings, projecting wonderful operating results if they are allowed to build the plants of their choice; assuring regulators that good generating performance will make

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1. The concept of uniqueness must be applied carefully. In one sense, no steam power plant is unique, since all such plants are alike in having a boiler, a turbine, and a heat sink. In another sense, every unit is unique, except for those few sister units which are <u>exact</u> carbon copies. Generally speaking, if a group of similar units can be defined, a meaningful comparative analysis can be conducted, and statistical tests can determine whether differences between plants are important.

marginal costs so low that volume discounts to large energy users are justified, conservation is counter-productive, and small power producers are unnecessary; and then denying that it is realistic to expect performance at those levels.

The application of this approach is limited by performance factors and units for which expectations and representations are either unavailable or otherwise of limited usefulness. For many fossil units constructed prior to the establishment of regulatory review, no reliability measures were ever projected. For other technologies, early performance expectations were widely held, based on virtually no data, and seriously incorrect; this certainly was true of projections for nuclear capacity factors made in the 1960's and early 1970's. In such cases, it seems unfair to hold an individual utility responsible for a universal, and perhaps understandable, error.

As an alternative to the projection standard, the cost-effectiveness standard may be particularly appealing: this standard asks only that the ratepayers be better off with the plant than without it, but this may be all that can be expected from new (and especially from exotic) generating units. This standard can be derived for all units, regardless of the existence of a comparison group, of prior data on the unit's own performance, or of pre-operational projections.

IV. CPCo's Approach

Q: How does CPCo project the performance of its nuclear units?

A: It is not entirely clear, but it appears that

1. CPCo has no specific or consistent methodology,
2. the capacity factor projections are descriptive, rather than prescriptive,
3. the derivation is essentially subjective, unreviewable, and arbitrary, and
4. whatever data supports the projections come primarily, and perhaps exclusively, from the CPCo units themselves.

The vaugeness displayed by CPCo in this regard greatly limits the ability of outsiders to describe, let alone comment on, the Company's procedures.

Q: What is the basis for your conclusions regarding the origins of CPCo's projections?

A: First, CPCo's filing provides no information about the origin of the capacity factor projections included in the filing. Second, CPCo's discovery responses do not offer any fundamental derivation of the projections. Finally, the cross-examination of Mr. Van Hoof and Mr. Lapinski indicates that no such formal derivation exists, and that "they start from . . . each individual unit's operating history" (Lapinski, Transcript p. 1319).

V. Recommendations

Q: What types of performance standards are appropriate for CNP's nuclear units in this proceeding?

A: The appropriate choices are different for each of the plants. For Big Rock Point, the options are quite limited. At 72 MW, Big Rock Point is one of the smallest domestic nuclear units to operate for any appreciable period of time. Of the other units which operated for more than a few years, only seven[2] were under 250 MW. Only three other units were less than 150 MW, one of which was the Shippingport PWR which was used as much for AEC/DOE experimentation as for power production.[3] Both Shippingport and Humboldt (63 MW) have been retired, after fairly short useful lives by power plant standards. Thus, the contemporary comparison group for Big Rock Point would be essentially limited to La Crosse (50 MW), the only reactor ever built by Allis-Chalmers. On the whole, only a self-referent standard seems reasonable for Big Rock Point.

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2. Half of these units were PWR's (Indian Point 1, Yankee Rowe, and Shippingport), while Big Rock Point is a BWR, like Humboldt, Dresden, and La Crosse.

3. Shippingport was converted to a light water breeder reactor in its later years.

This kind of problem does not arise for Palisades, which is a fairly typical PWR in terms of size. Palisades was also one of the earlier commercial-sized PWR's, but not the earliest: 10 units of more than 400 MW were ordered prior to the Palisades order, two more were ordered the same month (January 1966), and another 17 orders had been placed by the end of the year. Therefore, a comparative analysis seems quite appropriate.

A break-even standard would be the most appropriate approach for setting Midland performance targets. The plant is being built with the knowledge that it will be far more expensive per kw than other capacity sources, but with the expectation that it will pay off the additional capital costs through long hours of output at very low fuel cost. Even when it became clear that the plant would not be necessary in the near future for reliability purposes, CPCo continued construction to realize the anticipated fuel savings. Since the plant was built to save rate-payers money, it seems reasonable to expect it to do so.

Q: Does the intended use of a performance standard have any effect on the kind and level of standard which is appropriate?

A: Yes. It is important to remember that the performance standards to be set in this proceeding serve a particular (and quite limited) function. If CPCo's plants perform below the level established in this case, the power supply cost recovery factor will produce rates which do not fully cover the utility's costs. However, it is my understanding that CPCo will still have an opportunity in the reconciliation proceeding to explain and justify any deviations from expected performance.[4] Hence, the standards do not create an automatic penalty for operation which falls below the standards. Instead, the standards will basically flag performance which requires some scrutiny or explanation. Thus, a higher standard would be appropriate for this screening purpose than might be appropriate if there were automatic financial consequences when the utility failed to meet the standard. When a range of standards is available, I would therefore tend to recommend standards from the higher end of the range.

Q: What capacity factor standard would you recommend for Big Rock Point?

A: Table 1 (Exhibit PLC-1) lists the capacity factor for Big

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4. The converse is also true: if performance is better than expected, CPCo can keep its over-collections, at least until the reconciliation hearing.

Rock Point for each year, 1974 - 1983.[5] These capacity factors are calculated from the unit's Design Electrical Rating (DER) of 72 MW.[6] I recommend setting the Big Rock Point capacity factor standard at the simple average of mature experience,[7] which is 56.1%, or 354.1 GWH annually.

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5. This information is taken from NRC reports. Data prior to 1974, the starting date for the NRC report series, is much more difficult to obtain.

6. There are many ways of measuring plant capacity. Some capacity measures, such as Dependable Capacity, vary with the performance of the unit and may not be useful for measuring that performance. DER, a measure reported to the NRC and based upon the design of the equipment, is not usually subject to such changes. Where the reported DER has changed over time for a unit, as it has for Palisades, I use the earliest reported DER of which I am aware.

7. It is generally accepted that steam-electric power plants, including nuclear plants, go through a breaking-in period of relatively low reliability, followed by stabilization of performance at a mature level. Various analyses reach slightly different conclusions regarding the exact point at which nuclear plants mature, but most conclude that maturity occurs around the fifth full year of operation. For Big Rock Point, the fifth full year was 1968.

A: How did you determine an appropriate capacity factor standard for Palisades?

Q: I performed a series of regressions on the performance of other domestic PWR's of more than 400 MW capacity.[8] The basic data set included all full unit-years through 1982, for all units except for Palisades (which is the object of the study). A total of 312 unit-years were thus available.

Two types of analysis were conducted in this study. First, I analyzed all the available data, regressing capacity factor against plant age and size. This analysis produced the equations shown in Table 2 (Exhibit PLC-2). Equation 2 varies from Equation 1 by the limitation of the maturation effect to the first five years of unit life. Equation 2 is preferable to Equation 1, both statistically and in terms of prior expectations,[9] but the age variable is still weak, both statistically and practically.

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8. Throughout this comparative analysis, I used the original DER rating (or the earliest one I could identify), as reported for each unit to the AEC or NRC. For Palisades, this rating is 821 MW. The reported ratings for Palisades have varied widely over time, even more so than is typical of nuclear plants. Since the use of a lower capacity produces higher capacity factors, and vice versa, it is important to use a consistent definition of capacity, and to require utilities to explain why 821 MW units have become 800 MW, or even 700 MW units.

9. Power plant performance is expected to improve with maturation, not deteriorate.

Second, I examined the post-1978 data, to determine whether there were any post-TMI effects which might be confounding the age variable,[10] and which might also have practical significance. This analysis produced the equations shown in Table 3 (Exhibit PLC-3). Indeed, performance in each year from 1979 on has been significantly worse (in both the statistical and practical senses of "significant") than performance in the pre-TMI period. The best estimate of the effect varies from year to year, but these differences are small compared to the variation in each year; the best overall fit is achieved by Equation 5, which treats all of the post-TMI years as equivalent.

These analyses should be thought of as first approximations in the process of modeling PWR capacity factors. The exact shape of the age and size effects can be studied in more detail, although my results are consistent with most statistical analyses of nuclear capacity factors. The data may be improved for the specific purpose of determining average prudent performance by deleting the few specific unit-years which can be identified as reflecting acknowledged imprudent behavior on the part of the operators. A much larger fraction of the variation in the data can be explained, and more detailed annual targets can be set, by

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10. Post-TMI data will tend to be data later in unit life.

including a dummy variable for years in which a unit refueled, although this refinement would restrict the data set to years since 1974, the period for which refueling schedules are reasonably available.

Q: How can your results be utilized in determining a performance target for Palisades?

A: A comparative standard can be applied in at least two ways: on an annual basis and on a cumulative basis. The annual standard simply takes the group projection for the size, current age, refueling status, and other characteristics of the unit. In other words, it requires that

> A unit of these characteristics shall perform this year at the average level of similar units.

The cumulative approach derives the current year's standard which will bring the plant's cumulative performance to the group prediction.[11] Thus, the cumulative standard is indifferent to this year's performance, except to specify that

> A unit of these characteristics shall <u>through this year</u> perform at the average level of similar units.

For a unit which has performed well in the past, the

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11. If the utilitiy's cost recovery is determined by the target, rather than by actual performance, then the target should be used in subsequent computations.

cumulative standard is more lenient than the current standard; for a unit which has performed poorly, the cumulative standard is more stringent.

A: Which type of comparative standard do you believe is more appropriate?

Q: In general, I think that the cumulative standard is more equitable. A unit which performed exceedingly well in the past seems entitled to an off year or two, while one which has performed in an unsatisfactory manner has some catching up to do. On a more causal basis, the cumulative standard may be justified by the observation that many operating problems require some time out of service for their correction. A unit which has performed especially well may have deferred some maintenance or upgrading to achieve high reliability in the past, and may reasonably require more downtime now than a unit which has already been out of service for major modifications and maintenance. Nonetheless, I have calculated Palisades capacity factors for both current and cumulative comparative standards.

A: What are your specific recommendations for Palisades capacity factor targets?

Q: These recommendations are presented in Table 4 (Exhibit PLC-4). The cumulative standards may be compared to CPCo's estimate of a 63% mature capacity factor for all PWR's (see the response to Question 85-PR-219). If a lifetime cumulative performance standard is employed, as I have suggested, it is impossible for CPCo to catch up in 1984. Hence, the target for 1984 must be set at some lower, feasible level, such as 100% or 7211.7 GWH. Other possible targets would be 94% (the highest annual capacity factor in my data set) or some more likely value, such as 80%. The lower the annual target, the longer a time is required to catch up to the average. Even if only mature years are included, the cumulative standard would still be constrained to the highest feasible level. If a current standard is used, I would suggest that the target be set at 60.3%, if the Commission believes that the post-TMI effect will continue into 1984, or 64.1% if the Commission believes that average performance will recover towards the historic mean.

Q: What technique would you recommend using in the determination of Midland capacity factor targets?

A: I would recommend the use of a breakeven standard, for four reasons. First, a breakeven standard, or equivalent base rate treatment, is necessary to avoid serious equity problems over time. Second, neither Midland unit should cost ratepayers more than it it is worth in fuel savings and avoided capacity costs, unless the Commission specifically approves the recovery of increased costs. Third, a breakeven standard would provide better incentives for CPCo to accurately project the costs and benefits of Midland. Fourth, by providing an early warning that any excess costs will not be recovered easily, the standard may encourage CPCo to make more responsible decisions with regard to constructing, delaying, or canceling one or both units.

Q: Please describe the temporal inequities caused by traditional ratemaking treatment for expensive new baseload plants.

A: Normal ratemaking treatment tends to impose a disproportionately large share of the costs on customers in the first few years of a generating plant's life, even though (under current conditions) most of the benefits are expected much later, often in the second half of the unit's life. Costs tend to fall over the first decade or so, due to depreciation of the rate base contribution. The benefits of major baseload plants are generally relatively small in the early years, while the price of the alternative fuels[12] is low and the need for the added capacity does not exist. This pattern of costs and benefits is illustrated in Figure 1 (Exhibit PLC-5).[13]

As a result of this pattern of cost and benefits, customers

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12. For CPCo, nuclear fuel would be backing out primarily coal.

13. The data is from Northeast Utilities, for Millstone 3, and is illustrative of the general problem.

in the early years (frequently a decade or more) wind up worse off than they would have been if the plant had never been built. This may be true even if the plant is justified by its later savings, to a substantially different mix of customers. In essence, this situation amounts to a sizable tax on today's customers to provide lower cost power to tomorrow's customers.

Q: How would a breakeven standard produce a more equitable distribution of costs and benefits over time?

A: If the ratepayer benefits of the plant are constrained to be at least as large as the costs, the large ratepayer losses in the early years do not occur.[14] As a result, there is no subsidy (or less subsidy) by the ratepayers of the 1980's to the ratepayers of the next century. The people who receive the major benefits of the plant (avoiding the large costs of escalating fuel prices) also pay the major proportion of the costs.

Q: How would you recommend applying a breakeven standard to achieve these equity goals?

A: It is to be expected that Midland will fail the breakeven

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14. Alternatively, the non-fuel costs passed on to ratepayers may be constrained to be less than of equal to the savings received. As noted below, a breakeven standard may encourage CPCo to help develop base rate treatment for Midland which better follows the temporal pattern of customer benefits.

standard for several of its early years. So long as this is the case, I would recommend that CPCo be allowed to accrue interest on the difference between its actual power supply costs, due to actual Midland operation, and the fuel charges allowed under the breakeven target. If Midland eventually pays off, the actual costs will be less than those under the gradually decreasing) breakeven standard, and CPCo can collect its deferred fuel costs.

Q: Why do you believe that the Midland plant should not cost ratepayers more than it saves them, at least until the Commission explicitly approves such additional costs?

A: The breakeven standard for power plant performance avoids an unfortunate sequence of events, which I am afraid is becoming the norm for new baseload plants, especially nuclear ones. In that sequence:

1. the plant costs more than it is worth for the first few years of its life,

2. the utility projects better performance (or larger savings) later in the plant's life,

3. the regulators must decide whether to penalize the utility before finding out whether the projections are correct,

4. by the time that the plant's lifetime economics become

clear, it is likely to be saving money in current rates (although not necessarily enough to cover the initial years of net losses), and

5. the appropriate and compelling time for assessing a penalty, when the management and shareholders responsible for the project are still associated with the utility, and when the plant is imposing a burden on current ratepayers, has passed before regulators can determine whether the investment was in the interests of the ratepayers.

At best, conventional ratemaking in this situation substantially subsidizes future ratepayers at the expense of current ratepayers; at worst, it may penalize utilities for units that will eventually pay off, and fail to recognize that other units never do.

Q: How would a breakeven standard encourage better cost and benefit projections by CPCo?

A: So long as CPCo[15] can justify recovery of the cost of its new plants by projecting optimistic future operating costs and performance, long useful plant life, low costs of completion, backfitting, and decommissioning, along with high projected costs for avoided fuel and capacity costs, there is a

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15. This would be true of any utility in a similar position.

positive disincentive for CPCo to offer forthright cost projections to this Commission. If the Company's cost recovery is tied to the benefits of the plant, this strategy no longer works. If CPCo expects Midland to pay for itself, the breakeven standard will eventually make the shareholders whole, regardless of the company's cost projections, and there is no reason to bias those projections. For accounting reasons, CPCo may prefer to reflect the initial deferred excess costs in explicit base rate treatment, rather than as deferred fuel costs. If that is the case, accurate cost projections will provide more consistent and stable ratemaking treatment, and CPCo will benefit from the Commission having the best available data.

If, on the other hand, CPCo determines at some point in the future that Midland is not likely to repay its initial investment, the company should ask the Commission for explicit ratemaking treatment, just as it would for any other large investment which must be written off. In this situation, it would be crucial for CPCo be absolutely candid with the Commission regarding the costs and benefits of the plant, in order to accurately assess the size of the net loss.

Q: How would a breakeven standard improve CPCo's decision-making process?

A: Traditionally, utilities have had very asymmetrical incentives regarding decisions to complete or cancel construction projects. Completed plants, whether economical, or needed, are generally placed in rate base more or less when they enter service.[16] Canceled plants are generally considered to be at least partially imprudent (or at least partially the responsibility of the stockholders), and their costs are rarely recovered in full from the ratepayers. Therefore, a utility which can actually complete and operate a new plant is largely home free, even if the net cost of the project is greater than the cost of cancelation. The result is that utilities frequently continue with construction projects long after an impartial analysis would indicate that they should be abandoned.

With a breakeven cost recovery standard, this asymmetry is eliminated. Cost recovery will be far from automatic in any case, and (even if the plant is completed) will not rely on projections of future benefits. A completed plant which costs a billion dollars more than it is worth would pose the same problems for the utility as a plant which is canceled after a billion dollars have been spent on it. Therefore, the bias towards completion should be largely neutralized,

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16. More recently, some units have been phased into rate base over the period of a few years, resulting in limited costs being borne by the shareholders.

and decisions regarding cancelation, deferral, or completion should be made on the basis of total future costs and benefits, without regard to whether customers or shareholders are likely to bear the costs.

This may well be the most important effect of a decision by the Commisssion at this time to adopt the principle of a breakeven standard for Midland. The plant (and especially Unit 1) is unlikely to be completed, and the sooner CPCo receives the right incentives, the sooner it is likely to accept the inevitable, and stop sending good money after bad.

Q: How should the breakeven standard be set?

A: Quite simply, so long as CPCo projects that Midland will prove to be a good investment, the capacity factor required for either Midland unit to pay for itself, under current conditions, is

(annual cost)/[(fuel saving)*MW*8760]

where

annual cost	= the unit's costs in base rates, in $'s
fuel saving	= average cost differential between nuclear fuel and displaced fossil fuel
MW	= the unit's capacity, in MW
8760	= hours/year.

The breakeven capacity factor is dependent on the Commission's rate treatment of Midland investment and expenses. In general, the breakeven capacity factors would be expected to decrease over the first few years of each unit's life, as fossil fuel prices rise and as depreciation decreases the unit's contribution to rate base. When the Commission determines that the unit has contributed to reduced costs for other capacity (whether owned by CPCo or purchased as entitlements from other utilities' plants), those savings may be subtracted from the numerator.

As time goes by, the breakeven standard becomes less strict, and most plants eventually would be expected to exceed the standard. At that point, the deferred costs would be paid off from the difference between the plant's actual savings and the target. In the ordinary case, in which the plant is economically justified, the deferred costs would gradually be recovered, and the breakeven standard would finally become obsolete. At that point, a comparative standard could be substituted. That particular detail is quite academic for Midland; if either unit reaches commercial operation, it will still be many years before it reaches discounted breakeven.[17]

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17. I define "discounted breakeven" as the point at which cumulative benefits equal cumulative costs, including the time value of money.

Q: How would you change the breakeven standard if CPCo projects that the plant will not produce benefits equal to its costs?

A: I would suggest that the Commission first determine what portion of the total cost of the plant should be recovered over its life. This fraction may range from 100% of the costs down to the portion of costs justified by the savings.[18] Once that fraction is determined, a multiplier can be calculated, so that applying the breakeven standard with the multiplier over the anticipated life of the plant will recover that costs which the Commisssion has approved. The multipier may be applied to the fuel savings factor, to the cost of the displaced fossil fuel, to capacity cost savings, or to total savings.

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18. The extent of the savings seems to me to be the lower limit for cost recovery, so long as the utility's errors are confined to decisions to continue construction after that became imprudent. If the Commission finds that the plant should have been completed, but that competent management would have brought it into service for a much lower cost, then cost recovery may reasonably be limited to the cost of completing the plant prudently. For Midland, I expect that excess costs would result more from failure to cancel than from construction errors, but this would have to be determined by the Commission when CPCo requests special ratemaking treatment for the excess costs.

The choice of the multiplier to be applied should depend on the Commission's perceptions of why the plant will not pay,[19] why its completion was justified,[20] and what costs the plant represents the best insurance against.[21] Determination of the size and applicaton of the multiplier must await CPCo's admission that the plant will not pay for itself, and its request for recovery of the excess costs.

Q: Does this conclude your testimony?

A: Yes.

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19. For example, if the principle problem is that CPCo's capacity factor projections were too high, the multiplier might be applied to all fuel savings.

20. If the Commission found that some of CPCo's decisions to continue construction were reasonable because of concern that resurgent demand would otherwise require enormous efforts to catch up in installed capacity, the multiplier might be applied to the avoided capacity costs.

21. Even if it is not expected to pay for itself, a nuclear unit still provides some insurance against future coal price increases (from acid rain legislation, perhaps), in which case perhaps the excess costs are most appropriately recovered from a surcharge on avoided coal prices.

Case No. U-7785
Exhibit PLC-1

Year	GWH	Capacity Factor
1964	192.5	30.5%
1965	180.6	28.6%
1966	341.7	54.2%
1967	502.0	79.6%
1968	425.6	67.5%
1969	401.0	63.6%
1970	362.4	57.5%
1971	368.9	58.5%
1972	360.4	57.1%
1973	422.7	67.0%
1974	337.5	53.5%
1975	290.5	46.1%
1976	244.5	38.8%
1977	361.0	57.2%
1978	399.5	63.3%
1979	109.3	17.3%
1980	404.4	64.1%
1981	469.2	74.4%
1982	359.9	57.1%
1983	348.6	55.3%
Averages:		
1964-83	344.1	54.6%
1968-83	354.1	56.1%

Table 1: Big Rock Point Net Output in GWH (million KWH) and Capacity Factor (based on 72 MW DER)

	EQUATION 1		EQUATION 2	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	83.84%		78.99%	
Size [1]	-0.03%	-6.0	-0.03%	-5.8
Age [2]	-0.09%	-0.3	-	-
Age5 [3]	-	-	0.91%	1.6
Adjusted R	0.324		0.334	
F-stat	19.3		20.6	

Table 2: Simple Regressions on PWR Capacity Factors

Notes:
[1] Size = DER MW rating
[2] Age = years from commercial operation to middle of current year.
[3] Age5 = minimum of Age and 5

	EQUATION 3 Coef.	t-stat.	EQUATION 4 Coef.	t-stat.	EQUATION 5 Coef.	t-stat.
Constant		0.731		0.731		0.730
Size [1]	-0.02%	-4.3	0.02%	-4.3	-0.02%	-4.3
Age5	2.23%	3.2	2.23%	3.2	2.24%	3.3
Year Dummies [2]						
1979	-7.37%	-2.5	-7.36%	-2.5	-	-
1980	-8.99%	-2.9	-8.99%	-2.9	-	-
1981	-6.01%	-1.9	-	-	-	-
1982	-7.63%	-2.5	-	-	-	-
1981 or 1982	-	-	-6.84%	-2.7	-	-
1979 - 1982	-	-	-	-	-7.50%	-3.5
Adjusted R		0.369		0.372		0.378
F statistic		9.2		11.0		18.2

Table 3: PWR Capacity Factor Regressions with Year Dummies

Notes: [1] Size = Design Electrical Rating (DER) in MW.
[2] Dummy = 1 in this year, 0 otherwise.

Predictions for unit rated at 821 MW

			Number of Years
pre-1979, Age =			
1	58.86%		1
2	61.10%		1
3	63.33%		1
4	65.57%		1
5	67.81%		3
Age>5, year>1978	60.31%		4
1983 [1]	60.31%	62.18%	1
1984	60.31%	64.06%	1
Average for unit of COD: Dec-71			
lifetime	62.63%	63.06%	13
mature	62.81%	63.43%	9
Palisades average lifetime to 12/83	38.80%	38.80%	12
mature to 12/83	46.78%	46.78%	8
Target for 1984 based on			
lifetime	348.53%	354.15%	
mature [2]	191.05%	196.67%	
annual	60.31%	64.06%	

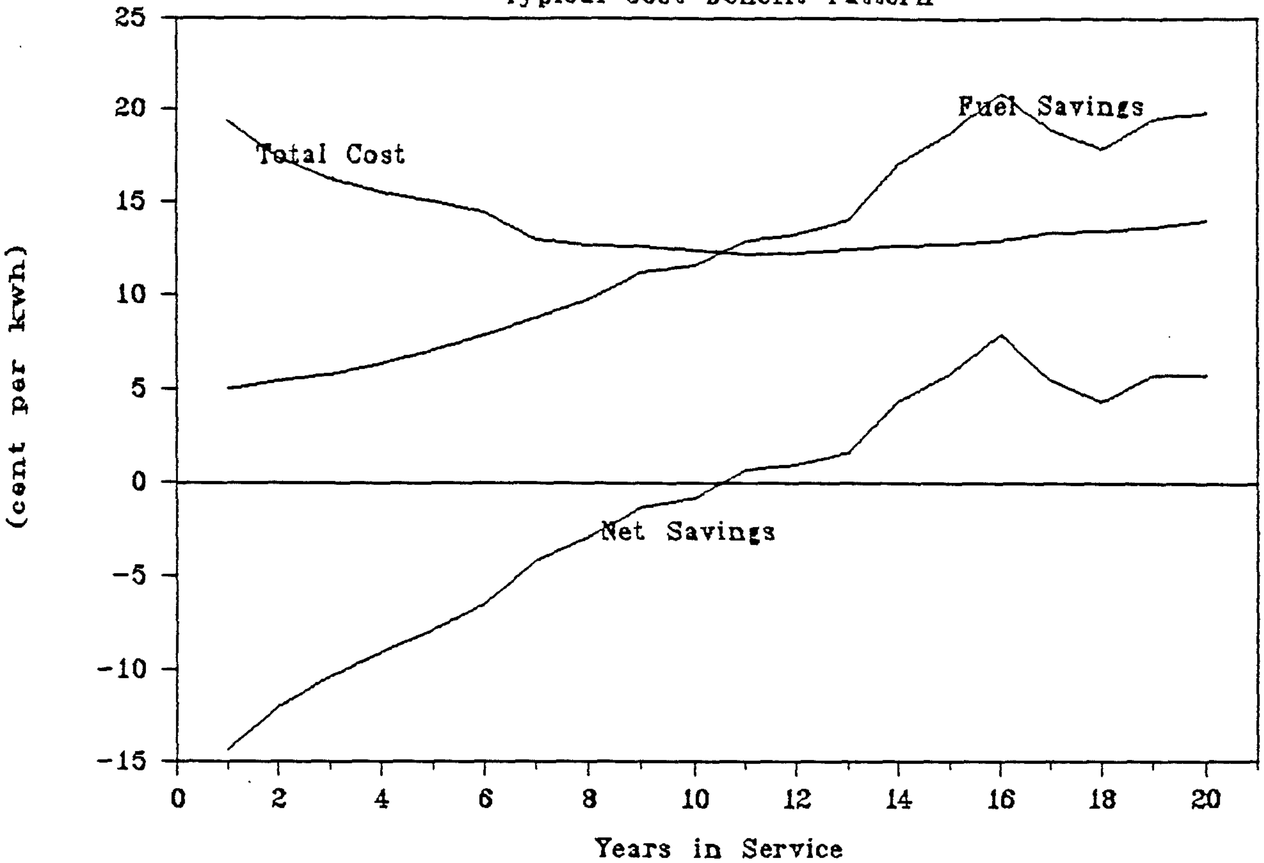
Table 4: Capacity Factor Targets for Palisades from Equation 5

Notes:
1. The first column assumes 1983 and 1984 are like 1979-82. The second column assumes a linear recovery over the next four years from the depressed performance of the previous four years.
2. Maturity starts with the fifth year of operation.

Case No. U-7785
Exhibit PLC-5

Figure 1: New Nuclear Plants

Typical Cost Benefit Pattern



APPENDIX A:

RESUME OF PAUL L. 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, Rebuttal, February 2, 1984.

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

30. Michigan PSC U-7775; Detroit Edison Fuel Cost Recovery Plan; Public Interest Research Group in Michigan; February 21, 1984.

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