

Environmentalists' Statement No. 2

**Before the
Pennsylvania Public Utility Commission**

**Pennsylvania Power & Light Company
Restructuring Plan**

**Testimony and Exhibits of
Bruce Edward Biewald**

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- Exhibit BEB-1 Resume of Bruce Edward Biewald
- Exhibit BEB-2 Graph of TLG Decommissioning Estimates: 1977 to 1995.
- Exhibit BEB-3 *Full Environmental Disclosure for Electricity: Tracking and Reporting Key Information*, March 1997.

1. Qualifications

Q: State your name, occupation and business address.

A: My name is Bruce Edward Biewald. My address is Synapse Energy Economics, Inc., 101 Chilton Street, Cambridge, Massachusetts, 01238.

Q. Please describe your current employment.

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

Q. What are your qualifications with regard to energy policy?

A. I graduated from the Massachusetts Institute of Technology in 1981, where I studied energy use in buildings. I was employed for 15 years at the Tellus Institute, where I was Manager of the Electricity Program, responsible for studies of electric system operation and planning, regulatory policy and industry restructuring, stranded costs, system benefits, market power, nuclear and fossil power plant costs and performance, renewable resources, power supply contracts and performance standards, nuclear plant decommissioning and radioactive waste issues, climate change policy, environmental externalities valuation, energy conservation and demand-side management, rates and fuel adjustment clause analysis, electric power system reliability, avoided costs, fuel prices, purchased power availability and cost, production costing modeling, economic analysis of power plants and resource plans, and risk analysis.

I have testified on these issues in more than thirty five cases in regulatory proceedings in eighteen states and two Canadian provinces.

I have co-authored approximately 80 reports including studies for the Electric Power Research Institute, the U.S. Department of Energy, U.S. Environmental Protection Agency, the Office of Technology Assessment, the New England Governors' Conference, the New England Conference of Public Utility Commissioners, and the National Association of Regulatory Utility Commissioners. My papers have been published in the Electricity Journal, Energy Journal, Energy Policy, Public Utilities Fortnightly and numerous conference proceedings, and I have made presentations on the economic and environmental dimensions of energy throughout the U.S. and internationally. My resume is provided here as Exhibit BEB-1.

Q. What is your experience with regard to environmental disclosure for electricity?

A. I have analyzed the issue on behalf of the Vermont Department of Public Service and

the Regulatory Assistance Project. The paper that I coauthored for RAP on environmental disclosure is provided here as Exhibit BEB-3. I have also made presentations on this issue at workshops sponsored by the Center for Clean Air Policy, the Energy Foundation, and the American Wind Energy Association.

Q. What was your role in preparing the report provided as Exhibit BEB-3?

A. Synapse Energy Economics worked as a contractor to the Regulatory Assistance Project. I was involved in conceptualizing the issues, preparing drafts, editing the entire report, and finalizing it. I am prepared to answer questions about any aspect of the report.

Q. What is your experience with regard to market power?

A. I have analyzed electricity market power issues in New York and New England. I testified on market power in the New Hampshire restructuring docket on behalf of the Consumer Advocate, and in the Vermont restructuring docket on behalf of the Department of Public Service. I also testified on market power in Consolidated Edison's restructuring case on behalf of the City of New York. I have conducted a study of market power in the New England Power Pool for the New England Conference of Public Utility Commissioners.

Q. What is your experience specifically with regard to nuclear decommissioning costs?

A. I have investigated, studied and testified on the topic of nuclear power plant economics and decommissioning costs since 1982. I have testified on the projected costs and funding of nuclear plant decommissioning in state regulatory proceedings in Arizona, California, New Hampshire, and Wisconsin. I have been invited to speak on decommissioning by the National Association of State Utility Consumer Advocates (NASUCA), and my papers on the subject have been published in the Energy Journal and Public Utilities Fortnightly. I have compiled and analyzed a database of nuclear plant decommissioning cost estimates that were prepared by TLG Engineering, PP&L's decommissioning consultant in this case. A graph of that data is presented in Exhibit BEB-2.

Q. Has your testimony served as the basis for regulatory commission decisions?

A. Yes. The Michigan Public Service Commission has adjusted Consumers Power Company and Detroit Edison Company projections of power costs based upon my projections of fuel costs, purchased power costs and sales revenues. The Massachusetts Department of Public Utilities adopted the set of monetary values for air pollutants recommended in my testimony. The California Public Utilities Commission adjusted a TLG Engineering, Inc. estimate of nuclear decommissioning costs by approximately

\$100 million, based upon my testimony. In addition, my recommendations have been reflected in several settlement agreements in cases on excess capacity, avoided costs and power plant performance.

2. Summary and Recommendations

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

A. I was retained by the parties to this case collectively known as "The Environmentalists" to comment on (1) environmental disclosure for electricity, (2) PJM market issues, (3) nuclear plant decommissioning costs, and (4) rate design for stranded cost recovery. What the Environmentalists envision for the market is that:

- customers will be well informed of their generation options, including price, risk and environmental attributes,
- "clean electricity" options in which customers can make a real and positive change to the region's resource mix will be developed and marketed effectively,
- a robust wholesale market will develop in which smaller companies will compete on fair terms with larger companies, and all customers will have an opportunity to benefit,
- nuclear plant decommissioning will be adequately funded to provide assurance of the availability of funds for eventual plant dismantlements,
- nuclear plant decommissioning costs will be managed carefully and shared equitably,
- any stranded cost recovery that is allowed should be recovered fairly, with all customers bearing their share of the burden.

My testimony should also be considered in conjunction with that of David Schoengold and Peter Bradford who are presenting the Environmentalists' perspective on other issues in this docket.

Q. Please summarize your conclusions and recommendations with regard to environmental disclosure for electricity and consumer education.

A. The Commission should require all retail electricity suppliers selling in Pennsylvania to disclose their fuel mix and key air and other waste emissions to consumers in a standard and easy to comprehend label. Disclosure should be mandatory for all suppliers. The tracking of transactions to support disclosure and labeling should be done by the Independent System Operator. These requirements should apply to PP&L.

I recommend that a set of objectives be adopted to guide the design and implementation of a fuel mix and environmental disclosure system. Specifically, the system should be effective, accurate, comprehensive, flexible, simple, expandable, inclusive and credible. It is essential that the system be created in such a way that customers who pay more for clean electricity actually make a difference to the resource mix.

A comprehensive program of consumer education on the environmental effects of electricity production and use should be implemented to complement disclosure. The Company and the Commission should include the Environmentalists and other interested parties in the process of developing and reviewing consumer education plans and

materials.

Disclosure and consumer education issues are discussed in Section 3 of my testimony, below.

Q. Please summarize your conclusions and recommendations with regard to PJM issues.

A. Undue vertical and horizontal market power can be obstacles to the development of competitive electricity markets. Vertical market power can best be addressed by establishing a strong and independent system operator for the transmission system, and by separating the distribution function as much as possible from generation. Horizontal market power in wholesale electricity markets may require limits on the ownership of capacity in the region. I recommend that the Commission take a strong position on these issues, and coordinate with the other PJM states. PJM market issues are discussed in Section 4 of my testimony.

Q. Please summarize your conclusions and recommendations with regard to nuclear decommissioning costs.

A. My key points on the treatment of nuclear decommissioning costs in this case are the following:

- The currently approved annual cost amount for PP&L's nuclear decommissioning obligations is about \$9.5 million per year (Kleha direct testimony, page 15).
- PP&L has suggested that nuclear decommissioning costs be collected in the CTC and that the CTC be extended "beyond the nine-year window provided by the Act to permit recovery of its nuclear decommissioning costs over the remaining life of the Susquehanna generating plant" (Kleha direct testimony, page 14).
- PP&L has not demonstrated mitigation of the nuclear decommissioning portion of its stranded costs.
- PP&L's nuclear decommissioning cost obligation is currently estimated by the Company to be \$724 million in 1993 dollars (PP&L Response to Interrogatories of the Environmentalists, Set 3, Attachment 1, page 4). This amount is large, very uncertain, and to some extent within the control of the plant owner.
- PP&L's nuclear decommissioning consultant, Mr. Tom LaGuardia, has been estimating decommissioning costs for 20 years. Even after adjusting for inflation, his recent estimates are roughly six times his 1976 cost estimate for dismantling a large pressurized water reactor, and the average annual rate of escalation in his estimates has out paced inflation by about 10 percent per year over the past two decades (see Exhibit BEB-2).
- Costs can, to some extent, spill over between nuclear decommissioning and the costs of operation and the costs of spent fuel disposal.
- There are currently important uncertainties about nuclear decommissioning related

to the policies of the Internal Revenue Service and the Nuclear Regulatory Commission.

- It is difficult to make a specific plan now for nuclear decommissioning costs are so uncertain and they will be incurred so far in the future.
- The principles that should guide sound nuclear decommissioning policy are: (1) **assurance** that adequate funds will be available to decommission the plants in a safe and timely manner, (2) **equity** between customers and shareholders, and across generations, and (3) **efficiency**, primarily provided by creating a framework in which the plant operator has an appropriate incentive to control the costs of the decommissioning project.

I recommend the following with regard to nuclear decommissioning costs:

- PP&L should be required to update its 1993 nuclear decommissioning cost study.
- For any additional costs for decommissioning that PP&L is allowed to recover through the CTC or to include in its stranded cost calculations, PP&L should be required to demonstrate that it will -- and has -- placed the funds into its external decommissioning fund.
- The Commission should require an adequate plan from PP&L for the mitigation of its decommissioning costs.
- Procedures should be put in place to ensure that the plant is operated in such a way that the decommissioning cost obligation is not increased.
- PP&L should be responsible for some portion of any decommissioning costs in excess of current projections, and responsible for all excess costs not demonstrated to be prudently incurred.
- In the event that decommissioning costs less than expected, customers should receive an appropriate refund.
- The Commission should address the complicated technical and policy issues of nuclear decommissioning in a generic case, in which limited regulatory resources can be used efficiently and a consistent policy can be developed that does not unfairly disadvantage one company relative to another.
- The Commission should carefully weigh the costs, benefits, and risks before assigning nuclear decommissioning to the wires business. It should consider the problems that occurred in the past when cost-based regulation was applied to the large, complex, expensive, and uncertain project of nuclear plant construction. It should consider the benefits of an incentive framework for nuclear decommissioning costs, in which the risks are shared between the Company and its customers. The Commission should not, at this point, extend the cost recovery for decommissioning beyond nine years.

With regard to spent nuclear fuel storage and disposal, my findings are the following:

- PP&L has been collecting and paying to the Department of Energy the one mill per

- kWh fee for nuclear spent fuel disposal.
- PP&L's filing includes the ongoing one mill per kWh fee in its projections of nuclear fuel costs (Exhibit JRS-1, Tab A, page 3) and hence these costs for spent nuclear fuel disposal have been reflected in the calculation of the market value of PP&L's nuclear units.
 - The U.S. Department of Energy has been slow to accept responsibility for spent nuclear fuel from commercial nuclear power plants.

I recommend the following with respect to spent nuclear fuel:

- PP&L and the U.S. DOE should bear the responsibility for storage and disposal of spent nuclear fuel, not captive customers paying through a wires charge.
- PP&L should recover the funds for spent nuclear fuel storage and disposal in the market through the revenue from the sales of energy from the nuclear plants.
- Spent nuclear fuel storage and disposal costs should be handled separately from decommissioning, with money set aside for both in separate funds, with different policies with regard to sharing the costs and risks.

Nuclear decommissioning and spent fuel storage issues are discussed in Section 5 of my testimony.

Q. Please summarize your conclusions and recommendations with regard to rate design for stranded costs.

A. I find that the customized rate design is unnecessarily complex, unfair, and does not promote true efficiency or the development of competitive markets. I recommend that the Commission adopt a simple, non-bypassable, volumetric charge for any stranded cost recovery that is allowed.

Rate design for stranded cost recovery is discussed in Section 6 of my testimony.

3. Environmental Disclosure for Electricity

Q. What is disclosure and how would it apply in the case of electricity and its environmental attributes?

A. Disclosure is the process in which consumers are informed about their electricity suppliers' sources of electricity. With environmental disclosure requirements for electricity, retail suppliers in the state would report their resource mix and key environmental attributes of their resource portfolio to their customers. Customer education is also very important -- and should be coordinated with disclosure so that consumers have the information they need to make decisions and the knowledge to understand that information.

Q. Why is environmental disclosure for electricity sound public policy?

A. First, electricity generation has extraordinary impacts on the environment. In the U.S. electricity generation is responsible for roughly two thirds of the total SO₂ emissions, nearly one third of total NO_x emissions, and more than one third of total CO₂ emissions. Fossil fueled electricity generating plants also emit heavy metals, and fine particulates, and have a number of impacts associated with mining and the creation of waste in the fuel cycle. Nuclear plants present different environmental and health risks, associated with accidents, nuclear fuel mining, fabrication and enrichment, spent nuclear fuel transportation and storage, and decommissioning. Land and water use of power plants can be substantial.

These and other impacts of electric power have been well studied. For example, I managed a large project for the Boston Edison Company Settlement Board that surveyed these impacts and quantified them where possible, for power plants in New England (*Non-Price Benefits of BECo Demand-Side Management Programs*). I also participated in a major study of the environmental externalities of electric power plants in New York (*New York State Environmental Externalities Cost Study*, for the Empire State Electric Energy Research Corporation and the New York State Energy Research and Development Authority). The U.S. Department of Energy conducted a major study of the environmental damages from electricity generation (*Estimating Fuel Cycle Externalities: Analytical Methods and Issues, Report Number 2 on the External Costs and Benefits of Fuel Cycles: A Study by the U.S. Department of Energy and the Commission of the European Communities*). In addition to such overview studies, many specific research projects have focused on particular impacts of power generation.

The second reason to implement disclosure for electricity is that many consumers are interested in the environmental implications of their purchasing decisions. Surveys repeatedly show a high degree of public support for and interest in clean energy sources. For example, a 1996 report by Farhar and Houston reviews data from more than 700 polls and concludes that the public supports renewable energy, backed by a willingness to

pay \$6 to \$25 per month more for electricity from less harmful sources by 76 percent of those surveyed. The Sustainable Energy Coalition survey revealed bipartisan support for renewables, stating that 57 percent of the 1200 registered voters surveyed would like congress to require a renewable portfolio standard. National consumer surveys conducted for the Edison Electric Institute concluded that 77 percent of consumers surveyed in 1993 stated that they make “changes in daily consumer behavior because of environmental concerns.”

Third, many electricity suppliers are interested in marketing a “clean product” or portraying themselves as a “green company.” For example, in the New Hampshire pilot program, many suppliers used environmental language in their marketing. A list of the environmental claims made by suppliers in the Massachusetts and New Hampshire pilot programs is provided in Table 1 on page 6 of Exhibit BEB-3. These range from specific information about the power supply sources (e.g., “more than 90 percent of the electricity in Green Mountain Energy Partners’ supply comes from hydropower sources”) to general statements (e.g., “its the beginning of our long-term commitment to you and the earth”).

Forth, with competition in electricity customers have an opportunity to choose their supplier. In order for this choice to be most meaningful the customers should have basic information about the suppliers in a standardized, easy-to-understand format. Fuel mix and environmental information can be disclosed along with standardized information on price and price volatility.

Q. Are regulators in other states requiring disclosure for electricity suppliers?

A. Yes. State regulatory commissions in Massachusetts and Vermont have included a mandatory disclosure provision as an element in their December 1996 electric industry restructuring orders. Maine’s May 1997 restructuring act includes a mandatory disclosure.

The National Association of Regulatory Utility Commissioners recently passed a “resolution in support of customer ‘right-to-know’ and product labeling standards for retail marketing of electricity.” NARUC “urges states adopting retail direct access programs to include enforceable standards of disclosure and labeling that would allow retail consumers easily to compare the price, price variability, resource mix, and environmental characteristics of their electricity purchases.” NARUC’s resolution is provided in full in Appendix A on page 26 of the report provided as Exhibit BEB-3. On June 3, 1997, the New England Governors’ Conference adopted a similar “resolution in support of customer ‘right-to-know’ and product labeling standards for the retail marketing of electricity in New England.”

Q. What should the objectives of an environmental disclosure system be?

A. I recommend that the following set of objectives be used in designing an environmental disclosure and tracking system for PP&L:

- **Effective:** it should make a difference in the actual mix of electricity resources.
- **Accurate:** It should provide consumers good, objective, and quantitative information about their supplier's sources of electricity.
- **Comprehensive:** It should allow for the disclosure of a wide range of environmental impacts, and fuel-type information.
- **Flexible:** It should encourage innovation in technology, contracting and marketing.
- **Simple:** It should be straightforward and readily understandable.
- **Expandable:** It should be adaptable to various scales so that it can start small and grow geographically.
- **Inclusive:** It should provide opportunities for both existing utilities and new players to offer renewable resources.
- **Credible:** It must be trustworthy both initially and over time. To the extent that the system embodies subjective value judgments, they must be made by an independent entity with individuals who have a proven track record for objectivity.

These criteria depend on each other and in some ways conflict with each other. They should be seen as design objectives for the system, and the inevitable tradeoffs among them should be made carefully.

Q. Which of the objectives do you consider to be most important?

A. In my view the first and the last objectives listed are the most important. If the system is not effective at “making a difference” then it is a waste of time or worse. That is, if a customer pays more for “clean electricity” thinking that this is influencing the resource mix then the transaction should actually influence the resource mix in a manner that is reasonably similar to what the customer believes to be the case.

The objective of “credibility” is related to this. The system must be credible in order to work. It must “make a difference” in order to be credible.

Q. Why should environmental disclosure be mandatory?

A. Some believe that disclosure should be optional. That is, that only suppliers who wish to make affirmative environmental claims need to disclose information about their resource mix. I disagree with this view. Certainly, some suppliers will voluntarily make specific environmental claims. These claims will likely range from credible statements to dubious assertions, and perhaps even fraudulent claims. In this environment a standardized system of mandatory disclosure has several important functions:

- verification of claims about the resource mix,
- disclosure of information to consumers about the “dirtier” suppliers, and
- standardization of information for ease of comparison.

Accurate claims about “cleanness” of the resource mix will be supported by the information on the standard label. Vague claims that are inaccurate will be discouraged.

This is analogous to food labeling: the front of the box typically has claims such as “low fat” while the back of the box has the standard mandatory label with ingredients and nutritional information. For electricity we will need to address both. The voluntary claims (“front of the box”) will need some rules and guidelines. The mandatory and comprehensive information (“back of the box”) is what disclosure addresses.

Q. What should be disclosed?

A. In general, and for PP&L specifically, the basic information that should be disclosed is the fuel mix and key air emissions. Specifically, the supply portfolio should, at a minimum, be reported by “fuel mix” -- coal, oil, gas, nuclear, hydro, and non-hydro renewables. In addition, key air emissions should be reported; including carbon dioxide, sulphur dioxide, nitrogen oxides, and fine particulates. To the extent that other major environmental impacts, such as waste creation, can be quantified, these should be included as well. A standardized point of comparison, such as the regional average level of pollution per kWh, should be indicated for reference.

Q. What vehicles should be used for communicating information to consumers?

A. The information can be disclosed in various formats and through various channels. The format for disclosure should probably follow the example of nutritional labeling: a straightforward standardized layout using percentages and relating technical information to commonly understood benchmarks. Research is currently underway to determine what information electricity consumers will want and be able to process. This is funded by the National Council on Competition and the Electric Industry, and is being coordinated by the Regulatory Assistance Project.

A sample label for electricity is provided on page 9 of Exhibit BEB-3. This is provided as a suggestion of what information might be included and how it might be presented. The specific design, format, and content should be developed with some input from Pennsylvania consumers. The label must balance the desire of some consumers for a great deal of detailed information with the desire of many for simple and quick summary information. The appropriate level of detail would also vary with the different communication vehicles. For example, the information disclosed on a bill might differ from the information required to be disclosed in marketing materials. It would also be appropriate to have a very detailed set of information provided to regulators on a periodic basis, to help in verifying claims, and to provide to those consumers and consumer agencies that request detailed information.

The vehicle for disclosure should include the bills that are sent to customers and the promotional materials that suppliers develop for marketing. The roles for industry,

government and others need to be worked out. At one extreme, a disclosure system could conceivably be entirely voluntary, designed and implemented by the market participants.

At the other extreme, government agencies could undertake the bulk of the activities themselves -- collecting data, calculating attributes, verifying and enforcing the system. Another model would rely upon independent parties to rate suppliers -- along the lines of "Consumer Reports."

The most successful approaches will probably draw upon all of these actors. The minimum role for suppliers would involve making the essential data (primarily quantities of energy transactions) available. Independent third-party rating systems are likely to develop in one form or another on their own accord. Government can take the role of outlining information requirements for industry to comply with, and then to spot check on disclosure accuracy.

Q. What time scales should a tracking and disclosure system work on?

A. There is first the issue of how frequently the information should be put in front of the customer. This issue should be researched along with the design of electricity labels.

A separate issue is the matter of time period for doing any calculations. For example, a system that tracks transactions on an hourly basis will give a different result than one based on annual averages. It may be that quarterly estimates provide the right balance between accuracy and burden.

Finally, there is the timing issue of prospective versus retrospective information. A disclosure system might base information on recent history, adjusted for major expected changes such as the expiration of a contract or a major plant outage. Utility rate cases often use actual data for a "test year," and then adjust it for "known and measurable changes." Perhaps an analogous approach could be developed for electricity disclosure. Alternatively, it may be preferable to use an approach with true-ups, where the information reported would be reconciled with actuals over time.

Q. Is the tracking of transactions to support disclosure feasible?

A. Yes. Electricity markets already involve numerous transactions among numerous market participants. These numbers and the overall complexity of the market are increasing. Nonetheless, it is entirely possible to track these transactions. Indeed, tracking is and must be done in order to settle the financial obligations. The fuel mix and environmental attributes can be tracked using a system that builds upon the existing information systems.

Q. How would a system of tracking and disclosure work in an electricity market with a spot market or power exchange?

A. Electric power pools have system agreements, approved by FERC, that lay out protocols for dispatching power plants and for billing. A typical arrangement has the actual dispatch optimized on a combined basis, that is, all of the available generators are used in a least-cost manner to serve total pool hourly loads. Then, for accounting purposes, each company is assigned its own units first toward its own load. The result will be that some companies generate more than their own load and some companies generate less. Energy transactions are then assumed in order to balance the system, and buyers compensate sellers according to the pricing provisions in the system agreement (marginal cost plus ten percent and “split-savings” are two pricing schemes). The pooling agreement and accounting systems could be modified for disclosure/tracking system to unambiguously allocate generation from each company’s owned units either to its own load or to sales. In situations where a number of companies sell in the pool, perhaps to several buyers, the sources of generation would be known, and attributed to the buyers, perhaps on a pro rata basis. With restructuring, much of this will remain the same, but dispatch will in many cases be based on bids rather than costs.

In effect, the tracking system can work by following the dollars. For any time period, there is a known amount of electricity generated, and a known amount of electricity consumed. These should be equal, after accounting for losses in the transmission and distribution systems. Retail buyers compensate the generators, perhaps in some cases with several intermediaries. By following the contracts and the flow of money from retail consumers to generators one can develop a reasonable measure of accountability.

Q. Is there a single approach that is theoretically superior to all others for tracking the attributes of generation to the point of retail sale?

A. No, there is no single unambiguously preferable approach. There are, however, several approaches to tracking, each with its strengths and weaknesses. The most important thing may be simply to agree on one system that can be applied consistently. Ideally the system would be applied at least on the scale of the PJM system, and perhaps even coordinated with neighboring systems. The Commission in Pennsylvania should simultaneously (1) establish the disclosure requirement for retail sellers in the State, and (2) work with other states and PJM to implement a tracking system for PJM as a whole. It should unambiguously express its intention to do so when it issues the order in this case, providing that PP&L conform its public information to that requirement.

Q. What approach to disclosure and tracking do you recommend?

A. I recommend that the state and the region adopt a company-based tracking system in which wholesale sales are allocated before retail sales. I believe that this is the most readily implementable approach.

Q. Why do you recommend a company approach?

A. A system that requires disclosure of provider companies is preferable to one that discloses individual “products” (or contracts). First, the company approach will be easier to implement. It will have a smaller number of “entities” for which information must be tracked, and hence a more manageable amount of data and computation requirements.

More importantly, company-based disclosure is more meaningful than product disclosure. A statement that the supplier has a certain resource mix is meaningful and reasonably straightforward. With product-based disclosure suppliers can simply allocate on paper their clean generation to a “clean product” and their dirty generation to a “cheap product.” Customers paying more for the clean product may be just receiving reallocated existing resources, and hence are not making a difference (objective number 1, above).

Q. What do mean by a tracking system that allocates wholesale sales first?

A. There are a variety of ways to approach the treatment of transactions in an environmental disclosure system for electricity. The most straightforward, and ultimately perhaps the best, approach is described below -- a company-based system with generation allocated to wholesale sales first. With this system each company would allocate its generation to its wholesale sales, and then allocate its remaining resource mix (generation and wholesale purchases) to its retail sales.

This simple system divides electric companies into their production and retail functions. Wholesale sales are assumed to be from producer’s own generation, unless the producer sells more at wholesale than it produces. If wholesale sales exceed own generation, then the extra is assumed to come proportionately from the companies the producer purchases from. This approach allows the complex web of electricity transactions to be dealt with in a straightforward manner, avoiding the difficulties and ambiguities of tracing power transactions back through several companies.

By separating the production and retail functions, this simple system shows great flexibility for representing the many types of entities and transactions that will occur in the market. Transactions from outside of the system might be treated differently than transactions within the system. For example, it may be appropriate to attribute marginal emissions and fuel mix to imports.

Q. Are there other systems that could be used for tracking transactions?

A. The “wholesale transactions first” approach is the most straightforward way to account for transactions, but other approaches that account for the web of transactions in a more subtle way are conceivable. For example, a retail sales first convention might be adopted. Or alternatively, each company might be seen as selling a slice of its own generation and its purchases -- both to its wholesale customers and its own retail customers. However, because the transactions comprise a complex web, and not a unidirectional chain, these approaches are more complex. They can involve working

back through sometimes many companies to find the mix for a single buying company. The implementation of some of these approaches would require sophisticated mathematical tools (e.g., linear programming) to implement.

Q. You mentioned that consistency is important in a tracking system. Why is that?

A. Without a consistent tracking system, it might happen that some of the power generated from dirtier sources is not disclosed or that the same clean power might be sold more than once. Consistency over the largest possible area helps to reduce the possibilities for gaming the system. Ideally, the PJM and neighboring systems (or their ISO equivalents) will adopt tracking systems that are the same, or at least reasonably consistent.

Q. What data are required to implement a tracking system?

A. The essential data for a disclosure system include generation by plant, and the buyer, seller and quantity of energy for each transaction. These data are, in general, currently made available to government agencies. There are, however, some gaps in what is reported, and there is an unacceptably long time lag before some data are publicly available.

Moreover, electricity market participants are becoming increasingly sensitive about making information available. Procedures should be implemented that respect the legitimate confidentiality concerns of market participants while ensuring that sufficient data are available to implement an environmental tracking system -- and to allow regulatory oversight of market power and electric system reliability.

Relevant data are currently provided to the Energy Information Administration, the Environmental Protection Agency, the Federal Energy Regulatory Commission, and various state agencies. Data sources and issues are discussed in Exhibit BEB-3 on pages 17 to 19, and Appendix C.

Q. Who should be responsible for implementing the tracking system to support disclosure?

A. The Independent System Operator should play the key role in implementing the tracking aspect of environmental disclosure. ISO's have the technical expertise, the necessary information on generation and transactions, procedures for handling sensitive data appropriately, and the independent status for credibility. It is important that Pennsylvania utilities and the Pennsylvania Public Utilities Commission encourage that the tracking function be included in the mandate of the PJM ISO, and that provisions for tracking fuel mix and key environmental attributes be included in current PJM software upgrades. If the Commission can clearly and satisfactorily delegate the tracking

and reporting function to the ISO it can assure that good information flows essentially automatically to retail sellers and aggregators, who would report the information to customers..

Q. Do you agree with Ms. Lennon that a customer education program is needed?

A. Absolutely. Ms. Lennon points out that “In a competitive electric generation market, it will be critical for all consumers to have access to up-to-date information about a variety of topics...” and that “This information will be particularly important in an evolving market that will include new, non-traditional sellers” (Lennon direct testimony, page 3). A customer education program that presents clear and unbiased information to consumers is essential for meaningful choice.

Q. What requirements in the Act relate to disclosure and consumer education?

A. The Act includes several requirements that should be addressed through an education program. First, the Act requires

each distribution company, electricity supplier, marketer, aggregator and broker to provide adequate and accurate customer information to enable customers to make informed choices regarding the purchase of all electricity services offered by that provider. Information shall be provided to consumers in an understandable format that enables consumers to compare prices and services on a uniform basis. (Section 2807 (d) (2))

Second, energy conservation services must be available in all distribution service territories (Section 2804 (9)). Third, customers must be informed of the changes in the electric industry (Section 2807 (d)(3)).

Q. What criteria should the Commission use to evaluate the appropriateness of PP&L's education program?

A. In order to be worthy of Commission approval, an education program must be effective, accurate, accessible, comprehensive and unbiased. Therefore, PP&L's education program should cover a broad range of options and issues, from pricing, billing and metering options to consumer protection and environmental impact information. In addition, the program should make educational materials accessible to all consumers, which will require information in multiple languages. Finally, the information that PP&L uses for consumer education must not include language that could inappropriately influence customers to choose to remain with their incumbent utility. I recommend that the Commission take strong leadership in this area, setting precise protocols and content requirements to prevent PP&L, and other utilities, from charging captive customers for tens of millions of dollars of “customer information” that may turn out to be little more

than marketing.

Q. How does consumer education relate to disclosure for electricity?

A. Pennsylvania consumers will, for the first time, be presented with a choice of electricity supplier, and -- through a disclosure requirement -- be presented with information about the fuel mix and environmental impacts of electricity generation. A comprehensive program of consumer education should be developed to assist buyers in comprehending electricity restructuring, comparing offers, and understanding the environmental impacts of their choices. The consumer education initiative should be coordinated with and complementary to the disclosure and labeling requirement.

Q. Does PP&L plan to include environmental information in its “customer choice education materials?”

A. Yes. While the April 10 draft of PP&L’s “Customer Choice Handbook” makes no mention of environmental issues (Attachment 1 to PP&L Response to Interrogatories of the Office of Consumer Advocate, Set IV, Question 2) and Ms. Lennon makes no mention of environmental and health issues in her direct testimony, PP&L has indicated that its customer choice education materials “will include discussion of the fuel mix and the ‘green’ energy issue” (PP&L Response to Interrogatories of the Office of Consumer Advocate, Set IV, Question 10). PP&L states that it will form a “Customer Choice Education Advisory Committee of representatives from community-based organizations which will work in partnership with the Company to develop approaches to presenting such information” (PP&L Response to Interrogatories of the Office of Consumer Advocate, Set IV, Question 10).

My clients in this case -- the Environmentalists -- should be included in PP&L’s Customer Choice Education Advisory Committee, since their perspective and expertise on environmental issues and communication will be valuable. The key customer education materials developed by PP&L should be subject to Commission review, including a process for parties to comment, prior to their release. If an appropriately representative P&L Advisory Committee does not approve the Company’s materials, the Commission should prohibit their issuance with customer dollars or bearing any Commission imprimatur.

Q. Is environmental disclosure for electricity a substitute for other environmental policies?

A. Absolutely not. Environmental disclosure for electricity is an important policy that can provide useful information to consumers about their electricity purchasing decisions. Other regulations, such as portfolio standards and emission caps, are necessary and appropriate, and in no way in conflict with disclosure specifically or electricity markets

generally. Restructuring of the electricity industry can and should be implemented in a way that improves Pennsylvania's environmental quality.

4. PJM Market Issues

A Competitive Electricity Marketplace

Q. What do the Environmentalists envision for the future electricity markets?

A. The Environmentalists envision a robust market:

The potential for competition to improve economic efficiency and to reduce long-term costs rests on having robust competition in the marketplace. Robust competition requires multiple service providers in the marketplace in order that customers have real choice.

All power generation will face full and fair competition. The utilities will not enjoy competitive advantage, either through massive stranded cost war chests or other anti-competitive actions.

There will be no unreasonable barriers to entry into the marketplace. Market development will be guided in a way that increases the role of competition among energy service providers and the role of choice for customers.

The concentration of ownership of generating capacity in the marketplace will be limited in order to minimize opportunities for abuse of market power. The ISO will play a role in monitoring and mitigating market power problems in the generation markets. The ISO governance will include public interest representation and will not be dominated by the current utility companies.

While I subscribe to these views, and I advised the Environmentalists as they drafted this statement, I am quoting from the Environmentalists' Vision for the New Electricity Marketplace.

Market Power Problems

Q. What sort of problems can arise in the functioning of a market?

A. There are various types of market power problems that can keep a market from functioning competitively. These include problems of undue vertical market power and horizontal market power.

Q. What is vertical market power?

A. Vertical integration provides opportunities for the following types of anti-competitive behavior:

- favoring affiliates in purchasing decisions;
- providing affiliates with preferential service;
- timing and siting transmission upgrades in a way that favors affiliated generators;
- cross-subsidizing unregulated affiliates; and
- providing affiliates with proprietary market data.

The Federal Energy Regulatory Commission has catalogued in detail the propensity of vertically integrated utilities to abuse their market power (70 FERC 61,357 [1995, 65-85]). FERC's observations include the following:

In the past, transmission-owning utilities have discriminated against others seeking transmission access. Transmission-owning utilities have denied access by outright refusals to deal.... More often, however, discrimination is likely to be manifested more subtly and indirectly. One such way would be [delaying negotiations until]....the window for the customer's trade opportunity has closed. Another way of frustrating access is to substantially change the terms of negotiated agreements through protracted delay including filings with regulatory agencies. Another way...is to allow access but only on noncomparable or unsupportable terms and conditions that are inferior to the conditions [available to]...the transmission owners themselves [such as refusing network services, denying postage stamp rates, denying priority service, insisting on long scheduling lead times, denying flexibility in the use of firm transmission capacity, providing inferior ancillary services, requiring onerous deposits, and requiring double payments in lieu of reciprocity].... Finally, an additional way for transmission-owning utilities to frustrate access and competition is by granting each other superior rights and lower rates, in pools, interconnection agreements and other protocols.

(Pages 71-78; citations omitted)

FERC describes similar past vertical market power abuses in the gas industry, when pipelines discriminated in favor of their own gas, and concludes:

Our experience in the gas area influences our decision that, at a minimum, functional unbundling of wholesale services is necessary in order to contain non-discriminatory open access and to avoid anticompetitive behavior in wholesale electricity markets.

(page 85)

With direct-access competition, market power at retail may also be a problem.

Incumbent utilities have a considerable advantage in providing retail service as a result of their current relationships with customers, detailed and valuable information about customers, and in some cases contracts with customers. Barriers to entry in the retail-services market may be particularly severe, given the working relationships that have built up over time between customers and their incumbent utilities.

Q. What is horizontal market power?

Horizontal market power in electricity arises from horizontal concentration in generation. A key mechanism for exploiting horizontal market power is for a large firm to raise market prices by withholding capacity from the market, raising the market price and thereby increasing profits over competitive-market levels.

Q. Is horizontal market power a concern in the PJM system?

Preliminary examination of market concentration in the PJM electricity market suggests that there may be opportunities for abuse of market power in generation if restructuring moves forward. These concerns arise mainly in situations where capacity is tight, for example during hours with high levels of demand or multiple large unit forced or scheduled outages.

Q. How does market concentration influence price and how is it measured?

A. An oligopoly is a market structure in which a few firms dominate the supply of a commodity. Its occurrence is quite common. Economic theory tells us that in oligopolistic markets prices can be expected to fall between the extremes of a perfectly competitive market at the low end and an unregulated monopoly market at the high end. It is impossible to say with confidence how a particular market will behave within the two tractable extremes.

The two most common measures of market concentration are the Herfindahl index, and the "concentration ratio." The Herfindahl index is the sum of the squares of individual firm's market shares. The higher the index number the greater the level of concentration, and the more likely that market power will be a problem. For example, the Herfindahl index would be 1000, for an industry with ten equal size firms. "Concentration ratios" are specified for a particular number of firms. For example, the three-firm concentration ratio (CR3) for that same industry would be 30 percent. No single metric can capture the complexities of the cost structures and relationships in a real market, but the Herfindahl and concentration ratio are both useful measures that can serve as starting points in analyses of market power.

Different oligopoly theories point to different measures of concentration as the most appropriate for explaining how significantly prices might deviate from marginal costs. Similarly, empirical explorations of concentration and price data in various industries are inconclusive in establishing a generally preferred measure of concentration for

accurately predicting pricing behavior. At one theoretical extreme, oligopoly firms may act competitively, or "quasi-competitively," resulting in reasonable market prices. At the other extreme, the firms may collude perfectly, with results much like an unregulated monopoly.

Theoretical models may offer some insight as to the behavior of a market in electricity generation. However, even for markets that have existed for years and have been studied in detail, there are likely to be differences of opinion about how the market has behaved. It is simply impossible to say with confidence how a complex market will work before it exists, and with many aspects of its regulation and structure unresolved. The most we can do is to study the current market structure and cost functions, and to identify areas of concern and potential solutions.

Q. What is the level of market concentration in PJM?

A. Based upon current ownership, the capacity shares of the six largest companies in PJM, including the NUG capacity they control by contract, are as follows:

PSE&G	20%
GPU	18%
PECO	16%
PP&L	15%
BG&E	12%
PEPCO	12%

The concentration ratio for the three largest companies (CR3) is about 54%, and the concentration for the five largest companies is 81%. The proposed merger of BG&E and PEPCO would create the new largest company in PJM and would increase the CR3 to about 62%.

The Herfindahl (or "HHI") index is about 1550. The pending BG&E-PEPCO merger would increase the HHI by roughly 300 points to about 1850. This is undesirable from a market concentration point of view. According to the Department Justice's April 2, 1992 "Horizontal Merger Guidelines" used by FERC in evaluating market power impacts of mergers (see FERC's Policy Statement Order No. 592, Docket No. RM96-6-000, issued December 18, 1996), markets with an HHI index of about 1000 are "moderately concentrated," and mergers that raise the HHI by more than 100 points "potentially raise significant competitive concerns." The guidelines also indicate that, at a Herfindahl above 1800, the market is "highly concentrated" and adverse effects are "presumed." In such concentrated markets, there are significant concerns of market power, although whether and to what extent there is a problem depends upon a variety of other factors, for example, barriers to market entry.

Q. Dr. Jones has described a "future competitive generation market" in which

suppliers bid their generation at its marginal cost, and receive payment for electricity that they generate at a market clearing price. Do you share this view of the future?

A. In many respects I agree with the view of the future electricity markets articulated by Dr. Jones on pages 5 through 7 of his direct testimony. I believe that it is likely that PJM will move to a bid-based dispatch in the near future, and that such a system can produce benefits. However, it is by no means certain that suppliers will bid at their marginal (or variable) cost. In order to ensure that they do, and that the market is appropriately competitive, it is important to conduct an analysis of the opportunities for suppliers in the market to add to their profits by raising prices. If the market is competitive, then strategies of withholding capacity or bidding above variable cost will not be profitable.

Q. Is it possible to analyze market power in PJM?

A. Yes. First, it is possible to calculate measures of market concentration, such as the HHI, for various product markets (e.g., generating capacity) in PJM. This has been done. It is useful but only a first step. After examining the measures of market concentration it is important to apply a model that can reflect some of the details of the market, such as which suppliers own capacity at various points along the supply curve, and how this intersects with the demand for the product. In electricity markets it is possible to use simulation models to directly inquire whether and to what extent anti-competitive strategies will be profitable to sellers in the market. I have applied such a model to the New England power pool and found that market power is likely to be a problem. A similar analysis should be done of the PJM electricity market before declaring that it is, or is not, adequately competitive. I urge the Commission to require PP&L to undertake such an analysis, using its dispatch modeling capability and inputs which stakeholders and the Commission staff agree upon.

Q. What are the factors that mitigate against the opportunities for abuse of horizontal market power?

A. There are several important mitigating factors, including market entrants (imports or new facilities), demand elasticity (the tendency of consumers to buy less of a product when the price increases), and antitrust regulation. These all play an important role in checking the magnitude of market power problems to the extent that they exist.

Q. How do vertical and horizontal market power relate to each other?

A. One way in which vertical and horizontal market power relate is that control of the transmission system can be used to limit the effective scope of the generation market. For example, creating a limitation on transmission capability into an area can lead to a situation in which an owner of capacity in that area has an increased ability to raise prices profitably within that area. It is also important to recognize that such

transmission limits can be created indirectly, by decisions about generators, since the configuration of generation on the system influences the amount of capacity that can be carried over various interties.

Vertical and horizontal market power are also related in terms of the solutions. Divestiture of generating capacity, if done appropriately, can be an effective way to address both types of market power -- vertical, in that the ownership interest in the wires is separate from the ownership interest in energy generations, and horizontal, in that the larger blocks of capacity can be split.

Market Power Solutions

Q. What do you recommend for removing or mitigating the potential exercise of market power?

A. The following policies may be necessary in order to prevent market power from undermining competition in electricity markets:

- First, a strong and independent system operator should be established to coordinate the dispatch, ensure system reliability, to implement open access to the transmission system, to conduct transmission system planning, and to identify market power problems.
- Second, the distribution function (“poles and wires”) should be separated as much as possible from the generation function, in order to minimize problems of vertical market power. While the Commission may not be able to require divestiture, it should encourage divestiture in its restructuring and ratemaking policies.
- Third, limits on the concentration of ownership of generating capacity should be established for participants in PJM.
- Fourth, detailed modeling studies should be conducted, in which strategic behavior is analyzed in the context of real markets with generation ownership patterns, transmission constraints, and opportunities for new entrants.

Q. What influence should the Pennsylvania Public Utilities Commission exert over these PJM issues?

A. Many of these issues are primarily to be resolved by FERC. There are, however, important ways in which the PUC can influence that process. First, the PUC can make it clear to the utilities what it would like to see in terms of market power protections. Second, the PUC should comment to the FERC on these issues in every possible forum. Third, the PUC should conduct or require analysis of market power. This analysis should include simulation modeling of the opportunities for large companies in the PJM system to influence the market price through strategic behavior in their bidding or by strategically withholding resources from the market. Fourth, the Commission should condition the exercise of its discretion in this and other restructuring cases on the

Applicant utility's complying with the Commission's concerns — if a utility like PP&L wants favorable treatment in the stranded costs, rates and terms areas of the Commission's discretion, it must enthusiastically demonstrate compliance with Commission market concerns.

Now that PP&L has filed for certification as competitive provider of electricity it has placed itself squarely in the middle of the analysis that looks for self-dealing, cross-subsidy and favoritism for affiliates. I do not claim that PP&L has undertaken such undesirable activities, or that it necessarily will. But its newly acquired status sets up favorable conditions. An additional factor, not yet evident in this case, but present with PECO Energy's securitization, is the existence of a suddenly acquired fund of billions of dollars with which to enable market distortions. The Commission should require particular, focused behaviors I describe above from Pennsylvania utilities that put themselves in situations that permit market abuse.

5. Nuclear Decommissioning Costs

Findings and recommendations with regard to nuclear decommissioning costs

Q. What are your key points with regard to nuclear decommissioning costs?

A. The Environmentalists' vision is that decommissioning costs will be adequately funded in a manner that is fair and efficient -- nuclear plant operators will be responsible for some portion of the decommissioning costs and will have an interest in controlling those costs.

My findings on the treatment of nuclear decommissioning costs in this case are the following:

- The currently approved annual cost amount for PP&L's nuclear decommissioning obligations is about \$9.5 million per year (Kleha direct testimony, page 15).
- PP&L has suggested that nuclear decommissioning costs be collected in the CTC and that the CTC be extended "beyond the nine-year window provided by the Act to permit recovery of its nuclear decommissioning costs over the remaining life of the Susquehanna generating plant" (Kleha direct testimony, page 14).
- PP&L has not demonstrated mitigation of the nuclear decommissioning portion of its stranded costs.
- Mitigation is difficult to do or to demonstrate at this point in time for nuclear decommissioning costs, since the key activities will occur so far in the future.

My key points on nuclear decommissioning costs more generally are the following:

- PP&L's nuclear decommissioning cost obligation is currently estimated by the Company to be \$724 million in 1993 dollars (PP&L Response to Interrogatories of the Environmentalists, Set 3, Attachment 1, page 4). This amount is large, very uncertain, and to some extent within the control of the plant owner.
- PP&L's nuclear decommissioning consultant, Mr. Tom LaGuardia, has been estimating decommissioning costs for 20 years. Even after adjusting for inflation, his recent estimates are roughly six times his 1976 cost estimate for dismantling a large pressurized water reactor, and the average annual rate of escalation in his estimates has out paced inflation by about 10 percent per year over the past two decades (see Exhibit BEB-2).
- Costs can, to some extent, spill over between nuclear decommissioning and the costs of operation and the costs of spent fuel disposal.
- Some decommissioning costs are the result of continued operation of the facilities.
- There are currently important uncertainties about nuclear decommissioning related to the policies of the Internal Revenue Service and the Nuclear Regulatory Commission.

- It is difficult to make a specific plan now for nuclear decommissioning costs are so uncertain and they will be incurred so far in the future.
- The principles that should guide sound nuclear decommissioning policy are: (1) *assurance* that adequate funds will be available to decommission the plants in a safe and timely manner, (2) *equity* between customers and shareholders, and across generations, and (3) *efficiency*, primarily provided by creating a framework in which the plant operator has an appropriate incentive to control the costs of the decommissioning project.

Q. Please summarize your recommendations with regard to nuclear decommissioning costs.

A. I recommend the following:

- PP&L should be required to update its 1993 nuclear decommissioning cost study.
- For any additional costs for decommissioning that PP&L is allowed to recover through the CTC or to include in its stranded cost calculations, PP&L should be required to demonstrate that it will -- and has -- placed the funds into its external decommissioning fund.
- The Commission should require an adequate plan from PP&L for the mitigation of its decommissioning costs.
- Procedures should be put in place to ensure that the plant is operated in such a way that the decommissioning cost obligation is not increased.
- PP&L should be responsible for some portion of any decommissioning costs in excess of current projections, and responsible for all excess costs not demonstrated to be prudently incurred.
- In the event that decommissioning costs less than expected, customers should be receive an appropriate refund.
- The Commission should address the complicated technical and policy issues of nuclear decommissioning in a generic case, in which limited regulatory resources can be used efficiently and a consistent policy can be developed that does not unfairly disadvantage one company relative to another.
- The Commission should carefully weigh the costs, benefits, and risks before assigning nuclear decommissioning to the wires business. It should consider the problems that occurred in the past when cost-based regulation was applied to the large, complex, expensive, and uncertain project of nuclear plant construction. It should consider the benefits of an incentive framework for nuclear decommissioning costs, in which the risks are shared between the Company and its customers. The Commission should not, at this point, extend the cost recovery for decommissioning beyond nine years.

Q. What are your findings and recommendations with regard to spent nuclear fuel storage and disposal costs?

A. My findings are:

- The spent nuclear fuel from operation of a nuclear power plant is much more radioactive than the plant components themselves.
- PP&L has been collecting and paying to the Department of Energy the one mill per kWh fee for nuclear spent fuel disposal.
- PP&L's filing includes the ongoing one mill per kWh fee in its projections of nuclear fuel costs (Exhibit JRS-1, Tab A, page 3) and hence these costs for spent nuclear fuel disposal have been reflected in the calculation of the market value of PP&L's nuclear units.
- The U.S. Department of Energy has been slow to accept responsibility for spent nuclear fuel from commercial nuclear power plants.

I recommend the following with respect to spent nuclear fuel:

- PP&L and the U.S. DOE should bear the responsibility for storage and disposal of spent nuclear fuel, not captive customers paying through a wires charge.
- PP&L should recover the funds for spent nuclear fuel storage and disposal in the market through the revenue from the sales of energy from the nuclear plants.
- Spent nuclear fuel storage and disposal costs should be handled separately from decommissioning, with money set aside for both in separate funds, with different policies with regard to sharing the costs and risks.

Treatment of nuclear decommissioning in PP&L's stranded cost calculation

Q. How does PP&L treat nuclear decommissioning costs in its estimate of stranded costs?

A. PP&L includes an annual amount of \$117 million for nuclear decommissioning in its stranded cost calculations (see Exhibit JRS 1, page 14). The amount included in jurisdiction rates is about \$9.5 million per year (Kleha direct testimony, page 15).

Q. Does PP&L believe that this is adequate to cover its share of the decommissioning expense for Susquehanna?

A. No. PP&L explains in its "Decommissioning Funding" document provided in response to Environmentalists Set 3, Question 139, that with its recommended assumptions for decommissioning cost and after-tax return on the fund balance that "the estimated cost of decommissioning the Susquehanna plant would exceed the projected value of the trust fund in the year 2022 for Unit No. 1 and 2024 for Unit No. 2 by about \$852 million (page 5).

Q. Do you agree with PP&L's assessment of the decommissioning fund adequacy?

A. I do not necessarily agree with the specifics of PP&L's assessment. I do, however, concur with the general conclusion that the annual funding amount appears to be inadequate. Moreover, PP&L's decommissioning cost study upon which the funding amount is based is dated. It was done in 1993, and decommissioning cost estimates can change dramatically over a three-and-one-half year period.

Nuclear decommissioning costs and stranded cost mitigation

Q. What is the estimated magnitude of PP&L's nuclear decommissioning costs?

A. PP&L has estimated its nuclear decommissioning cost obligation to be \$724 million in 1993 dollars (PP&L response to Interrogatories of the Environmentalists, Set 3, Attachment 1, page 4).

Q. Do you believe this to be an accurate estimate of nuclear decommissioning cost?

A. No. PP&L's nuclear units have operating licenses that expire between the years 2014 and 2029. Dismantling a large, highly radioactive nuclear unit is a large, complex undertaking for which experience is currently quite limited, and regulations continue to evolve. It is not possible now to produce an accurate estimate at for the cost of decommissioning PP&L's nuclear units. Even if PP&L were to update its 1993 cost study (which I recommend be done) the new estimate will be subject to considerable uncertainty -- technical, economic, and regulatory.

Q. Please describe the basis for this conclusion.

A. I have reviewed many engineering estimates of nuclear decommissioning cost over the past 15 years. While the state of the art of nuclear decommissioning cost estimation has improved over the past 15 years, there are still important deficiencies. I have found that even the more recent cost estimates are inherently based upon a number of uncertain or unsupported assumptions. For example, it is typical to assume a hypothetical facility will be available for the acceptance of low level radioactive waste. Transportation costs are then estimated based upon an assumed distance to the non-existent facility. Disposal fees for the non-existent facility are typically based upon either the current fees at existing facilities unlikely to accept the waste from the nuclear power plant at issue, or the results of studies that estimate the prices that the un-sited, non-existent facility will charge for radioactive waste disposal.

The method and timing of decommissioning are also major sources of uncertainty. Even if one could say for certain that Limerick will operate to the end of its current license

expiration date in 2029, it is not possible to say with confidence whether the plant will be dismantled five years or fifty years after that date.

The dismantlement process itself involves considerable uncertainty, as experience dismantling commercial nuclear reactors is limited to smaller units or special cases such as the Shoreham unit in Long Island, which operated only at low power for a short period of time. Dismantling a full-scale nuclear unit that has operated for many years will present new challenges.

Q. Have U.S. utility industry nuclear decommissioning cost estimates been accurate in the past?

A. No. Engineering estimates of nuclear power plant decommissioning costs emanating from American utilities have a poor track record. The Company's decommissioning consultant, on whose judgment they rely for their estimates of nuclear decommissioning costs, is Mr. Tom LaGuardia, of TLG Engineering. Mr. LaGuardia has prepared dozens of nuclear power plant decommissioning cost estimates over the past 20 years.

Q. How do Mr. LaGuardia's estimates from 20 years ago compare with his estimates today?

a. Mr. LaGuardia's current decommissioning cost estimates are in the range of 15 times greater than his 1976 estimate for dismantling a large pressurized water reactor. Adjusted for inflation, the recent cost estimates are approximately 6 times higher than the older estimate. This is an escalation in cost of 600 percent.

The 1976 study that I refer to is an engineering analysis of the decommissioning cost of a large nuclear power plant for the Atomic Industrial Forum (*An Engineering Evaluation of Nuclear Power Reactor Decommissioning Alternatives*, AIF/NESP-009) in which Mr. LaGuardia estimated the cost to be \$26.9 million (in 1975 dollars for immediate dismantlement of a generic 1160 MW pressurized water reactor). In today's dollars that would amount to about \$70 million. In contrast, Mr. LaGuardia's recent site-specific estimates filed by PP&L in this case average about \$400 million.

Q. What has the trend been in Mr. LaGuardia's estimates between 1976 and the present?

a. The trend is for continually increasing decommissioning cost estimates, at an alarming rate of escalation. I have compiled a database of about 180 of Mr. LaGuardia's site-specific estimates done between 1977 and 1995, all for the "immediate dismantlement" method of decommissioning. I have adjusted these for inflation, and have plotted them in Exhibit BEB-2. As the graph shows, the engineering estimates have been increasing rapidly over time. The two lines in the graph are linear and log-

linear fits to the data. The average annual rate of increase is roughly 10% faster than inflation over this period. This amounts to a doubling of the estimates every 7 or 8 years.

Q. Why is the growth in Mr. LaGuardia's estimates relevant to his current decommissioning cost estimates for PP&L's nuclear capacity?

A. The escalation in Mr. LaGuardia's estimates is important for at least two reasons. First, it shows that decommissioning cost estimation is not a mature, stable undertaking. While progress has been made over the last 20 years, and decommissioning estimates are now generally presented in a standardized format, the alarming rate of change in the estimates indicates considerable uncertainty in the current estimates. Second, the decommissioning cost estimates do not simply show volatility -- there has been a clear upward trend. Decommissioning policy and stranded cost policy should not ignore this trend. A head-in-the-sand approach will not be productive. Rather, understanding the past trends, the driving factors, and the implications for the future decommissioning costs is essential to making sound policy decisions.

Q. So, can the Commission simply adjust Mr. LaGuardia's PP&L estimate by a 10% increase and proceed with the balance of its stranded cost review?

A. This would not be adequate. A 10% increase (the historical rate of increase) would account for only one year of cost escalation. Moreover, while the past rates of increase must be considered, it is not reasonable to simply state that decommissioning cost estimates will continue to increase at the rate that they have in the past. What is needed is the establishment of a framework for decommissioning that ensures that the needed funds will be available in a timely manner, that provides for customers and shareholders to bear their fair share of the costs over time, and that provides incentives for the plant owner to control the magnitude of decommissioning costs.

Q. Are there other considerations that point to the possibility of further increases in the nuclear decommissioning cost estimates?

A. I believe that some of the factors that have driven past increases in the decommissioning cost estimates will continue to influence nuclear decommissioning costs in the future. For example, the cost of low-level radioactive waste disposal has increased rapidly over the past two-decades, and could continue to do so. A substantial portion of the increases in decommissioning cost estimates has been related to spent nuclear fuel. While the cost of transportation and long-term storage of spent fuel is generally not included in the decommissioning cost estimates, the delays in the Department of Energy's schedule for accepting spent fuel from commercial nuclear reactors have driven decommissioning cost estimates upward due to the on-site implications of spent fuel handling and storage upon the scope and timing of

decommissioning activities.

In addition, there is a general pattern of cost underestimation for large, complex projects; particularly those that involve institutional uncertainties. This phenomenon was evident in the case of nuclear power plant construction costs. The trends to date for nuclear decommissioning cost estimates suggest a similar, albeit somewhat different, set of factors at work. As large, fully radioactive nuclear power plants begin to be decommissioned, regulations and technology will evolve together... in most cases leading to higher costs.

Q. In addition to escalation of the cost estimates, are there other reasons to be concerned about the adequacy of nuclear decommissioning funding?

A. Yes. The possibility of nuclear plant shutdown prior to the license termination date is a major concern. Several units have shut down already, and further shutdowns are likely as nuclear plants are increasingly subjected to market forces. I have analyzed the operating economics of nuclear power plants in many regulatory proceedings over the last fifteen years. While on average, capacity factors have improved, the low market prices for electricity render some existing power plants uneconomic on an operating cost basis. This is true particularly for some nuclear plants. In a paper authored for the January/February 1997 *Electricity Journal*, I concluded that there are about ten nuclear plants in the U.S. that may be uneconomical to operate, based upon 1995 data. Other observers of the utility industry have reported similar conclusions. For example, a 1995 report by Moody's Investors Service stated that "there are at least 10 nuclear plants (out of 109 in the U.S.) that might be closed in the event of deregulation." (*Stranded Costs Will Threaten Credit Quality of U.S. Electrics*, August, 1995). More recently, Moody's found that "The propensity for certain nuclear plants to require expensive capital additions to comply with the standards of their Nuclear Regulatory Commission (NRC) operating license increases the likelihood that the number of early shutdowns might be even greater than those 10 originally identified." (*Moody's Assesses Nuclear Power Risks in A More Competitive Market*, November, 1996). Similarly, a report by the INGAA Foundation found that 40 percent of the nation's nuclear capacity is "vulnerable to shutdown" with increasing competition in the electric industry. (*Nuclear Power Plants and Implications of Early Shutdown for Future Natural Gas Demand*, 1997).

With decommissioning funding based upon the full license period, if a nuclear unit is retired prior to the license termination date, there will be a funding deficiency, in some cases of considerable magnitude. In particular, if PP&L's units shut down early there will be a net deficit in the funding available to decommission the units. PP&L estimate of the "current shortfall" in 1996 is \$596 million, based upon its 1993 cost estimate for decommissioning (PP&L's Response to Interrogatories of the Environmentalists, Set 3, Question 139).

Q. Is it conceivable that a nuclear plant operator might find itself bankrupt or otherwise unable to carry out decommissioning for lack of funds?

A. It is possible that a nuclear plant owner could, after the shutdown of the plant, find that the funds set aside for decommissioning are inadequate for the task -- as a result of premature shutdown and/or higher than expected decommissioning cost. This may come at a time when the Company is financially stressed as a result of the loss of generating capacity and the associated income stream. The Nuclear Regulatory Commission has taken this possibility seriously, and has set up external funding requirements to avoid such a situation. The NRC is also currently considering the implications of electric industry restructuring upon the adequacy of nuclear decommissioning funding.

Q. Does PP&L have an obligation to mitigate with regard to its nuclear decommissioning costs?

A. As a regulatory technical person, I read the Act to say "Yes." The legal interpretation is properly left to the Commission and the lawyers who argue this case. Even independently, as a matter of regulatory policy, the Commission should require as a precondition to providing stranded cost recovery, that the utility has taken all reasonable and prudent measures to mitigate its stranded costs. Nuclear decommissioning represents a large portion of stranded costs. I assume that the Commission will look to the Pennsylvania's Electricity Generation Customer Choice and Competition Act, "transition or stranded costs" definition in Section 2808. It defines stranded costs as those "...which the commission determines will remain following mitigation by the electric utility." Nuclear decommissioning should not be an exception -- if stranded cost recovery is to be allowed then these costs should be aggressively mitigated.

Q. How might PP&L mitigate its stranded costs as they relate to nuclear decommissioning?

A. One way to mitigate the decommissioning portion of stranded costs is to contribute shareholder dollars to the fund, reducing the deficiency. Accelerating decommissioning funding in order to reduce the fund deficiency is another approach.

Since decommissioning is a process that hasn't taken place yet, there are additional opportunities for mitigation that are not possible for uneconomic plant construction costs. For example, good planning and cost control measures for the decommissioning process that reduce the total cost exposure for decommissioning would translate into stranded cost reductions. I have not seen evidence of a comprehensive PP&L program to minimize the cost of this de-construction program. This would be hands-on mitigation, not just shifting costs in time or among the various parties.

Q. What do you conclude regarding stranded cost mitigation and nuclear decommissioning?

A. I believe that PP&L has not addressed the issue of stranded cost mitigation as it relates to nuclear decommissioning, and that the Commission should require a plan for and evidence of such mitigation prior to approving CTC recovery of stranded costs. PP&L's decommissioning obligation as currently forecast by the Company is large. It could be larger still, with further increases in nuclear decommissioning cost estimates and further requirements for spent fuel storage and disposal. Therefore, I recommend that the Commission require of PP&L that it take clear and significant efforts to mitigate its future nuclear stranded investment. PP&L's shareholders funding the decommissioning provides an opportunity to demonstrate the Company's good faith and to protect citizens and the environment.

Responsibility for nuclear obligations

Q. Are you recommending that PP&L's customers pay additional amounts to the cover nuclear decommissioning costs?

A. No. This is exactly what I am concerned about. Providing assurance of adequate funding for safe and timely nuclear decommissioning is imperative. At the same time, customers should not be saddled with an open-ended obligation to bear these costs. I am concerned that PP&L's customers will be asked in the future to pay for additional, as-yet-unfunded nuclear decommissioning costs. I am also concerned that the Commission avoid enabling the same kind of cost-plus de-construction that plagued the nuclear power industry's construction efforts, contributing to the high costs of nuclear capacity.

Q. Is it efficient for PP&L to bear responsibility for the cost of decommissioning its nuclear capacity?

A. Yes, it is efficient in several different ways. First, there is the fuzzy line between operating costs and decommissioning costs.

It is possible to run the Susquehanna plant in a very clean manner, with somewhat higher operating costs but lower decommissioning costs. For example, by thoroughly decontaminating equipment and by removing radioactive wastes from the site during the plant's operating life, decommissioning costs will be lower. Conversely, if operating costs are kept low by only doing essential decontamination and by storing radioactive wastes at the plant site, decommissioning costs will be higher. Unfortunately, the competitive market that Susquehanna's operators are entering will tend to encourage the operators toward shifting such costs into the future.

If operating costs and decommissioning costs are treated differently (e.g., the former recovered in market prices and the latter recovered in a wires charge, like the CTC) then inefficient decisions may result. Certainly, it would be an important, if somewhat burdensome, regulatory necessity to watch the boundary between operation and decommissioning.

Also, an efficient incentive structure would have the nuclear plant owner responsible for at least some of the decommissioning costs. Cost-based regulation is arguably responsible for the nuclear plant construction cost debacle. Electricity restructuring is motivated in large measure by a desire to move away from a system in which a utility's cost recovery is based entirely on what it spends. By allocating substantial decommissioning costs to operators instead of to customers, the Commission would help ameliorate some of the pressures toward higher decommissioning costs.

We should not rely on the cost-plus, customer-pays system for a cost as large and important as nuclear plant decommissioning. Rather, the nuclear plant owner should bear its rightful responsibility for the costs of decommissioning, in a sensible, fair and efficient framework, in which there are reasonable incentives to control decommissioning costs.

A further concern is the reorganization of the electricity industry, including what we presently know as PP&L. For instance, PP&L may in the future spin its nuclear assets off into generating companies that lack the solid funding of the T&D monopoly. As the formerly PP&L nuclear units ended their useful lives, we could find the nuclear generating companies undercapitalized, unable to handle the true cost of decommissioning and waste storage/disposal. It is safer, and more equitable, if society now invests in the decommissioning of the nuclear plants, rather than saddling our children with the cost responsibility. This investment should be fairly shared.

The worst case scenario is a future in which "hot" shut-down nuclear plants remain in place, for lack of funds to properly dismantle them and store the radioactive waste. Pennsylvania cannot afford the burden of untended nuclear derelicts in the 21st century; and the state will not have the option of letting them sit relatively unattended, as it has with many old non-radioactive steel-making facilities. As a component of a restructuring plan, requiring the present nuclear owner and operator to "mitigate" by reducing unfunded obligations with shareholder funds is a reasonable expectation.

Q. PP&L proposes that the Commission extend the CTC "beyond the nine-year window provided by the Act to permit recovery of its nuclear decommissioning costs of the remaining life of the Susquehanna generating plant" (Kleha direct testimony, page 14). Do you agree with this proposal?

a. I agree with PP&L's proposal in part. It may be reasonable to have a "wires charge" for a portion of the decommissioning funding.

It is not reasonable, however, to have the wires charge be the sole means for funding the Company's nuclear decommissioning obligations. This would, in effect, provide a subsidy to the continued operation of the plant. It would also relieve the plant operator from the burden of controlling decommissioning costs.

The Commission should develop a decommissioning policy in which the obligation to pay for nuclear decommissioning costs is shared in an equitable and efficient manner between the customers (in a wires charge) and the generation portion of the company (which could attempt to recover these costs in the market prices charged for electricity). In this way, the operator of the nuclear units would have a direct financial interest in managing the magnitude of the decommissioning cost. With any system, all of the costs that are collected for decommissioning -- those from the wires charge and those from the plant operator -- should be placed in one or more external funds to ensure that they are available for plant decommissioning when needed. The Commission should not, at this point in time, extend the CTC.

Q. Does your proposal create a risk that decommissioning will not be adequately funded?

A. A policy that the nuclear plant owner will be responsible for a share of the decommissioning costs might, if implemented irresponsibly, create significant added risk of fund inadequacy. However, I believe that if the sharing mechanism is well designed, and the Company acts responsibly, then there is little added risk.

In my view there is some substantial benefit to having the owner "involved" in the funding, making decommissioning a central concern of management rather than a diversion of attention with costs that will be passed directly through to captive customers in a wires charge. Moreover, the utility's share of the decommissioning obligation can and should be placed into the external fund, in order to provide added assurance of the availability of funds. I understand that the Nuclear Regulatory Commission, which has an important role in assuring that decommissioning funding is in place, would not have a problem with such a proposal.

Q. How should the Commission go about developing a policy to address this difficult situation?

A. I recommend that the Commission undertake a process to establish this policy, ideally on a generic basis, for all of the utilities in the state with nuclear investments. Fortunately, the PP&L and PECO restructuring orders will issue at the same time, in January 1998, allowing the Commission to effectively set a generic policy with two of

the state's larger nuclear owners. The following information should be collected from the companies and considered in developing the specific approach:

- estimation of the amount of decommissioning cost that is dependent upon continued operation of the plants,
- analysis of the degree of uncertainty in the current decommissioning estimates,
- identification of the activities and costs that are in the “grey area” between nuclear decommissioning and plant operations and the development of protocols for ensuring that costs that should be a part of ongoing plant operation do not slip into decommissioning,
- examination of the implications of national spent fuel disposal policy upon decommissioning timing and cost,
- analysis of the tax implications of a shared funding approach, and
- analysis of the funding assurance implications, including the connection with any NRC decisions on decommissioning funding for utilities in a restructured environment.

Q. What about the obligation to dispose of spent nuclear fuel?

A. Currently, nuclear plant owners pay a one mill per kWh charge to the Department of Energy to cover the costs of the high-level radioactive waste disposal program. The nature of the DOE's obligations to accept nuclear waste, most importantly the timing of that acceptance, is currently a disputed matter, and subject to considerable uncertainty.

In PP&L's filing, these costs of spent nuclear fuel disposal are included in the nuclear fuel cost projections (Exhibit JRS 1, Tab A, page 3) and hence have been reflected in the calculation of the market value of PP&L's nuclear units. The same is true for “costs associated with supplemental on-site spent fuel storage” (Exhibit JRS 1, Tab A, page 3). If these costs are understated then PP&L should, in the future, bear responsibility for the under-funding of the fuel disposal obligation.

Q. What do you recommend with regard to the responsibility for nuclear obligations, such as spent fuel and nuclear decommissioning?

A. My recommendations are presented in the beginning of Section 5, above.

6. Rate Design for Stranded Cost Recovery

Q. How does PP&L propose recovering its stranded cost?

A. PP&L has proposed a “customized rate design” for the CTC through which the company will recover stranded costs. Rather than having a per kWh charge for the CTC, the proposal is to move one half of the charge to a fixed payment, based upon the customer’s kWh consumption in calendar year 1996. The remaining half would be based upon actual kWh usage as it evolves over time. (Tierney direct testimony, page 5)

Q. Would all of PP&L’s customers be on the “customized rate design?”

A. No. PP&L proposes that this would be mandatory for commercial and industrial customers, and optional for residential customers (Tierney direct testimony, page 21). Presumably, to the extent that they have full information and are make rational choices, residential customers with increasing usage will opt onto the customized rate, while those with decreasing usage will not. Customers of any class who are on the rate have an added incentive to increase consumption relative to a scenario in which they face a volumetric price structure.

Q. What reasons does the Company give for proposing the customized rate?

A. Dr. Tierney lists three reasons for believing that the rate is desirable (quoted from Tierney direct testimony, pages 20 and 21):

- It is socially efficient: consumers making consumption decisions on the margin should not be influenced by transition costs.
- It speeds the transition to the competitive world, by reducing the influence of transition charge recovery on prices in emerging competitive markets.
- And it fosters economic development as commercial and industrial customers “see” prices that more accurately reflect the cost to serve.

Q. Do you agree with the Company?

A. No. I believe that “social efficiency” is a term that necessarily includes all of the costs of electricity production and use, even those that are not directly included in current market costs. For example, in thinking about social efficiency it is important to consider the health and environmental costs of air pollution from power plants.

These “externalities” can be large. For example, one set of calculations of the health and environmental damages of existing coal generation estimate the external costs to be between 2 cents per kWh and 7 cents per kWh depending upon the assumptions used. These are “damage cost” estimates for a hypothetical 300 MW unit with typical existing

coal plant emissions factors, located on the lower Hudson in New York State. They were calculated using “EXMOD,” a computer model for estimating power plant human health and environmental damages developed for the “Empire State Electric Energy Research Corporation.”

Using the “marginal cost of control” values adopted by Dr. Tierney when she served as a Department of Public Utilities Commissioner in Massachusetts (see DPU order 89-239, August 31, 1990), the social costs of an existing coal unit for air emissions alone can be well in excess of 10 cents per kWh. Any policy claiming to be “socially efficient” must recognize these costs.

Q. Do you agree that the customized rate design “speeds the transition to the competitive world?”

A. I do not. Policies that promote open access and provide opportunities for entry to the market by new competitors speed the transition to competition. Providing customers with declining block rates or other creative rate structures for the stranded cost portion of their electricity bill does not hasten real competition in any meaningful way.

Q. Will the customized rate design “foster economic development” among commercial and industrial customers?

A. Perhaps. Some large customers, with a portion of their bill “fixed” based upon 1996 levels of electricity consumption, will proceed to consume more electricity in the future than they would have otherwise. However, electricity consumption is not synonymous with economic development. Promoting inefficient use of electricity in the name of economic development is not sound policy. The state should encourage clean and efficient economic development through other policies -- not by giving large and growing existing customers a break on their share of whatever stranded costs the Commission decides should be recovered.

Q. In your view is the customized rate design a fair way to recover stranded costs?

A. No. If any stranded costs are to be recovered, the rate design should be a simple volumetric charge that is non-bypassable. All customers at a particular time should pay the same amount per kWh.

Dr. Tierney has argued that the customized rate design is “fair because it more closely matches historical usage of generation and related costs to stranded cost recovery than does a pure usage-based charge” (PP&L Response to Interrogatories of the Office of Consumer Advocate, Set III, Question 33). According to PP&L’s estimate, \$2.9 billion out of \$4.6 billion total stranded costs is associated with the Susquehanna plant (Exhibit JRS 1, Tab B, page 1). To the extent that one takes the view (consistent with Dr. Kalt’s

direct testimony on behalf of PP&L) that the stranded nuclear assets were built to serve growing load, that load included forecast increasing sales to existing commercial and industrial customers as well as new customers moving into the service territory. Moreover, because the plant was and is a baseload unit, then the high load factor customers, like the industrials, have a particularly large responsibility for it. They should pay their share of the Susquehanna costs, rather than secure the discount that the Company proposal would provide them.

In fact, the stranded portion of power supply assets is by definition uneconomic -- and not "used and useful" in serving anyone. It makes no sense to construct a complex, non-standard design for recovering such costs, and justifying it on the basis of fairness. For costs of this sort a simple allocation based upon kWh sales seems appropriate and fair.

Q. What is the cost of implementing the customized rate design?

A. The Company does not know. The Environmentalists inquired about the cost of implementing the customized rate design and PP&L responded that "The Company has not conducted any analysis that addresses the activities or costs of implementing the customized rate design option" (PP&L Response to Interrogatories of the Environmentalists. Set 2, Question 108).

I believe it will be unnecessarily expensive. While I cannot say what the cost would be, it is clear that the customized rate design option will add a layer of complexity and cost to PP&L's billing activities. Each individual customer's usage in 1996 must be kept and used to figure subsequent bills. Issues will surely arise as to whether certain customers are "new" or had some anomaly in their 1996 metered usage. There is also the unnecessary, added complexity for the customers -- who will already be inundated with complex, but important and necessary, information about electricity restructuring, unbundled bills, and competing electricity service offers.

Q. Please summarize your findings and recommendations with regard to PP&L's customized rate redesign.

A. I find that the customized rate design is unnecessarily complex, unfair, and does not promote true efficiency or the development of competitive markets. I recommend that the Commission adopt a simple, non-bypassable, volumetric charge for any stranded cost recovery that is allowed.

Q. Does this conclude your testimony?

A. Yes.