

CUB DT EXHIBIT # 1.1

**Illinois Commerce Commission
Docket No. 00-0361**

**Commonwealth Edison Company
Petition for Approval of a Revised
Decommissioning Expense Adjustment Rider.**

**NON-PROPRIETARY / PUBLIC VERSION
Proprietary material has been deleted.**

Direct Testimony and Exhibits of

Bruce Edward Biewald

On Behalf of the

Citizens Utility Board & The City of Chicago

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Exhibit BEB-1	Resume of Bruce Edward Biewald
Exhibit BEB-2	Summary of ComEd Funding Proposal
Exhibit BEB-3	Summary of CUB/City Funding Proposal
Exhibit BEB-4	Calculation of After-Tax Return on Decommissioning Funds

1 **1. Qualifications**

2 **Q. State your name, occupation and business address.**

3 A. My name is Bruce Edward Biewald. My address is Synapse Energy
4 Economics, Inc., 22 Crescent Street, Cambridge, Massachusetts, 01238.

5 **Q. Please describe your current employment.**

6 A. I am President of Synapse Energy Economics, Inc., a consulting company
7 specializing in economic and policy analysis of electricity restructuring,
8 particularly issues of consumer protection, market power, stranded costs,
9 efficiency, renewable energy, environmental quality, and nuclear power.

10 **Q. What are your qualifications in the fields of electric utility regulation
11 and energy policy?**

12 A. I graduated from the Massachusetts Institute of Technology in 1981, where
13 I studied energy use in buildings. I was employed for 15 years at the Tellus
14 Institute, where I was Manager of the Electricity Program, responsible for
15 studies on a broad range of electric system regulatory and policy issues. I
16 have testified on energy issues in more than seventy regulatory proceedings
17 in twenty-four states, two Canadian provinces, and before the Federal
18 Energy Regulatory Commission. I have co-authored more than one
19 hundred reports, including studies for the Electric Power Research Institute,
20 the U.S. Department of Energy, the U.S. Environmental Protection Agency,
21 the Office of Technology Assessment, the New England Governors'
22 Conference, the New England Conference of Public Utility Commissioners,
23 and the National Association of Regulatory Utility Commissioners. My
24 papers have been published in the *Electricity Journal*, *Energy Journal*,
25 *Energy Policy*, *Public Utilities Fortnightly* and numerous conference
26 proceedings, and I have made presentations on the economic and
27 environmental dimensions of energy throughout the U.S. and
28 internationally. My resume is provided here as Exhibit BEB-1.

29 **Q. What is your experience specifically with regard to nuclear power plant
30 decommissioning?**

31 A. I have investigated, studied and testified on the topic of nuclear power plant
32 economics and decommissioning costs since 1982. I have testified on the
33 projected costs and funding of nuclear plant decommissioning in state
34 regulatory proceedings in Arizona, California, Illinois, Massachusetts, New
35 Hampshire, Pennsylvania, and Wisconsin. I have been invited to speak on
36 decommissioning by the National Association of State Utility Consumer

1 Advocates (NASUCA), and my papers on the subject have been published
2 in the Energy Journal and Public Utilities Fortnightly. I have compiled and
3 analyzed a database of nuclear plant decommissioning cost estimates that
4 were prepared by TLG Engineering, Commonwealth Edison's
5 decommissioning cost consultant in this case. In January, 1999, I
6 completed a report for Citizens Action Coalition Education Fund, Inc. and
7 Mullet & Associates on nuclear power plant economics, decommissioning,
8 and spent nuclear fuel disposal. I testified on behalf of Illinois CUB in
9 Illinois Commerce Commission Docket No. 99-0115 on decommissioning
10 costs. I have consulted with the US Department of Energy (DOE) on
11 nuclear decommissioning cost issues — specifically, I worked with the
12 Energy Information Administration of the DOE.

1 **2. Summary and Recommendations**

2 **Q. What is the purpose of your testimony in this case?**

3 A. I was retained by the Illinois Citizens Utility Board and the City of Chicago
4 to review and comment on Commonwealth Edison’s nuclear
5 decommissioning funding proposal in this proceeding. My testimony was
6 prepared in coordination with the testimony of Mr. David Schlissel, also
7 testifying in this case on behalf of the Citizens Utility Board and the City of
8 Chicago.

9 **Q. Please summarize your conclusions and recommendations.**

10 A. My key conclusions are the following:

11 ComEd proposes to collect from its customers about \$121 million each year
12 for six years to decommission its fleet of nuclear plants. ComEd promises
13 that it will not seek further collections after the six years of collections
14 expire. ComEd will place these collections in trust funds owned by Genco,
15 an affiliate of ComEd that will soon own the plants. ComEd currently
16 collects about \$90 million each year for decommissioning. Based upon past
17 collections and earnings on the funds, ComEd has already collected about
18 \$2.55 billion for decommissioning. Because of these past collections and
19 future decommissioning options, ComEd’s customers need not contribute
20 anything further towards decommissioning — thus, the decommissioning
21 rate should be zero, not \$121 million each year.

22 ComEd’s proposal changes the incentives for the Company to efficiently
23 decommission the plants. Under ComEd’s proposal, Genco would keep any
24 decommissioning funds that remain in the trusts after completion of all
25 decommissioning. Conversely, if the trusts become under-funded, Genco
26 would be required to make up the deficiency. This aspect of the proposal
27 follows the structure that I recommended in the 1999 decommissioning case
28 (ICC Docket No. 99-0115). This structure makes sense, in that it provides a
29 financial incentive for the owner of the plants to efficiently dismantle them.

30 ComEd’s testimony claims that the trusts are at risk of shortfall under
31 certain unfavorable contingencies. However, the risk of potential shortfalls
32 in the trusts given unfavorable contingencies has already been addressed to
33 some extent by TLG’s decommissioning estimate methodology — by the
34 inclusion of contingency factors in decommissioning cost estimates.
35 Further, many of the uncertainties identified by ComEd have the potential
36 to act in favor of reducing decommissioning costs as much as they might act
37 to raise decommissioning costs.

1 Certain “economies of scale” can be achieved in decommissioning because
2 of the ComEd/PECO merger. After the proposed ComEd/PECO merger,
3 the newly formed company will manage more than a dozen nuclear units.
4 According to AmerGen, a company that will be affiliated with ComEd after
5 the merger, savings of 23% can be achieved on decommissioning a plant
6 because of these economies of scale. Even if we assume only a 20% savings
7 in decommissioning costs for ComEd’s plants, ComEd will have a surplus
8 of \$680 million (year 2000 present value dollars) in decommissioning costs
9 — an amount that, by itself, would largely make further ComEd collections
10 unnecessary.

11 In addition, ComEd can delay the dismantlement of its plants and thereby
12 earn additional interest on the trust funds. Since ComEd assumes that the
13 interest rate on the trust funds will be higher than the cost escalation of
14 decommissioning (7.36% vs. 4.11% in the Base Case), the trust funds will
15 benefit substantially by any delay in the commencement of
16 decommissioning. The economic arguments in favor of delayed
17 dismantlement are clear; costs incurred in the future are more desirable than
18 costs incurred today. In fact, delayed dismantlement has been selected by
19 ComEd for Dresden 1 and Zion, ComEd’s closed nuclear plants. If we
20 assume only a twenty year delay to decommissioning the plants, the trusts
21 will have a surplus of about \$1.2 billion (year 2000 present value dollars) an
22 amount that, by itself, would make further ComEd collections unnecessary.
23 (See Exhibit BEB-2).

24 Finally, as detailed in David Schlissel’s testimony, the ComEd plants that
25 are still operating today are likely to receive twenty year license extensions
26 from the Nuclear Regulatory Commission. A twenty year life extension
27 will result in a surplus in the trusts of about \$1 billion (year 2000 present
28 value dollars) an amount that, by itself, would make further ComEd
29 collections unnecessary. (See Exhibit BEB-2).

30

31 **Q. Based upon these conclusions, what do you recommend?**

32 A. I recommend that the Commission modify the Company’s proposal.
33 Customers should not be required to pay for any additional
34 decommissioning costs in regulated rates, and rates to recover those
35 additional amounts would not be just and reasonable. In addition, the
36 Commission should ensure that the decommissioning funds already
37 collected are used only for legitimate decommissioning activities, and that
38 no money is removed from the trusts until decommissioning of ComEd’s
39 nuclear plants is completed.

1 **3. ComEd's Decommissioning Funding Proposal**

2 **Q. What is ComEd's current cost estimate to decommission the thirteen**
3 **nuclear units covered in the current proposal?**

4 A. According to the ComEd's witness Thomas S. LaGuardia, ComEd's plants
5 will ultimately require \$4.86 billion (1996 constant dollars) for radiological
6 decommissioning and an additional \$539 million (1996 constant dollars) in
7 non-radiological costs, or a total of \$5.4 billion (1996 constant dollars) to be
8 adequately decommissioned. The trusts currently hold about \$2.55 billion
9 (2000 dollars). To meet the cost of decommissioning, ComEd estimates
10 that the fund needs \$132,258,000 per year for the years 2001 through 2006.
11 Of this \$132 million, ComEd seeks \$120,933,300 per year from its
12 customers and it will contribute \$11,324,700 per year from
13 decommissioning funds it collected from customers prior to 1989. My
14 recommendation specifically requires ComEd to only contribute the \$11.3
15 million per year in previously collected funds, with customers contributing
16 nothing more to the trusts.

17 **Q. Do you think that the Company's proposal is in the public interest?**

18 A. Not without my modifications, but the proposal offers a framework for
19 decommissioning funding that has many benefits.

20 **Q. Please explain what you mean about the framework.**

21 A. In my testimony in ICC Docket No. 99-0115 I said:

22 ... the ultimate cost of decommissioning Zion, or any
23 other nuclear unit, will depend upon the regulatory
24 framework in which the decommissioning takes place.
25 If the owner of the plant is able to pass the cost
26 through to customers then there is little or no incentive
27 for cost control. Decommissioning could easily end up
28 costing far more than ComEd's current estimates. If an
29 appropriate incentive framework is put in place then
30 the Company will be more creative in finding
31 opportunities to control costs and decommission the
32 plant efficiently.

33 This point remains valid. ComEd's proposal in this docket places a limit on
34 customer contributions to decommissioning. After the six additional years
35 of customer payments to the decommissioning funds, ComEd would bear
36 the risk of under-funding. That is, with the Company's proposal, if the

1 funds under-perform, or if decommissioning costs more than anticipated,
2 then additional money from the Company would be required. On the other
3 hand, if the funds perform better than expected, or if decommissioning costs
4 less than currently anticipated, then the Company would keep the surplus. I
5 believe that this aspect of the Company's proposal – that the entity in the
6 best position to manage decommissioning costs has an incentive to
7 dismantle the plants efficiently – is an excellent step forward in
8 decommissioning policy.

4. Uncertainties Associated with Decommissioning Costs

Q. ComEd witness Randall L. Speck describes risks associated with estimating the cost of decommissioning. Can you address these risks?

A. Yes, in the Direct Testimony of Randall L. Speck potential financial uncertainties to decommissioning are discussed. These risks include: (1) DOE's failure to accept spent nuclear fuel for permanent disposal; (2) the availability and cost of low-level radioactive waste disposal; (3) changes in the scope of the required decommissioning work; (4) modifications to or reinterpretation of the regulations governing decommissioning; (5) normal inflation; and (6) poorer than expected performance by decommissioning fund investments.

Exhibits BEB-2 and BEB-3, as discussed in the subsequent pages of this testimony, describe the effects of many of the uncertainties discussed above.

Q. Please discuss the risks associated with the DOE's failure to accept spent nuclear fuel for permanent disposal.

A. If the DOE fails to accept spent nuclear fuel at Yucca Mountain or a comparable facility, ComEd may have to pay to store spent fuel until such a time when a disposal site is available. However, for reasons discussed in the testimony of David Schlissel in this case — mainly that Federal Courts have already found that the DOE is in breach of contract — this risk should not concern the ICC at this time.

Q. Please discuss the availability and cost of low-level radioactive waste disposal.

A. Low-level radioactive waste accounts for approximately 15 to 25% of the estimated costs of decommissioning a nuclear unit. Increases in the costs of low-level waste disposal will certainly increase the cost of decommissioning but it is not probable that it will double or triple estimates on its own. The estimates produced by TLG Services contain an average contingency factor of 23.05% for the most recent DECON estimates and 19.86% for the most recent SAFSTOR estimates. These contingency factors are included to account for the uncertainties presented in any estimate of future costs. When considering that low-level waste burial has been estimated to account for approximately 25% of decommissioning costs (according to ComEd¹), it would follow that even a doubling of these costs

¹ This figure is taken from a presentation produced by ComEd for the purposes of settlement discussions.

1 would raise decommissioning costs by around 25%. Exhibit BEB-2, Case 2
2 details the impact of a doubling of LLRW costs, which is a shortfall of \$725
3 million (2000 present value dollars).

4 All estimates produced by TLG Services for ComEd assume a \$364/ cu.ft.
5 waste burial charge, based on the completion of the Midwest Compact
6 (costs developed by Vance & Associates). ***
7
8

9

10 *** The ICC allows ComEd to use a 10% escalation rate for LLRW, or an
11 approximately 7.50% real rate of escalation. This would see LLRW burial
12 charges on the order of \$2,220 / cu.ft. (2000 constant dollars) when the
13 decommissioning of Braidwood 1 begins. ComEd's assumed rate of
14 escalation for total decommissioning costs (4.11%) is based on the ICC's
15 10% nominal escalation factor and seems generally reasonable. I believe
16 that the inclusion of a 23.05% contingency factor along with the
17 incorporated 10% LLRW escalation rate is sufficient to recognize the risks
18 associated with LLRW burial charges in this case.

19 **Q. Please discuss the effect of changes in the scope of the required**
20 **decommissioning work.**

21 A. The scope of work may not necessarily change to increase costs. Exhibit
22 BEB-2, Case 3 details the effects of inflating the contingency factor to 50%
23 and comparing it to a scenario where the contingency factor is removed
24 altogether. The result is a shortfall of \$635 million (2000 present value
25 dollars) for a 50% contingency factor to a surplus of \$670 million (2000
26 present value dollars) for a removal of any contingency factor. These
27 figures do not assume the contingency factor is designed to account for
28 changes in the scope of work, rather the manipulating of the contingency
29 factor serves as a convenient tool for illustrating the effects of cost changes.

30 **Q. Please discuss the effects of modifications to or reinterpretation of the**
31 **regulations governing decommissioning.**

32 A. The 23.05% contingency factors for DECON and 19.86% contingency for
33 SAFSTOR are specifically designed to account for such eventualities.
34 Regulations may be designed to alleviate the burden of decommissioning or
35 they may be tightened to inflate the costs of decommissioning. Concepts
36 such as "rubblization" are currently being discussed by the NRC as possible
37 alternatives the three standard decommissioning alternatives. In the case of

1 Maine Yankee, “rubblization” was projected to save 16% on the overall
2 costs of decommissioning by fixed-priced decommissioning bidder Stone &
3 Webster, who petitioned the NRC for acceptance of the idea. An analysis
4 was run on the effects of a 16% increase and decrease in decommissioning
5 costs. Exhibit BEB-2, Case 4 details the effect of the change, which sees a
6 shortfall of \$489 million (2000 present value dollars) for a 16% cost
7 increase and a surplus of \$436 million (2000 present value dollars) for a
8 16% cost decrease.

9 **Q. Please discuss the effect of “normal inflation” on the costs of**
10 **decommissioning.**

11 A. Based on his testimony, I assume Mr. Speck uses the term “normal
12 inflation” to refer to the escalation rate of decommissioning costs. The
13 escalation of decommissioning costs has been assumed to be 4.11% by
14 ComEd. ***

15
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19 ***It is worth noting that the owners of Vermont Yankee see
20 decommissioning costs escalating at 3.8%.

21 ***

22
23
24 ***I ran sensitivity cases based on an increase of the cost escalation rate to
25 5.11% and a decrease in the cost escalation rate to 3.11%. The result is a
26 shortfall of \$592 million (2000 present value dollars) for an increase of the
27 escalation rate versus a surplus of \$480 million (2000 present value dollars)
28 for a decrease of the escalation rate to 3.11%. Please see Exhibit BEB-2,
29 Case 5 for the presentation of these figures.

30 **Q. Please discuss the effects of poorer than expected performance by**
31 **decommissioning fund investments.**

32 A. ComEd’s use of an after-tax rate of earnings on its funds of 7.36% is
33 conservative and favors the Company. When using *Ibbotson, Stocks*,

1 *Bonds, Bills & Inflation Yearbook* to look at the historic performance of the
2 market over the last several decades, it is clear that an after-tax return
3 (assuming the same allocations as ComEd) of 8.11% could be more
4 appropriate. See Exhibit BEB-4 for the derivation of this figure. I feel that
5 7.36% is not an unfair assumption to use but in my opinion the probability
6 of a return greater than 7.36% is much more likely than a return less than it.

7 Further, there is an asymmetry in the sensitivity of the decommissioning
8 fund rate due to compounding. That is, a 1% increase in the earning rate
9 yields a much larger positive than a 1% decrease in the earnings rate yields
10 a negative. A sensitivity run assuming a 1% increase in return and a 1%
11 decrease in returns yielded the following results. A 1% increase in the
12 after-tax return on funds to 8.36% provides a surplus of \$380 million (2000
13 present value dollars), the resulting shortfall of a decrease in the after-tax
14 return on funds to 6.36% is \$310 million (2000 present value dollars).
15 Please see Exhibit BEB-2, Case 6 for the presentation of these figures.

16 **Q. Several of the “risks” identified by Mr. Speck point to the possibility of**
17 **higher decommissioning costs, could you comment generally on the**
18 **level of decommissioning costs?**

19 A. Yes, Mr. Speck specifically identified possible increases in LLRW disposal
20 costs, changes in scope, changes in regulations, and cost escalation as risk
21 factors related to decommissioning cost. AmerGen, a company that will be
22 a ComEd affiliate when the Unicom merger is complete, has indicated that
23 decommissioning will cost less than TLG estimates, and has identified
24 “economies of scale” as the key reason.

25 **Q. Please explain what you mean by “economies of scale” and how the**
26 **concept is relevant in this case.**

27 A. William Sherman of the Vermont Department of Public Service in VT PSB
28 Docket 6300, page 45 lines 7-21 and page 46 lines 1 and 2 states:

29 “VYNPC engaged TLG Associates to prepare a new,
30 site specific decommissioning estimate for Vermont
31 Yankee in 1999 which determined a cost for
32 decommissioning of \$499 million in December 1998
33 dollars. This compares with the previous Vermont
34 Yankee decommissioning estimate, prepared by TLG
35 Associates in 1994, of \$312 million (\$362 million in
36 1999 dollars). The latest estimate includes costs to
37 return the site to its original condition
38 (“greenfielding”) and costs for storage of spent nuclear

1 fuel until 2031. AmerGen has performed its own
2 estimate for decommissioning and believes it can
3 accomplish this same scope of work for
4 decommissioning for \$384 million (in 1999 dollars).
5 In his pre-filed testimony of November 30, 1999,
6 AmerGen Witness Hawthorne states, at 3-4,
7 “AmerGen has made its own, independent evaluation
8 of the costs and expenses of decommissioning and, if
9 the costs are higher than projected, AmerGen will bear
10 those costs. The final result of the decommissioning
11 will be the same as the existing owner has planned —
12 i.e., return of the site to “greenfield condition.”
13 According to Witness Hawthorne, “We acknowledge
14 that our estimate for this task is lower than the estimate
15 utilized by VYNPC. AmerGen intends to take
16 advantage of both synergies available to a large nuclear
17 operator and experience in achieving our
18 decommissioning goals in a more efficient manner than
19 was possible for or foreseen by VYNPC.”

20 By use of its AmerGen subsidiary, PECO is able to capture an “economy of
21 scale” in the nuclear decommissioning “market.” With one of Genco’s
22 parents being PECO it will enjoy the same economies of scale in the
23 decommissioning of the 13 units in question. The AmerGen estimate of
24 \$384 million (1999 constant dollars) is approximately 23% lower than the
25 \$499 million (December 1998 constant dollars) estimate produced by TLG
26 Services. When assuming a 20% reduction in disbursements from those
27 estimated by TLG services for the 13 nuclear units in question a \$680
28 million surplus is seen (2000 present value dollars).

1 **5. Funding Implications of Delayed Dismantlement**

2 **Q. ComEd witnesses Calvin Manshio and Randall L. Speck say that**
3 **Genco absorbs \$1 billion of decommissioning costs that would be borne**
4 **by customers, do you agree with this?**

5 A. No. ComEd’s witness Randall L. Speck states on page 3, lines 1 through 3
6 that, “... Genco assume approximately \$1 billion in currently estimated
7 decommissioning expenses that ratepayers would otherwise pay ...”
8 Further, ComEd’s witness Calvin Manshio states on page 3, lines 20
9 through 22 that, “... the proposal eliminates the need for annual regulatory
10 proceedings, granting customers the benefit of not paying about \$1 billion
11 in decommissioning costs ...” This claim is not substantiated or discussed
12 further in either testimony and in my view is not realistic. My assessment
13 of the uncertainties is that over-collection is much more likely than under-
14 collection due to the possibilities of delaying dismantlement, extending the
15 life of the units, achieving an economies of scale through the use of PECO
16 Energy’s AmerGen unit or any combination of these scenarios.

17 **Q. Please discuss the possibility of delaying dismantlement.**

18 A. I feel that a delay in the dismantlement of the units in question is highly
19 probable since they will be owned by a private company with substantial
20 incentives to delay the expenditure of funds on decommissioning. Under
21 ComEd’s proposal Genco will not be obligated to return excess
22 decommissioning funds to consumers. The understandable and logical
23 economic intent of any for profit corporation is to maximize profits. The
24 delaying of decommissioning expenditures is in line with this goal. In a
25 regulated environment, generators were able to collect funds from
26 ratepayers, use them for the purposes of decommissioning and then, under
27 regulation, return any excess funds to ratepayers by way of a rate reduction.
28 This scenario is changing. Private generating companies can not expect
29 ratepayers to pay to decommission. Generators are now themselves
30 responsible to pay for the burden of decommissioning. It makes only
31 logical and economic sense that a generator would pursue the most cost
32 effective method possible which will still satisfy applicable health and
33 safety regulations.

34 Deferring costs to a point much later into the future is an effective way of
35 reducing the net present value of costs. Decommissioning funds will have
36 additional time to accumulate earnings and expenditures will not occur until
37 a much later date. The analysis I ran assumes a 20 year delay in
38 dismantlement and is based upon the earnings estimates and escalation rates
39 provided by ComEd and the disbursements as provided by TLG Services in

1 their SAFSTOR estimates for each of the 13 units (excluding Dresden 1).
2 As displayed in Exhibit BEB-2, Base Case column 2, the net present value
3 of this scenario is approximately \$1.2 billion (year 2000 present value
4 dollars) assuming the proposed collections are accepted. This is saying that
5 Genco will have a windfall of \$1.2 billion. This is including a collection of
6 approximately \$700 million over the next six years from ratepayers. This
7 collection is not necessary under this scenario.

8 **Q. Please discuss the possibility of extending the life of ComEd's nuclear**
9 **units.**

10 A. It is probable that Genco will seek to extend the operational life of its
11 nuclear fleet according to the testimony of David Schlissel in this case. Mr.
12 Schlissel states the following on page 15, lines 6 through 19.

13 "I think that it is likely that the Company ultimately
14 will decide to apply to the NRC to extend the operating
15 lives of the Braidwood, Byron, and LaSalle stations:
16 (1) All four of the Braidwood and Byron units have
17 been strong performers since the units began
18 commercial operations; (2) the Company has recently
19 installed new steam generators at Braidwood Unit 1
20 and Byron Unit 1, which involved very expensive
21 modifications; (3) the Company has made significant
22 expenditures to improve the material condition and
23 operating culture at LaSalle and on restarting the two
24 LaSalle units from their multi-year outages; (4)
25 planned power uprates at Braidwood, Byron, and
26 LaSalle will further improve the economic viability of
27 each of these plants; and (5) the high prices at which
28 utilities have been able to sell electricity in the new
29 competitive markets."

30 Mr. Schlissel further testifies on page 13, lines 11-18 and page 14, lines 1-3
31 the following:

32 "I think that it is reasonable to expect that ComEd will
33 decide to submit an application to the NRC to extend
34 the operating lives of the Dresden and Quad Cities
35 plants for the following reasons: (1) each unit's
36 dramatically improved performance in recent years; (2)
37 the high prices for which utilities have been able to sell
38 electricity in the new competitive markets; (3) the
39 significant expenditures that ComEd has made and

1 continues to make on improving the material condition
2 and operating cultures at each of these plants,
3 including the installation of the 48 cooling towers at
4 Dresden that I have already discussed; and (4) the
5 relatively low cost of completing the license renewal
6 process.”

7 Life extension of the nuclear units defers the expenditures of
8 decommissioning and has a similar effect on the funding surpluses as did
9 delayed dismantlement without plant life extension (discussed above). The
10 net present value to Genco, including the proposed collections, of a 20 year
11 life extension of 10 of the 13 units in question (Dresden 1, Zion 1 and Zion
12 2 are not assumed to have life extensions) is approximately \$1 billion (year
13 2000 present value dollars). Again, this includes approximately \$750
14 million of rate-payer contributions. This collection is not necessary under
15 this scenario. Please see Exhibit BEB-2, Base Case column 3.

16 **Q. Please discuss the possibility of combining the delayed dismantlement**
17 **with life extension.**

18 A. It is reasonable to assume Genco will pursue one or both of these options
19 given its goal of maximizing profits for its share holders (or parent
20 corporation shareholders). With delaying dismantlement by 20 years after a
21 life extension of twenty years, large decommissioning fund surpluses are
22 produced. A surplus of \$1.8 billion is seen (2000 present value dollars)
23 through the combination of these options. The proposed collection of funds
24 is not necessary under this scenario. Please see the right most column of
25 Exhibit BEB-2.

26 **Q. Please explain the results in Exhibit BEB-3.**

27 A. BEB-2 examines the ComEd proposal in this case. BEB-3 presents the
28 CUB/CITY alternative proposal. The format of Exhibit BEB-3 is identical
29 to that of Exhibit BEB-2. The difference between the two tables is that in
30 Exhibit BEB-2 I have included the Company’s proposed collection of \$121
31 million per year for six years.

32 In Exhibit BEB-3, these collections are discontinued immediately. As the
33 chart indicates, the fund balances still show many very large surpluses,
34 particularly for the scenarios with delayed dismantlement and/or plant life
35 extension.

36 **Q. Are you recommending that the nuclear plants have their licenses**
37 **extended or their dismantlement deferred by twenty years post shut**

1 **down?**

2 A. No. License extension and the timing of dismantlement should both be
3 evaluated on their own merits at the appropriate time. My testimony is that
4 both seem reasonably likely at this time, particularly given ComEd's
5 proposed treatment of decommissioning costs. They should definitely be
6 considered in evaluating the risks and benefits of ComEd's proposal.

7 **Q. Have you reviewed the Hearing Examiner's Questions?**

8 A. Yes and the questions, which are applicable to my analysis (interrogatories
9 2 & 5) have been answered in the testimony given above. Interrogatory 2
10 asks what units I feel would be likely candidates for life extension and
11 interrogatory 5 asks what impact of the assumed life extensions would have
12 on the fund balance. Both issues were addressed in Section 5 above.

13 **Q. Does this conclude your testimony?**

14 A. Yes.

BENEFITS FOR UNICOM/EXELON
UNDER COMED'S CURRENT FUNDING PROPOSAL
 (Projected Trust Fund Surpluses After the Conclusion of Decommissioning
 in Billions of Year 2000 Present Value Dollars)¹

Scenario	Timing of Decommissioning			Delayed Dismantlement and Plant Life Extension
	Immediate Dismantlement	Delayed Dismantlement ²	Plant Life Extension ³	
1. Base Case⁴	0.0	1.2	1.0	1.8
2. Low Level Radioactive Waste				
2a. Doubling of LLRW Costs	(0.7)	1.1	0.4	1.8
3. Scope of Work Changes				
3a. 50% contingency factor	(0.7)	1.1	0.5	1.8
3b. Zero contingency factor	0.6	1.3	1.5	1.9
4. Regulatory Changes				
4a. 16% increase in costs	(0.5)	1.1	0.7	1.8
4b. 16% decrease in costs	0.4	1.2	1.4	1.8
5. Escalation Rate Changes				
5a. 5.11% escalation rate	(0.6)	0.5	0.3	1.1
5b. 3.11% escalation rate	0.5	1.7	1.5	2.2
6. Earnings Rate Changes				
6a. 6.36% earnings rate	(0.3)	0.4	0.4	0.7
6b. 8.36% earnings rate	0.3	2.4	1.9	3.7

Exhibit BEB-3

1 All scenarios include collection of \$132 million per year for six years (\$121 from customers and \$11 from ComEd), as proposed by ComEd.

2 The delayed dismantlement cases assume a 20 year "SAFSTOR" period.

3 The plant life extension cases assume a 20 year license extension for all units except the three units already shut down (Dresden 1, and Zion 1 and 2).

4 The base case scenario has a contingency factor of 23%, decommissioning cost escalation at 4.11%, and fund earnings at 7.36%. It is based upon ComEd's calculation provided in response to Question 11 of CUB's First Set of Data Requests.

**BENEFITS FOR UNICOM/EXELON
UNDER THE CUB/CITY FUNDING PROPOSAL**
(Projected Trust Fund Surpluses After the Conclusion of Decommissioning
in Billions of Year 2000 Present Value Dollars)¹

Scenario	Timing of Decommissioning			Delayed Dismantlement and Plant Life Extension
	Immediate Dismantlement	Delayed Dismantlement ²	Plant Life Extension ³	
1. Base Case⁴	(0.6)	0.5	0.3	1.1
2. Low Level Radioactive Waste				
2a. Doubling of LLRW Costs	(1.3)	0.4	(0.3)	1.1
3. Scope of Work Changes				
3a. 50% contingency factor	(1.2)	0.4	(0.2)	1.1
3b. Zero contingency factor	0.0	0.5	0.8	1.2
4. Regulatory Changes				
4a. 16% increase in costs	(1.1)	0.4	(0.1)	1.1
4b. 16% decrease in costs	(0.1)	0.5	0.7	1.2
5. Escalation Rate Changes				
5a. 5.11% escalation rate	(1.2)	(0.3)	(0.4)	0.4
5b. 3.11% escalation rate	(0.1)	0.9	0.8	1.5
6. Earnings Rate Changes				
6a. 6.36% earnings rate	(0.9)	(0.2)	(0.3)	0.2
6b. 8.36% earnings rate	(0.3)	1.4	1.1	2.7

Exhibit BEB-4

1 All scenarios exclude ComEd's proposed collection of \$121 million per year for six years.

2 The delayed dismantlement cases assume a 20 year "SAFSTOR" period.

3 The plant life extension cases assume a 20 year license extension for all units except the three units already shut down (Dresden 1, and Zion 1 and 2).

4 The base case scenario has a contingency factor of 23%, decommissioning cost escalation at 4.11%, and fund earnings at 7.36%. It is based upon ComEd's calculation provided in response to Question 11 of CUB's First Set of Data Requests.

Weighted After-Tax Rate of Return Derivation¹						
	S&P 500	U.S. Govt. Bonds	Mortgage Backed Securities	Corp Bonds	Tax-Exempt Bonds	Total
Non-Tax Qualified						
Tax Rate	35%	35%	35%	35%	N/A	
After-Tax Return	8.45%	3.64%	5.30%	3.97%	5.70%	
Allocation	58%	-	-	-	42%	
Overall After-Tax & Fees Earnings Rate						7.68%
Tax-Qualified						
Tax Rate	20%	20%	20%	20%	N/A	
After-Tax Return	10.40%	4.48%	6.50%	4.88%	5.70%	
Overall After-Tax & Fees Earnings Rate						8.21%
Weighted After-Tax Earnings Rate²						8.11%

1. All return figures from Ibbotson, Stocks Bonds Bills & Inflation 1998 Yearbook.

2. Assumes a 20% allocation to the non-tax qualified fund and an 80% allocation to the tax-qualified fund.

Exhibit BEB-1

Bruce Edward Biewald

President

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. President, 1996 to present. Consulting on issues of energy economics, environmental impacts, and utility regulatory policy, including electric industry restructuring, electric power system planning, performance-based regulation, stranded costs, system benefits, market power, mergers and acquisitions, generation asset valuation and divestiture, nuclear and fossil power plant costs and performance, renewable resources, power supply contracts and performance standards, green marketing of electricity, environmental disclosure, nuclear plant decommissioning and radioactive waste issues, climate change policy, environmental externalities valuation, energy conservation and demand-side management, electric power system reliability, avoided costs, fuel prices, purchased power availability and cost, dispatch modeling, economic analysis of power plants and resource plans, and risk analysis.

Tellus Institute, Boston, MA. Senior Scientist and Manager of the Electricity Program, 1989 to 1996. Responsible for research and consulting on all aspects of electric system planning, regulation, and restructuring.
Research Associate, later Associate Scientist, 1980 to 1988.

EDUCATION

Massachusetts Institute of Technology,
BS 1981, Architecture, Building Technology, Energy Use in Buildings.
Harvard University Extension School,
1989/90, Graduate courses in micro and macroeconomics.

SUMMARY OF TESTIMONY, PUBLICATIONS, AND PRESENTATIONS

Expert testimony on energy, economic, and environmental issues in nearly seventy regulatory proceedings in two Canadian provinces, twenty four States, and before the Federal Energy Regulatory Commission.

Co-author of more than one hundred reports, including studies for the Electric Power Research Institute, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the Office of Technology Assessment, the New England Governors' Conference, and the National Association of Regulatory Utility Commissioners.

Papers published in the Electricity Journal, the Energy Journal, Energy Policy, Public Utilities Fortnightly, and numerous conference proceedings.

Invited to speak by American Society of Mechanical Engineers, International Atomic Energy Agency, National Association of Regulatory Utility Commissioners, National Association of State Utility Consumer Advocates, National Consumer Law Center, the Latin American Energy Association (OLADE), the Swedish Environmental Protection Agency (SNV), the U.S. Environmental Protection Agency, and others.

RECENT TESTIMONY

California Public Utilities Commission (Docket 98-12-015) – July 2000

Ratemaking policy for distributed resources.

Arkansas Public Service Commission (Docket No. 00-048-R) – June 2000

Market power analysis and modeling.

Illinois Commerce Commission (Docket No. 99-0115) – September 1999

Review of ComEd's nuclear power plant decommissioning cost estimates.

West Virginia Public Service Commission (Case No. 98-0452-E-GI) – August 1999

AEP and Allegheny Power restructuring, market power, divestiture of generation, electric system market price modeling, statistical analysis of comparable sales, and responsibility for stranded costs and gains.

Mississippi Public Service Commission (Docket No. 96-UA-389) – August 1999

Review of Entergy Mississippi, Inc. and Mississippi Power Company stranded cost filings, divestiture of generation, statistical analysis of comparable sales, responsibility for stranded costs and gains.

Connecticut Department of Public Utility Control (Docket No. 99-03-36) – July 1999

Connecticut Light and Power Company standard offer service, market prices for electricity and the influence of market power, simulation analysis of the New England electricity market.

Connecticut Department of Public Utility Control (Docket No. 99-03-35) – July 1999

United Illuminating Company standard offer service, market prices for electricity and the influence of market power, simulation analysis of the New England electricity market.

Utah Public Service Commission (Docket No. 98-2035-04) – June 1999

Cost savings expectations for the proposed merger of PacifiCorp and Scottish Power.

Washington Utilities and Transportation Commission (Docket No. UE-981627) – June 1999

Cost savings expectations for the proposed merger of PacifiCorp and Scottish Power and assessment of whether the merger is in the public interest.

Federal Energy Regulatory Commission (Docket Nos. EC98-40-00, et al.) – April 1999

Horizontal market power and barriers to entry in consideration of the proposed merger of American Electric Power Company and Central and South West Corporation.

Connecticut Department of Public Utility Control (Docket No. 99-03-04) – April 1999

Market power, market prices, and simulation modeling as related to the application of United Illuminating Company for recovery of stranded costs.

Connecticut Department of Public Utility Control (Docket No. 99-02-05) – April 1999

Market power, market prices, and simulation modeling as related to the application of Connecticut Light & Power Company for recovery of stranded costs.

Maryland Public Service Commission (Case No. 8797) – January 1999

Simulation analysis of the ECAR market and projected market prices for electricity for estimation of Potomac Electric Company's stranded generation costs and unbundled rates.

Maryland Public Service Commission (Case No. 8795) – December 1998

Simulation analysis of the PJM market and projected market prices for electricity for estimation of Delmarva Power and Light Company's stranded generation costs and unbundled rates.

Maryland Public Service Commission (Cases Nos. 8794 and 8804) – December 1998

Simulation analysis of the PJM market and projected market prices for electricity for estimation of Baltimore Gas and Electric Company's stranded generation costs and unbundled rates.

Vermont Public Service Board (Docket No. 6107) – September 1998

Excess capacity, used & useful, and the economics of Green Mountain Power's purchase from Hydro Quebec.

Mississippi Public Service Commission (Docket No. 96-UA-389) – September 1998

Analyses of market concentration and market power, behavior of affiliated companies, need for an independent system operator.

California Public Utilities Commission (Application No. 97-12-020) – July 1998

Nuclear power plant decommissioning and radioactive waste disposal. Also, rebuttal testimony in August.

Federal Energy Regulatory Commission (Docket No. EC97-46-000) – June 1998

Affidavit on market power implications of the proposed merger between Allegheny Power System and Duquesne Light Company.

New Jersey Board of Public Utilities (Docket Nos. EX4120585Y, EO97070460, and EO97070463) – March 1998

Economic and environmental benefits of energy efficiency, including estimation of marginal air emissions from the PJM System. (Joint testimony with Nathanael Greene, Edward Smeloff, and Thomas Bourgeois.)

Vermont Public Service Board (Docket No. 6018) – February 1998

Excess capacity and the economics of Central Vermont Public Service Company's purchase from Hydro Quebec.

Public Service Commission of Maryland (Case No. 8774) – February 1998

Market power implications of the APS-DQE merger.

Federal Energy Regulatory Commission (Docket Nos. OA97-237-000 and ER97-1079-000) – January 1998

Market power in New England electricity markets.

British Columbia Utilities Commission – November 1997

British Columbia Hydro and Power Authority Wholesale Transmission Services Application.

Pennsylvania Public Utility Commission (Docket R-00973981) – November 1997

West Penn Power Company Restructuring Plan. Environmental disclosure, consumer education, and allocation of default customers.

Pennsylvania Public Utility Commission (Docket R-00974104) – November 1997

Duquesne Light Company Restructuring Plan. Environmental disclosure, consumer education, nuclear decommissioning, and allocation of default customers. Also surrebuttal testimony in December 1997.

Mississippi Public Service Commission (Docket No. 97-UA-496) – November 1997

Petition of Mississippi Power Company for a Certificate of Public Convenience and Necessity Authorizing Construction of a Generating Plant in Jackson County.

Pennsylvania Public Utility Commission (Docket Nos. R-00973953 and P-00971265) – November 1997

Application of PECO Energy Company for approval of its restructuring plan and petition on Enron Energy Services Power, Inc. for approval of an electric competition and customer choice plan. Allocation of default customers.

Vermont Public Service Board (Docket No. 5983) – October 1997

Excess capacity and the economics of Green Mountain Power Company's purchase from Hydro Quebec. Also rebuttal testimony in December 1997 and supplemental rebuttal testimony in January 1998.

Pennsylvania Public Utility Commission (Docket No. R-00973953) – September 1997

Joint petition for partial settlement of PECO Energy Company's proposed restructuring plan and application for a qualified rate order. Environmental disclosure, nuclear decommissioning and spent fuel.

Pennsylvania Public Utility Commission (Docket No. R-00974009) – September 1997

Pennsylvania Electric Company's Restructuring Plan. Environmental disclosure, customer education, and nuclear issues.

Pennsylvania Public Utility Commission (Docket No. R-00974008) – September 1997

Metropolitan Edison Company's Restructuring Plan. Environmental disclosure, customer education, and nuclear issues.

Indiana Legislature, Regulatory Flexibility Committee -- September 23, 1997.

Testimony on "Electric Industry Restructuring To Benefit Consumers and the Environment: Stranded Costs, Nuclear Issues, and Air Emissions."

Pennsylvania Public Utility Commission (Docket No. R-00973954) – June 1997

Pennsylvania Power & Light Company's Restructuring Plan. Environmental disclosure, customer education, PJM market structure, nuclear decommissioning and spent fuel, rate design for stranded cost recovery. Also, surrebuttal testimony in August.

Pennsylvania Public Utility Commission (Docket No. R-00973953) – June 1997

PECO Energy Company's Restructuring Plan. Environmental disclosure, PJM market structure, nuclear decommissioning and spent fuel.

New York Public Service Commission (Case 96-E-0897) -- April 1997

Consolidated Edison Company's Plans for Electric Rate Restructuring. Analysis of market power in the New York City load pocket.

Pennsylvania Public Utility Commission (Docket No. R-00973877) -- February 1997

Application of PECO Energy Company for Issuance of a Qualified Rate Order. Nuclear power plant decommissioning costs, stranded cost recovery, and securitization.

For a list of testimony prior to 1997 please see www.synapse-energy.com.

RECENT REPORTS

Electricity Market Distortions Associated With Inconsistent Air Quality Regulations, by Tim Woolf, Bruce Biewald, and David White for the Project for Sustainable FERC Energy Policy, November 18, 1999.

Avoided Energy-Supply Costs for Demand-Side Management Screening in Massachusetts, a Resource Insight report for the AESC Study Group, by Rachel Brailove, Paul Chernick, Susan Geller, Bruce Biewald, and David White, July 7, 1999.

Comments on the Scope of Issues for FERC Staff's Environmental Assessment of the Proposed Rule on RTOs by the Project for Sustainable FERC Energy Policy on behalf of Multiple Parties, prepared by Terry Black and Bruce Biewald, June 14, 1999.

Stranded Nuclear Waste: Implications of Electric Industry Deregulation for Nuclear Plant Retirements and Funding for Decommissioning and Spent Fuel, by Bruce Biewald and David White, January 15, 1999.

New England Tracking System, a report to the New England Governors' Conference, Inc., funded by a grant from the U.S. Environmental Protection Agency, prepared with Environmental Futures, Inc. and Tellus Institute, October 1998.

The Role of Ozone Transport In Reaching Attainment in the Northeast: Opportunities, Equity and Economics, a Synapse Energy Economics report for the Northeast States for Coordinated Air Use Management, by Tim Woolf, David White, Bruce Biewald, and William Moomaw, July 1998.

Competition and Market Power in Northern Maine Electricity Market, a Synapse Energy Economics report for the Maine Public Utilities Commission, by Tim Woolf, Bruce Biewald, and Duncan Glover, November 24, 1998.

Grandfathering and Environmental Comparability: An Economic Analysis of Air Emission Regulations and Electricity Market Distortions, a Synapse Energy Economics report for the National Association of Regulatory Utility Commissioners, by Bruce Biewald, David White, Tim Woolf, Frank Ackerman, and William Moomaw, June 11, 1998.

Analysis of Market Power in the APS and Duquesne Service Territories, prepared for the Maryland Office of People's Counsel, by Bruce Biewald and David White, February 9, 1998.

Performance-Based Regulation in a Restructured Electric Industry, a Synapse Energy Economics report for the National Association of Regulatory Utility Commissioners, by Bruce Biewald, Tim Woolf, Peter Bradford, Paul Chernick, Susan Geller, and Jerrold Oppenheim, November 8, 1997.

Massachusetts Electric Utility Stranded Costs, a Synapse Energy Economics report for MASSPIRG, Union of Concerned Scientists, Clean Water Action, Massachusetts Citizens for Safe Energy, and Public Citizen, by Bruce Biewald, Tim Woolf, and Marc Breslow, November 4, 1997.

Horizontal Market Power in New England Electricity Markets: Simulation Results and a Review of NEPOOL's Analysis, prepared for the New England Conference of Public Utility Commissioners, by Bruce Biewald, David E. White, and William Steinhurst, June 11, 1997 (a draft was published as Vermont DPS Technical Report No. 39 in March, 1997).

Zero Carbon Electricity: The Essential Role of Efficiency and Renewables in New England's Electricity Mix, a Tellus Institute report for the Boston Edison Company Settlement Board, by Bruce Biewald, Tim Woolf, Bill Dougherty, and Daljit Singh, April 30, 1997.

Full Environmental Disclosure for Electricity: Tracking and Reporting Key Information, a Regulatory Assistance Project report funded by the Pew Charitable Trusts, the Joyce-Mertz Gilmore Foundation, the U.S. EPA, and the U.S. DOE, by David Moskovitz, Tom Austin, Cheryl Harrington, Bruce Biewald, David E. White, and Robert Bigelow, March 1997.

Restructuring the Electric Utilities of Maryland: Protecting and Advancing Consumer Interests, for the Maryland People's Counsel, by Paul Chernick, Jonathan Wallach, Susan Geller, John Plunkett, Roger Colton, Peter Bradford, Bruce Biewald, and David Wise, February 20, 1997.

Sustainable Electricity for New England: Developing Regulatory and Other Governmental Tools to Promote and Support Environmentally-Sustainable Technologies in the Context of Electric Industry Restructuring, a report to the New England Governors' Conference, by Bruce Biewald, Max Duckworth, Gretchen McClain, David Nichols, Richard Rosen, and Steven Ferrey, Tellus No. 95-310, January 1997.

For a list of reports prior to 1997 please see www.synapse-energy.com.

RECENT PAPERS

Follow the Money: A Method for Tracking Electricity for Environmental Disclosure, Bruce Biewald, David White, and Tim Woolf, *The Electricity Journal*, May 1999.

Book Review of "U.S. Utility Mergers and the Restructuring of the New Global Power Industry," in *Energy*, October 1998.

“Implications of Premature Nuclear Plant Closures: Funding Shortfalls for Nuclear Plant Decommissioning and Spent Fuel Transportation and Storage,” Bruce Biewald and David White, prepared for the United States Association for Energy Economics and International Association for Energy Economics, 19th Annual North American Conference, Albuquerque, NM, October 1998.

“Efficiency, Renewables and Gas: Restructuring as if Climate Mattered,” Tim Woolf and Bruce Biewald, *The Electricity Journal*, January/February 1998.

“Green Electricity: Tracking Systems for Environmental Disclosure,” B. Biewald and J.A. Ramey, proceedings of WINDPOWER '97, the American Wind Energy Association's annual conference in Austin, Texas, forthcoming.

“Competition and Clean Air: The Operating Economics of Electricity Generation,” *The Electricity Journal*, January/February 1997.

For a list of papers prior to 1997 please see www.synapse-energy.com.

RECENT PRESENTATIONS

(Note: Presentations that were accompanied by a written paper are listed in the section for “papers,” above.)

Presentation on “How Green is Green? Verifying Energy Advertising Claims,” at the New England Conference of Public Utility Commissioners Symposium, Bretton Woods, New Hampshire, May 25, 1999.

Presentation on “Consumer Perspectives on Market Power – Case Studies from New England, New York, PJM, and Mississippi,” IBC Conference on Market Power, Washington DC, May 24, 1999.

Presentation on “Grandfathering and Environmental Comparability,” at the National Association of Regulatory Utility Commissioners 1998 Summer Committee Meetings, Seattle, July 26, 1998.

Presentation on “Tracking Electricity in the New England Market,” at the National Association of Regulatory Utility Commissioners 1998 Summer Committee Meetings, Seattle, July 26, 1998.

Presentation on “Tracking Electricity in the New England Electricity Market,” at the National Council on Competition and the Electricity Industry National Executive Dialogue on Customers' Right to Know, Chicago, May 13, 1998.

Presentation on “Comparable Environmental Regulations in a Restructured Electricity Industry: The Grandfathering Effect,” National Association of Regulatory Utility Commissioners meeting in Washington, D.C., March 1, 1998.

Presentation on “Market Power in Electricity Generation,” National Consumer Law Center Conference, Washington, D.C., February 9, 1998.

Presentation on “Electricity Market Power in New England,” Massachusetts Electric Industry Restructuring Roundtable, Boston, December 15, 1997.

Presentation on wind power development and air quality, National Wind Coordinating Committee New England Wind Issues Forum, Boston, November 7, 1997.

Invited speaker on market power, National Association of State Utility Consumer Advocates meeting in Boston, November 12, 1997.

Presentation on “Distortions to Future and Current Competitive Electric Energy Markets Due to Grandfathering Environmental Regulations of Electric Power Plants,” National Association of Regulatory Utility Commissioners meeting in Boston, November 9, 1997.

Presentation on “Electric Industry Restructuring as if the Environment Mattered,” Boston Area Solar Energy Association, October 9, 1997.

Invited speaker on “Modeling Market Power in Electricity Generation,” National Association of Regulatory Utility Commissioners meeting in San Francisco, July 22, 1997.

Presentation on “Performance-Based Regulation in a Restructured Electric Industry,” National Association of Regulatory Utility Commissioners meeting in San Francisco, July 20, 1997.

Presentation on “State Initiatives and Regional Issues,” New England Governors’ Conference Workshop on Restructuring and Environmentally Sustainable Technologies, Warwick, Rhode Island, March 25, 1997.

For a list of presentations prior to 1997 please see www.synapse-energy.com.
