COMMONWEALTH OF MASSACHUSETTS
ENERGY FACILITIES SITING COUNCIL

Eastern Utilities Associates System	)
E.F.S.C. No. 79-33	)

TESTIMONY OF PAUL L. CHERNICK
ON BEHALF OF THE ATTORNEY GENERAL

FRANCIS X. BELLOTTI
Attorney General

By: Robert L. Dewees, Jr.
Assistant Attorney General
Utilities Division
Public Protection Bureau
One Ashburton Place
Boston, MA 02108
(617) 727-1085

July 16, 1980

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

A: My name is Paul Chernick. I am employed by the Attorney General as a Utility Rate Analyst. My office is at One Ashburton Place, 19th Floor, Boston, Massachusetts 02108.

Q: Please describe briefly 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 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 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. During my graduate education, I was the teaching assistant for courses in systems analysis. I have served as a consultant to the National Consumer Law Center for two projects: teaching part of a short course in rate design and time-of-use rates, and assisting in preparation for an electric time-of-use rate design case.

Q: Have you testified previously as an expert witness?

A: Yes. I have testified jointly with Susan Geller before the Massachusetts Energy Facilities Siting Council and the Massachusetts Department of Public Utilities in the joint proceeding concerning Boston Edison's forecast, docketed by the E.F.S.C. as 78-12 and by the D.P.U. as 19494, Phase I. I have also testified jointly with Susan Geller in Phase II of D.P.U. 19494, concerning the forecasts of nine New England utilities and NEPOOL, and jointly with Susan Finger in Phase II of D.P.U. 19494, concerning Boston Edison's relationship to NEPOOL. I also testified before the E.F.S.C. in proceedings 78-17 and 78-33, on the 1978 forecasts of Northeast Utilities and Eastern Utilities Associates, respectively; jointly with Susan Geller before the Atomic Safety and Licensing Board in Boston Edison Co., et. al, Pilgrim Nuclear Generating Station, Unit No. 2, Docket No. 50-471 concerning the "need for power"; in D.P.U. 20055 regarding the 1979 forecasts of EUA and Fitchburg Gas and Electric, the cost of power from the Seabrook nuclear plant, and alternatives to Seabrook purchases; in D.P.U. 20248 on the cost of Seabrook power; and in D.P.U. 200 on Massachusetts Electric Company's rate design and conservation initiatives. I have also submitted prefiled joint testimony with Ms. Geller in the Boston Edison time-of-use rate design case, D.P.U. 19845, but we have not yet testified.

Q: What is the purpose of your testimony?

A: My testimony is intended to highlight deficiencies in EUA's forecasting methodologies and, where possible, to suggest improvements. This strategy has been effective in the past to some extent. EUA's recognition of efficiency improvements in replacement appliances appears to be a direct result of my participation in the reviews of the 1978 forecast, for example. The separation of the commercial forecast from the residential forecast also seems to be a response to past criticisms.

My testimony is not designed to determine the magnitude (and in some cases, not even the direction) of EUA's errors, and it is certainly not an alternative forecast.

I will frequently refer to my testimony in D.P.U. 20055 for illustrations of the problems I will discuss, but the purpose and direction of that testimony was quite different than the purpose and direction of the current testimony. For convenience, I will refer to that testimony as "Chernick, 1980".

Q: On which aspects of EUA's forecast will you be testifying?

A: I will be discussing:

a. customer number projections,

b. the consistency of EUA's estimates of historic trends with its projections of those trends in the future,

c. the consistency of short-term and long-term projections,

d. appliance efficiency computations, and

e. New Developments,

all in the residential model, and

f. specification of the commercial equations,

g. data manipulation and forecasting methodology in the industrial sector,

h. peak load calculation, and

i. sales for resale.

I will also discuss some of the shortcomings in EUA's supply plan.

Q: What is wrong with EUA's customer number projection?

A: As I pointed out last year (Chernick testimony, EFSC 78-33, pp. 4-5) and again in D.P.U. 20055 (Chernick, 1980, pp. 3-5), EUA's household size projection is based on archaic data, and using more recent data yields very different results. EUA's response (Exh. M-76, D.P.U. 20055) is that using the right data period yields the wrong answer. Given EUA's apparent lack of any other system or criteria for selecting a family size projection, it appears that the data period was selected so that the projection agreed with the forecasters' expectation. If EUA believes that family size in its service territories can be predicted from an examination

of national projections, it should make that assertion directly, and then act on it. If EUA believes that historic trends are more reliable, then it should properly develop a projection from the data available. Unfortunately, EUA seems to be doing the former and calling it the latter.

There is no inherent reason why EUA should not:

a. determine the historical relationship between service territory household size and national household size;
b. select an independent and impartial forecast of national household size (not one produced by EEI, like the one used on Exh. M-76, or by any other utility lobby); and
c. project local household size as a plausible function of national trend.

On the other hand, there is no basic reason why EUA could not properly:

a. select a relevant recent data set,
b. select a theoretically appropriate function form, and
c. project territory household size on the basis of time trends,

but I doubt that EUA's data is good enough to support such a time trend. Most of the data are estimates, since the population is only counted every five or ten years, and unknown, varying numbers of master-metered apartments (and conversions to single meters) further obscure the

agree with the results of a trend analysis on consistent, recent data, and will presumably wish to avoid this method in the future.

If EUA chooses the alternative of basing its household projection on national projections, it should take care to accurately copy the projected trend, as well as the final result. EUA was not so careful in its past "modelling" of Brockton family size on the trends for Blackstone and Fall River (Chernick, 1980, p. 5).

Q: Do you have any other comments regarding family size?

A: Yes. If EUA does believe that the future households in its service territories will be smaller than current households, energy use per customer should be projected to decrease accordingly (Chernick, 1980, pp. 21-22).

Q: What are the consistency problems to which you referred?

A: EUA estimates that energy use per customer for electric space heating and water heating has declined dramatically in the post-embargo period (Chernick, 1980, pp. 17-20), yet these changes are not extrapolated into the future. Some of EUA's crucial Base Use calculations are based on the assumptions that space and water heat use have been falling, that appliance saturations have remained constant since 1975, and that appliance efficiencies have not changed. Yet the forecast in which the Base Use projections are used assumes the opposite: no change in

water heat average use, an increase in space heat average use, increasing applicance saturations, and appliance efficiencies which have changed since 1972. (The last assumption is only partially implemented, as I will explain.)

These inconsistencies are problematic for two reasons. First, by projecting that average usage will stop falling, EUA is simply assuming away further conservation. Second, the Base Use projection is artificially inflated, compared to other elements of the forecast, because of the assumptions about average use and saturations in the Base Use derivation, and perhaps deflated by the appliance efficiency assumptions. (See Chernick, 1980, pp. 22-24).

Q: What are the inconsistencies between short-term and long-term projections to which you referred?

A: EUA projects penetrations, saturation increases, conversion rates, Base Use growth, unforeseen appliance growth, and the decrease in Brockton family size, to be small (in some cases zero) in the next couple of years, but then to rapidly increase in the mid-to late- 1980's. (See Chernick, 1980, pp. 7-9, for some examples.) As a result, in the near future, about which EUA may have more reliable information (see Exh. M-76, D.P.U. 20055, p.15) and in which EUA will be held responsible for this forecast, growth is slow; in the late 1980's, it is considerably faster.

In general, EUA's support for these differences are minimal. The low short-term Base Use growth was selected to make the forecast more reasonable (Exh. M-76, p. 15). EUA does not say why the higher growth rates are plausible past 1980. No real justification is given for the inconsistencies in most of the appliance parameters, but EUA does argue that increases in fossil fuel prices will make electricity "more desirable". I discussed a few flaws in this reasoning in D.P.U. 20055 (Chernick, 1980, pp. 10-11), but I will concentrate here on the most important problem in terms of EUA's behavior.

At present, the promotional rate structures (declining blocks, preferential rates for space heating customers) of EUA's retail companies encourage the use of electricity in applications for which direct fossil heat is simply more efficient. What EUA's forecasters are suggesting is that New England burn about 3 BTUs of oil to supply additional electricity, so that homeowners will burn one BTU less of oil. EUA rate designers are encouraging the wasteful use of oil-fired electricity, and EUA's forecasters are assuming they will succeed.

It is important to recognize that EUA is in a position to plan sales as well as predict them. If a utility wants to encourage energy waste, it will find ways to do so. If a utility wishes to promote energy efficiency, it

can do that too. It is likely that, in the next few years, the regulatory system will start to eliminate the most wasteful aspects of EUA's energy policy. It would be vastly preferable if EUA were to change its energy policy on its own, to replace utility-inspired waste with utility-inspired conservation, both in its forecast and in reality.

Q: How did EUA err in estimating the impact of appliance efficiency standards?

A: First of all, its basic assumptions are out of date. DOE had suggested tougher new standards on January 2, 1979 (Federal Register Vol. 44, p. 49). These were extended on December 13, 1979 (Federal Register Vol. 44, p. 72276), and tightened up still more on June 30, 1980 (Federal Register Vol. 45, p. 43976). See Chernick, 1980, pp. 14-16, for the 1979 proposals. The improvements between 1972 and 1988 will be much larger than the old DOE standards on which EUA's forecast is based.

Second, EUA seems to have assumed that the final regulations will be weaker than the old voluntary standards; in fact, DOE seems to be moving toward more exacting requirements with each new proposal.

Third, EUA assumes that 1978-80 appliances are already considerably more efficient than 1972 appliances. There have undoubtedly been some improvements in certain appliances (especially televisions, which EUA does not

model), but there is no evidence of the widespread efficiency gains EUA hypothesizes. Furthermore, EUA has incorrectly modelled the past improvements it assumes. In essence, EUA assumes that new appliances are already more efficient than the existing stock (with the effect of understating future appliance efficiency gains) but then neglects the improvements in efficiency as old appliances are replaced by new ones in 1980, and assumes that replacement appliances in 1981-1988 will be replacing current moderate-efficiency appliances, not the stock of old, inefficient appliances. EUA's errors in this regard seem to be caused by insufficiently clear modelling of the appliance stock. Perhaps EUA's forecasters would find it helpful to follow the structure of the NU forecasting model (as documented in 1978 and 1979), or of the ESRG model, both of which seem to have reasonably modelled this sector (which is not very difficult to do, since little more than bookkeeping is required).

In summary, I would recommend that EUA, in its next forecast, explicitly

a. state its expectation for DOE standards,
b. state its expectation for the effectiveness of those standards, if less than 100%,

c. state its best estimate of current appliance stock efficiency and new unit efficiency, and the source of those estimates, and

d. model new appliance efficiency and stock efficiency on an annual basis from the base year to the end of the forecast.

The current forecast fails to distinguish clearly between (b) and (c), and inconsistently models (d), greatly reducing the effect of appliance efficiency standards on the forecast.

Q: What comments would you like to make regarding New Developments?

A: There does not appear to be any valid reason for separating this category from Base Use. As I explained in some detail in D.P.U. 20055 (Chernick, 1980, pp. 26-29), the definition and justification of New Developments are confused and very weak.

EUA has never been able to provide a derivation of the magnitude or timing of the New Developments increments. If EUA cannot do a better job with New Developments (and I do not believe it can), it should discard the category and the concept.

The only plausible purpose for EUA to separate out New Developments from Base Use is that EUA wants to have small forecast growth in the early 1980s, and high forecast growth in the late 1980s. (See the discussion of short-

and long-term consistency, for other examples of this tendency in the EUA forecast.) Until EUA is able to accurately differentiate the various miscellaneous components of the residential sector (existing small appliances, lighting, such major appliances as TV's and dishwashers, new small and large appliance types, and just plain errors), no increase in accuracy is to be expected by arbitrarily selecting one hypothetical component and judgementally projecting it to increase rapidly near the end of the forecast. After all, EUA does not model the effect of decreasing demand for existing appliance types as they become fully saturated, nor the impact of more efficient lighting, nor the load reduction and capacity increase as photo voltaics become competitive with utility-generated power in the mid-to late-1980s.1/

Q: Can you describe the specification process for the commercial model, that is, how EUA selected the models used in the forecast?

A: No. EUA has never been able to explain:

a. what models (and data periods) were selected for examination, in what order, and why;

b. what criteria were used to screen specifications; and

c. why the final specifications are believed to be superior to the alternatives.

1/ DOE and its contractors are projecting that photovoltaics will be commercially competitive by 1985 or 1986. This seems no more speculative than the assumption that electric cars will be in widespread private use in the same period.

All EUA was able to do in D.P.U. 20055 was produce a small collection of regression runs, which indicated that certain specifications had been attempted for one service territory but not for another, and that some of the rejected specifications appeared to be superior to the accepted ones. In the case of customer number in Fall River, for which no suitable specification was identified, only one specification was attempted.

Again, as in the family size regressions, it appears that EUA's forecasters simply manipulated data periods and models until the desired forecast was obtained. This is not a legitimate use of regression analysis; after all, if enough analysts run enough data sets through enough specifications, they will eventually find one that support any preconception. It is very important that the specification process start with theoretically desirable models and data, and then proceed through a reasoned, deductive search for a suitable specification. If EUA's forecasters are not familiar with the documentation processs necessary to support an econometric model, perhaps the EFSC staff could arrange for a seminar on the subject. In fairness to EUA, other utilities' forecasters have also been unable to document their specification process.

Unless and until EUA is willing and able to apply regression techniques in a reasonable, thoughtful, and

consistent manner, it can not expect to produce an acceptable forecast using those techniques.

Q: Aside from EUA's inability to explain how it derived the commercial equations, are there other problems with the specifications.

A: Yes, several. These include:

1. Commercial customer number simply is not a useful forecasting concept (Chernick, 1980, p.30);
2. Customer Number and Average Use data are estimates, rather than values (ibid.). Trying to split commerical use into Average Use and Customer Number increases the sensitivity of the forecast to errors in the estimates;
3. The specifications utilized are inappropriate (Chernick, 1980, pp. 31-32). In particular, they are additive, and should be multiplicative;
4. Price is not reflected in any specification of average use;
5. Total population has no logical connection with average commercial use (ibid.);
6. Household size produces opposite signs for Blackstone and for Brockton; EUA seems to have made no effort to resolve this apparent contradiction;
7. No Fall River customer number equation was derived. It is not clear how EUA projected this factor.

Q: Is EUA's allowance for commercial conservation appropriate?

A: EUA's 20% energy reduction for new customers seems to be consistent with the effects of ASHRAE 90-75 standards. However, some existing customers will also be in new buildings by 1988, due to fire, demolition, or relocation. The BEPS program may also greatly increase building efficiency.

There are a whole host of other conservation measures, including increased appliance efficiency, Nola power controllers, solar water heating and passive space heating, and a variety of price induced effects. None of these are explicitly modelled, and EUA's 5% reduction of existing use does not seem to be adequate to capture them all.

Q: Please discuss the methodological problems with the industrial forecast.

A: There are four basic problems:

1. data is omitted arbitrarily;
2. the results for small Brockton customers are ignored;
3. 1979 growth rates are assumed to be more typical of the early 1980s than are the 1970-79 growth rates; and
4. to the extent that the forecast relies on any consistent methodology, it is based on extrapolating out a combination of 1970-79 average compound growth and 1978-79 growth.

The first three problems are described in my D.P.U. 20055 testimony (Chernick, 1980, pp. 32-35). The fourth problem is that the most basic one. Neither 1970-79 nor 1978-79 growth rates seem to be particularly relevant predictors of 1979-88 industrial sales. EUA has not attempted to relate industrial sales to national industrial output, industrial electric prices, or any other explanatory variables. The extrapolation of arbitrarily chosen growth rates (why not 1973-79? 1976-79?) is not a desirable forecasting technique.

Q: Please describe the errors in EUA's derivation of its peak forecast from its energy forecast.

A: EUA seems to be using the wrong peak temperature, as I discussed in D.P.U. 20055 (Chernick, 1980, p. 36). EUA apparently believe that the oil embargo made the temperature at peak lower (D.P.U. 20055, Exh. M-76, p. 21). If there is some rationale for this belief, EUA should present it.

EUA's methodology for estimating the impact of load management is not consistent with the set of load management measures EUA is trying to model. EUA wishes to model a variety of measures, including load controls on existing and new appliances in existing homes and businesses, controls of the appliances of new customers, and rate design. Specific options include time of use

rates, interruptible rates, storage heating, and various strategies for water heater control. EUA's "proxy" for this range of actions is an assumed penetration (30%) of storage space heating in the new residential electric heating market, and an equal effect in the commercial sector. At the very least, water heating control and the effects of TOU rates (especially for large commercial and industrial customers) can be modelled directly. It is not clear why EUA is not planning to require control of all new water heating and space heating, and to strongly encourage control of existing water and space heating, especially in light of the uncertainty in the in service dates of its nuclear units, and EUA's professed concern for oil price and availability in the late 1980s.

Q: What problems arise in EUA's wholesale forecast?

A: It is not at all clear that Montaup's unaffiliated wholesale customers expect to take the amounts of demand and energy EUA projects for them. MMWEC's forecast, presented on behalf of Middleboro, projects no contract demand from EUA past 1981. Pascoag is attempting to purchase 1.8 MW of Seabrook capacity, which should produce about 9500 MWH annually when it comes on line. Since neither Pascoag nor Newport provides forecasts to the EFSC, the best that EUA can expect to do is to layout a clear explanation of:

a. what the customer seems to be projecting for energy output, demand, and capacity;

b. how this translates into need for Montaup services, and

c. what services have been contracted for, and for what period.

The explanation should include the derivation of load factor, as well as peak demand. (The degree of detail justified for the Newport sales, which are nearly the size of Fitchburg G & E's total output, is clearly greater than that justified for the small Pascoag sale.)

For the sales to Middleboro, the situation is quite different. MMWEC's filing with the EFSC seems to contradict EUA's assumptions; the companies should make a joint statement clarifying the responsibility for meeting Middleboro's future demand. (It is also not clear that MMWEC and NU are consistent in their forecasting; the problem is not limited to EUA.)

Q: Is EUA's supply plan adequate?

A: No. As my testimony in D.P.U. 20055 indicates (pp. 55-84), the nuclear power plants in which EUA is participating will be very expensive. In fact, modifying Exh. M-65 in D.P.U. 20055 to reflect reasonable projections of nuclear costs and capacity factors results in the conclusion that, at EUA's assumed oil prices, it is cheaper to burn oil than to build Seabrook (A.G. Brief

20055, pp. 89-95). It is perfectly possible that EUA's forecast of the price of oil is too low, either for market prices or for social value, and that Seabrook is cheaper (for EUA, or its customers, or the United States) than oil.

But, if Seabrook is economically justified on the basis of oil substitution, and if Pilgrim 2, which will be even more expensive if it is ever completed, is so justified, than many other investments are also likely to be justified, including:

a. strict building and appliance efficiency requirements;
b. a variety of insulation and other conservation measures, implemented by grant, loan and subsidy programs;
c. restrictions on the use of electricity for space heating;
d. rate designs (e.g., inverted rates) to encourage conservation;
e. the termination of special promotional rates for selected uses of electricity;
f. cataloging of wind and cogeneration sites;
g. development of cogeneration, wind generation, and waste-fired generation;
h. offer of fair rates for power generated by small producers;
i. study of uses for the waste heat from the generating plants in Somerset (e.g., district heating);

j. attempts to restrict supply voltages to the minimum level required to meet customer requirements;

k. updated studies of coal conversion at Somerset;

l. promotion of solar water and space heating, through various subsidies, and

m. conversion of master-metered buildings to individual meters.

In some of the above instances, utility action is inherently crucial. In other cases, the utility can serve as a source of capital; as a resource assessor (if a particular wind, hydro or cogeneration site proves to be feasible, it should hardly matter to the utility whether it is developed by the utility, the municipality, or a private party); or as a price signaller, increasing the incentives (by rates and subsidiaries) for private conservation and development of alternatives until those incentives approximate the cost of new utility plants. It is important to realize that, even if EUA obtains a 5% interest in the Seabrook plant, and even if all the planned nuclear units are completed on schedule, EUA's nuclear capacity will be only 324 MW, or, at a 65% capacity factor, 1845 GWH annually. This is only half of EUA's current annual energy output requirements, and 37% of EUA's projected 1988 requirements. EUA lists no other non-oil fired capacity, either existing or planned, in its current forecast.

Therefore, EUA will remain primarily dependent on oil for the indefinite future, under its announced plans. It does not seem to be prudent to neglect so many promising alternatives for reducing oil use.