

1. <u>REPORT DATE:</u> October 10, 1991	2. <u>BUREAU AGENDA NO.:</u> OCT-91-OSA-172*
3. <u>BUREAU:</u> Office of Special Assistants	5. <u>PUBLIC MEETING DATE:</u> October 24, 1991
4. <u>SECTION(S):</u>	
6. <u>APPROVED BY:</u> Director: C. W. Davis Supervisor:	
7. <u>MONITOR:</u>	
8. <u>PERSON IN CHARGE:</u> A. Arnold 7-8032	
9. <u>DOCKET NO.:</u> A-110550, F055	
10. (a) CAPTION (abbreviate if more than 4 lines) (b) Short summary of history & facts, documents & briefs (c) Recommendation	

DOCKETED

FEB -4 1992

- (a) Application of Philadelphia Electric Company
- (b) On March 6, 1991, the Commission adopted an Order which denied the Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval ("Petition/Petitioners") of an order entered February 9, 1990 which granted Philadelphia Electric Company's ("PECO") authority to reconstruct an abandoned Conrail 138 kv electric line as the Woodbourne-Heaton 230 kv line. On April 2, 1991, Petitioners filed a Petition for Review with the Commonwealth Court. On April 26, 1991, Petitioners applied for a stay pending review. On May 24, 1991, the Commonwealth Court, per Judge Palladino, issued an order remanding the matter to the Commission to hold a hearing on the question of whether Petitioners will be adversely affected. On September 3, 1991, Petitioners filed a Request for production of Documents which is directed to the Commission.
- (c) The Office of Special Assistants recommends that the Commission adopt the attached Opinion and Order which denies the request.

OPINION

ORDER

11. MOTION BY: Commissioner Rhodes
SECONDDED: Commissioner Chm. Smith

Commissioner Holland - Concurring &
Commissioner Dissenting in part
Commissioner Rolka - Yes

CONTENT OF MOTION: That prosecutory staff comply with Petitioners' Requests for production of Documents Numbers 1, 2, and 5; compliance with ordering paragraph 1 shall be sufficient upon provision of a bibliography of reports and studies about EMF that are in the prosecutory staff's possession and by making available copies of only those reports or studies that Petitioners do not possess or cannot obtain; prosecutory staff shall not provide any advisory memoranda or reports on EMF or any other subject that may have been prepared by advisory staff; OSA shall draft the appropriate Order.



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P. O. BOX 3265, HARRISBURG, Pa. 17120

December 12, 1991

IN REPLY PLEASE
REFER TO OUR FILE

A-110550, Folder 55

PAUL R BONNEY ESQUIRE
PHILADELPHIA ELECTRIC COMPANY
2301 MARKET STREET PO BOX 8699
PHILADELPHIA PA 19107

In re: Application of Philadelphia Electric Company

To Whom It May Concern:

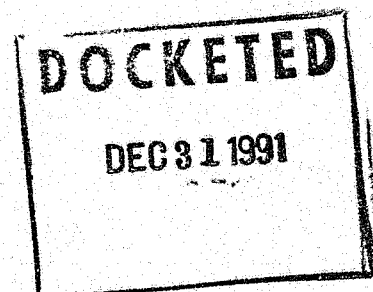
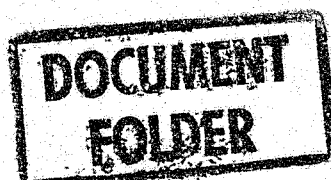
This is to advise you that the Commission at Public Meeting held October 24, 1991 adopted an Opinion and Order in connection with the above entitled proceeding.

A copy of the Opinion and Order is enclosed for your records.

Very truly yours,

Jerry Rich, Secretary

JZ
Encls.
Certified Mail
Receipt Requested
Copy of Opinion and Order to: See attached list.



NVZ

117 PARK AVENUE
WILLOW GROVE PA 19090
TOWNSHIP OF LOWER MORELAND

0006
CHARLES G. MARTE, JR., SOLICITOR
344 SOUTH BELLEVUE AVENUE
LANGHORNE PA 19047
LOWER SOUTHAMPTON TOWNSHIP

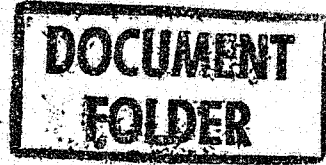
0007
KATHLEEN E. O'DOLAN, MANAGER
DENNIS O'BRIEN, CHAIRMAN
1500 DESIRE AVENUE
FEASTERVILLE PA 19047
LOWER SOUTHAMPTON TWP

0008
JOHN J. GERRARD, CHAIRMAN
PLANNING COMMISSION
1500 DESIRE AVENUE
FEASTERVILLE PA 19047
LOWER SOUTHAMPTON TWP

0009
ROBERT J. MELLAGRING, TWP MANAGER
DAVID SHAFER & JERRY S. GOLDMAN
989 STREET RD
SOUTHAMPTON PA 18966
UPPER SOUTHAMPTON TWP

POOR ORIGINAL

PENNSYLVANIA
PUBLIC UTILITY COMMISSION
Harrisburg, PA 17120



Public Meeting Held October 24, 1991

Commissioners Present:

William H. Smith, Chairman
Joseph Rhodes, Jr., Vice-Chairman
Wendell F. Holland, Concurring & Dissenting in part
David W. Rolka

In re: Application of Philadelphia
Electric Company

A-110550, Folder 55

DOCKETED

DEC 31 1991

OPINION AND ORDER

BY THE COMMISSION:

Before the Commission for consideration is the self-styled, Petition of Protestants for Discovery From the Commission, filed on September 3, 1991 in the above-captioned matter. There are no recorded responses to said petition.

History of the Proceeding

On November 21, 1989, Philadelphia Electric Company ("PECO") initiated proceedings pursuant to our regulations at 52 Pa. Code Sections 57.72(d), et seq. relating to letter notification in lieu of application, for the siting and construction of electric transmission lines. Through this request, PECO proposed to reconductor and rebuild an existing high voltage 138kv transmission line to operate as the Woodbourne-Heaton 230kv line within Montgomery and Bucks County.

By Order entered February 9, 1990, we granted approval to rebuild the above-described Woodbourne-Heaton line.

On September 14, 1990, Robert Small, Frank English and Diane Koerper, on behalf of themselves and others similarly situated, filed an Emergency Petition of Non-Noticed Property Owners to Intervene For Reopening and To Suspend Approval of our

February 9, 1990 Order.¹

The Emergency Petition... averred, among other things, that Robert Small, et al. ("Protestants" hereafter) did not receive actual notice of PECO's letter notification and that their property rights would be adversely affected by the reconstruction. It was also averred that had Protestants been permitted the opportunity to intervene they would present the following issues: (1) whether the proposed line was needed, (2) whether the line would create a health risk because of the intrusion of electromagnetic fields (EMF) generated by the line on Protestants' property through encroachment on their airspace, and (3) whether the proposed line would negatively affect aesthetics, would cause interference with television or radio reception, would heighten the potential for destructive fires, and would depreciate their property values. Protestants subsequently alleged that PECO erroneously used the letter notification procedure because of certain misstatements of fact.

On September 18, 1990, PECO filed an Answer to the Emergency Petition..., essentially arguing that Protestants had no property rights which would be adversely affected by the reconstruction and that it properly utilized the letter notification procedures in this matter. PECO also argued that Protestants had not alleged any new or novel evidence that they would present, if given the opportunity.

On January 3, 1991, the Office Of Consumer Advocate ("OCA") filed a Notice of Intervention and statement in support of the Emergency Petition. The OCA took no position on the merits of Protestants' allegations, but supported their procedural request for a hearing. The OCA also raised the issue of whether the difference between a 138kv line and the proposed 230kv line is substantial. PECO replied to OCA's statement.

By Order entered March 8, 1991, we denied the Emergency Petition.

On April 2, 1991, Protestants filed a Petition for Review with the Commonwealth Court requesting that the Court set aside the Commission Order denying reopening and remand the matter for a hearing. On April 26, 1991, Protestants also filed with the

¹ Robert Small, Frank English and Diane Koerper, et al. are members of a Pennsylvania non-profit corporation, Parents Against an Unsafe Environment (PAUSE).

Court a Petition for Stay Pending Review which Petition requested that construction of the Woodbourne-Heaton line be delayed pending review.

On May 24, 1991, the Commonwealth Court, per Judge Palladino, issued a Memorandum Opinion and Order (unreported) which remanded the matter to the Commission for a hearing on the question of whether Protestants will be adversely affected by the reconductoring of the high tension electrical line at issue. See No. 761 C.D. 1991.

Discussion

In the proceedings on remand, Protestants, by cover letter dated August 27, 1991, filed a Petition pursuant to Section 334 of the Public Utility Code, requesting the Commission to make disclosure of certain documents.² The averments in support of the request are reprinted below:

1. This Commission has already adopted a substantive decision with respect to the EMF issue which is before the ALJ at this time, based on non-record considerations.
2. While various Commissioners and public statements, and the Commission in its decision, alluded to various studies, there is no indication that the Commissioners and the staff may have considered other literature and other sources of information.
3. Since the question will be coming before the Commission again, and since the ALJ should have the benefit of all available information which the Commissioners considered persuasive or influential, it is appropriate, and necessary, in the interest of full disclosure, that all sources considered are made available to the Commission be known to the Protestants.
4. There is no other possible means by which the information could be made available other than disclosure by the Commissioners themselves and by the staff which wrote the

² Interrogatories to the Commission are properly requested under Section 333(d) of the Public Utility Code, 66 Pa. C.S. Section 333(d).

Commissions' opinion based on the meeting of March 6, 1991.

5. The attached interrogatories request that the information, except for that available through seminars, which is being furnished to the Protestants as a result of the Order of the ALJ upon the Prosecutorial Staff. These interrogatories were served upon Prosecutorial Staff, which has declined to act on them pursuant to Section 334, because the Law Bureau is now acting as Prosecutorial Staff, and it would be inappropriate for the said Prosecutorial Staff to advise the Commission in responding to these interrogatories.

WHEREFORE, Protestants petition that the Commission release the information sought in the interrogatories pursuant to Section 334 of the Public Utility Code.

Through this request, Protestants seek production of the following documents from the Commission:

1. All EMF studies available to the Commission.
2. Applicable safety standards for 238 KV transmission lines being constructed new in 1991.
3. Transcripts or best available compilation of data presented at Commission sponsored seminars on EMF, 1985 -1991.
4. All documents received and/or distributed by the Commission at the EMF seminars, 1985 - 91.
5. All economic studies available to the Commission relating to the costs of adjusting electrical facilities standards to deal with EMF, and/or the potential liabilities of not avoiding EMF exposure.

The pertinent section of the Public Utility Code pertaining to interrogatories addressed to the Commission is found at 66 Pa. C.S. Section 333(d). That section states as follows:

...Interrogatories directed to the commission shall be allowed only upon an order of the commission based upon a specific finding that the interrogating party is seeking significant, unprivileged information not discoverable by alternative means...

Further, we are bound by the Right-to-Know Law, 65 P.S. Section 66.1, et seq., and the Sunshine Act, 65 P.S. Section 271, et seq., with regard to our taking official action. Additionally, 66 Pa. C.S. Section 335(d) of the Code, pertaining to release of documents, requires us to make part of the public record and release publicly, documents relied upon in reaching a determination on an investigation of an act or practice of a public utility.³

On consideration of the request of the Protestants, we shall, hereby, grant said request subject to the considerations more fully explained below.

Generally, there are two means by which a party may seek access to internal Commission documents. A party may serve interrogatories upon an appropriate Commission official so designated for the preparation of answers. This method would be part of a formal, ongoing proceeding and such a request would have to comport with the conjunctive criteria that the information sought is significant, unprivileged and not discoverable by alternative means. 66 Pa. C.S. Section 333(d). See Re Tristate Household Goods Tariff Conference, Inc., Agent, 59 P.U.C. 301 (1985); Pennsylvania Public Utility Commission v. West Penn Power Company, Docket No. R-901609 (Order entered July 20, 1990); Pennsylvania Public Utility Commission v. Pike County Light and Power Company, 57 P.U.C. 529 (1983).

In addition to interrogatories addressed to the Commission pursuant to 66 Pa. C.S. Section 333(d), a party may proceed in accordance with our regulations at 52 Pa. Code Section 1.71-1.77, pertaining to public access to Commission records. Staff reports, investigative materials and all other materials not subject to public disclosure requirements are placed in our files under "Report Folder." Materials in our Report Folder are not available for public inspection except as provided for on petition made to the Commission. 52 Pa. Code Section 1.74.

³ Documents protected by legal privilege, proprietary information, and information which could operate to the prejudice or impairment of one's reputation or subject one to retaliation are excluded.

The subject of EMF was the focal point of extensive comment at our Public Meeting of March 6, 1991. Chairman William H. Smith, Vice-Chairman Joseph Rhodes, Jr. and Commissioners Wendell F. Holland and David W. Rolka submitted prepared statements which were entered into the record.

Chairman Smith's statement and comments of March 6, 1991 reference ten studies, and/or reports. None of the studies and/or reports cited by Chairman Smith are materials outside of the public domain.

Likewise, Commissioner Holland, who cited a potential National Association of Regulatory Utility Commissioners study, a site visit to the affected area of the proposed transmission line, and decisions of the Maryland and New Jersey Public Service Commissions along with two Orders of this Commission which reference the issue of EMF, alluded to no authority not discoverable with the exercise of reasonable diligence.

Also, Commissioners Rhodes and Rolka, in their prepared statements, acknowledged materials and/or studies and reports available to the public.

To date, this Commission has not formally adopted a substantive position on EMF, contrary to the averment of Protestants in their petition.⁴ Our Order of March 6, 1991 was clear in stating the following: "Although the Commission has not independently investigated the issue of EMF, it is well apprised of current scientific thought on this subject. We, therefore, cannot agree with the Petitioners' conclusion that EMF from high voltage transmission lines represents an acknowledged health risk." Slip op. at page 13.

The Protestants' request seeks those documents by which they may learn the evidentiary basis for our Order adopted on March 6, 1991 in this proceeding.⁵ While Protestants have a right to

⁴ Individual statements of Commissioners are not binding upon the Commission. 52 Pa. Code Section 1.96.

⁵ The Presiding Administrative Law Judge has ordered that the Prosecutory Staff provide Protestants with the documents described in Paragraph Nos. 3 and 4 of their Petition. Consequently, those requests are satisfied,

know what evidence has been considered by the Commission, they do not have a right to staff advisory reports or to the deliberations of the Commission beyond what appears in the opinions of individual Commissioners and the orders of the Commission. The instant request does not seem to request such privileged advisory reports or deliberative materials.⁶

Notwithstanding that our March 6, 1991 Order had the practical effect of dismissing Protestants' claims without a hearing on the issues they alleged, our determination would be no less subject to the protection of the deliberative process privilege were it implicated in this request.

Based on the foregoing, we will direct our Prosecutory Staff to comply with the Protestants' request for the production of documents identified in Paragraph Nos. 1, 2, and 5 of their Petition.

Compliance with Paragraph No. 1 shall be sufficient upon provision of a bibliography of reports and studies about EMF that are in the Prosecutory Staff's possession and by making available copies of only those reports or studies that Protestants do not possess or cannot obtain.

Prosecutory Staff shall not provide any advisory memoranda or reports on EMF or any other subject that may have been prepared by advisory staff.

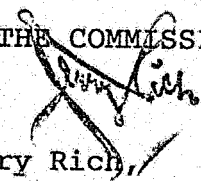
The subject of EMF, and its health effects, will be a material issue in the instant proceeding. To the extent parties would have the Commission take official notice of facts not appearing in the evidence, or exercise judicial notice of any material facts, they should be cognizant of 66 Pa. C.S. Section 332(e) and our regulations at 52 Pa. Code Section 5.408; THEREFORE,

⁶ The deliberative process privilege protects the Commission from the disclosure of its mental processes derived from staff reports. As an administrative agency, our decisional process should be free from public or private inquisition as would judicial proceedings. Pennsylvania v. Pennsylvania Public Utility Commission, 17 Pa. Commonwealth Court 351, 331 A. 2d 598 (1975).

IT IS ORDERED:

1. That the Petition of Protestants for Discovery From the Commission be, and is hereby, granted to the extent delineated within the body of this Order.

BY THE COMMISSION


Jerry Rich,
Secretary

(SEAL)

ORDER ADOPTED: October 17, 1991

ORDER ENTERED: DEC 12 1991

PENNSYLVANIA
PUBLIC UTILITY COMMISSION
Harrisburg, PA 17120

Public Meeting Held October 24, 1991

Commissioners Present:

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Chairman Smith's statement and comments of March 6, 1991 reference ten studies, and/or reports. None of the studies and/or reports cited by Chairman Smith are materials outside of the public domain.

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Also, Commissioners Rhodes and Rolka, in their prepared statements, acknowledged materials and/or studies and reports available to the public.

To date, this Commission has not formally adopted a substantive position on EMF, contrary to the averment of Protestants in their petition.⁴ Our Order of March 6, 1991 was clear in stating the following: "Although the Commission has not independently investigated the issue of EMF, it is well apprised of current scientific thought on this subject. We, therefore, cannot agree with the Petitioners' conclusion that EMF from high voltage transmission lines represents an acknowledged health risk." Slip op. at page 13.

The Protestants' request seeks those documents by which they may learn the evidentiary basis for our Order adopted on March 6, 1991 in this proceeding.⁵ While Protestants have a right to

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⁵ The Presiding Administrative Law Judge has ordered that the Prosecutory Staff provide Protestants with the documents described in Paragraph Nos. 3 and 4 of their Petition. Consequently, those requests are satisfied,

know what evidence has been considered by the Commission, they do not have a right to staff advisory reports or to the deliberations of the Commission beyond what appears in the opinions of individual Commissioners and the orders of the Commission. The instant request does not seem to request such privileged advisory reports or deliberative materials.⁶

Notwithstanding that our March 6, 1991 Order had the practical effect of dismissing Protestants' claims without a hearing on the issues they alleged, our determination would be no less subject to the protection of the deliberative process privilege were it implicated in this request.

Based on the foregoing, we will direct our Prosecutory Staff to comply with the Protestants' request for the production of documents identified in Paragraph Nos. 1, 2, and 5 of their Petition.

Compliance with Paragraph No. 1 shall be sufficient upon provision of a bibliography of reports and studies about EMF that are in the Prosecutory Staff's possession and by making available copies of only those reports or studies that Protestants do not possess or cannot obtain.

Prosecutory Staff shall not provide any advisory memoranda or reports on EMF or any other subject that may have been prepared by advisory staff.

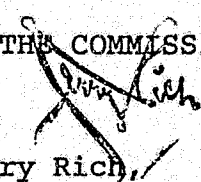
The subject of EMF, and its health effects, will be a material issue in the instant proceeding. To the extent parties would have the Commission take official notice of facts not appearing in the evidence, or exercise judicial notice of any material facts, they should be cognizant of 66 Pa. C.S. Section 332(e) and our regulations at 52 Pa. Code Section 5.408; THEREFORE,

⁶ The deliberative process privilege protects the Commission from the disclosure of its mental processes derived from staff reports. As an administrative agency, our decisional process should be free from public or private inquisition as would judicial proceedings. Pennsylvania v. Pennsylvania Public Utility Commission, 17 Pa. Commonwealth Court 351, 331 A. 2d 598 (1975).

IT IS ORDERED:

1. That the Petition of Protestants for Discovery From the Commission be, and is hereby, granted to the extent delineated within the body of this Order.

BY THE COMMISSION


Jerry Rich,
Secretary

(SEAL)

ORDER ADOPTED: October 17, 1991

ORDER ENTERED: **DEC 12 1991**

X-Cal
10-24-91
ED

PENNSYLVANIA
PUBLIC UTILITY COMMISSION
HARRISBURG, PA. 17120

Petitioners Request for
Production of Documents

Public Meeting
October 24, 1991
Docket No. A-110550, F055
OCT-91-0SA-172

MOTION OF COMMISSIONER JOSEPH RHODES, JR.

On September 3, 1991, Petitioners filed a Request for Production of Documents. This Petition follows and repeats a previous Request for Production of Documents made on May 31, 1991.

Both discovery requests sought five categories of documents: 1) "EMF studies available to the Commission"; 2) "safety standards for 238 KV transmission lines being constructed new in 1991"; 3) "Transcripts or best available compilation of data presented at Commission sponsored seminars on EMF, 1985-1991"; 4) "All documents received and/or distributed by the Commission at the EMF seminars, 1985-91"; and 5) "All economic studies available to the Commission relating to the costs of adjusting electrical facilities standards to deal with EMF, and/or the potential liabilities of not avoiding EMF exposure." ALJ Smolen ordered that Commission prosecutory staff provide Petitioners with the documents described in Numbers 3 and 4. Apparently, Petitioners already have received such material. Consequently, those requests are satisfied.

As the remainder of Petitioners' Request for Production of Documents makes clear, Petitioners seek these documents to learn the evidentiary basis for the Commission's Order adopted on March 6, 1991 in this proceeding. Adopted 3-2, with Commissioner Rolka and I dissenting, the March 6, 1991 Order stated:

Although the Commission has not independently investigated the issue of EMF, it is well apprised of current scientific thought on this subject. We, therefore, cannot agree with the Petitioners' conclusion that EMF from high voltage transmission lines represents an acknowledged health risk. The overwhelming consensus in the technical community, after review of available epidemiological and scientific studies, is that there is no conclusive evidence of the adverse health effects associated with EMF from electric transmission lines.

This section of the order constitutes a finding on the merits of the issue about the safety of EMF. Such a finding was premature in my opinion.

It is basic to a fair proceeding that decisions should be limited to the record and, if evidence beyond the record is relied upon, decision-makers should take judicial notice of that evidence. The purpose of these rules is to make sure that all parties know fully what evidence influenced the outcome of their case. In his March 6th Dissenting Opinion, Commissioner Rolka suggested that references to scientific and other literature on EMF were in the nature of official or judicial notice of these documents, and our regulations at 52 Pa Code 5.408 entitled the Petitioners to notice and opportunity to respond to these documents.

While Petitioners have a right to know what evidence has been considered by the Commission, Petitioners do not have a right to staff advisory reports or to the deliberations of the Commission beyond that which appears in the opinions of individual Commissioners and the orders of the Commission. Petitioners' Request for Production of Documents, however, does not seem to request such privileged advisory reports or deliberative materials.

Speaking for myself, at the time of the March 6, 1991 Order, I tried to separate the substance of the EMF controversy from the decision on whether Petitioners had a right to a hearing. The merits of the EMF controversy were not addressed in my March 6, 1991 Dissenting Opinion. Having said that, beyond the one study specifically mentioned in my Dissenting Opinion of March 6, 1991, I wish to inform all parties that I have reviewed the October 1990 Environmental Protection Agency Report entitled "Evaluation of the Potential Carcinogenicity of Electromagnetic Fields."

In their March 6th statements, Chairman Smith and Commissioner Holland also identified various materials that they reviewed on the EMF subject. This disclosure was appropriate and should be mandatory at the staff level as well.

THEREFORE, I MOVE THAT:

1. Prosecutory staff comply with Petitioners' Requests for Production of Documents Numbers 1, 2, and 5;
2. Compliance with ordering paragraph 1 shall be sufficient upon provision of a bibliography of reports and studies about EMF that are in the prosecutory staff's possession and by making available copies of only those reports or studies that Petitioners do not possess or cannot obtain;

Page Three
OCT-91-OSA-172
October 24, 1991

3. Prosecutory staff shall not provide any advisory memoranda or reports on EMF or any other subject that may have been prepared by advisory staff;
4. OSA draft the appropriate order.

10/23/91
Date

Joseph Rhodes, Jr.
Joseph Rhodes, Jr.
Commissioner

CROWELL & MORING

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44-71-936-3036

FACSIMILE 44-71-936-3035

November 1, 1991

183:5067
67480.010

VIA TELECOPY

Tanya J. McCloskey, Esquire
Assistant Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120

DOCUMENT
FOLDER

NOV 4 1991

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

Dear Ms. McCloskey:

Enclosed are Philadelphia Electric Company's supplemental answers to the
Office of Consumer Advocate's Interrogatories and Requests for Production of
Documents and Data for the Applicants, Set II. Copies of Mr. Van Dyke's land use
publications will be sent by mail.

Sincerely,

Ward L. Smith

Ward L. Smith

Attachment

NVL

cc: Jerry Rich, Secretary
See Certificate of Service

NOV 4 1991

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

By Telecopy and First Class Mail

Tanya J. McCloskey, Esquire
Assistant Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120

David Rosenbaum
Risk Analysis Corp.
Suite 202
6723 Whittier Avenue
McLean, VA 22101
(OCA Consultant)

Robert J. Sugarman, Esquire
Sugarman & Associates
16th Floor, City Place
101 North Broad Street
Philadelphia, PA 19107
(Counsel for Intervenors)

By First Class Mail

Patricia Krise Burket, Esquire
Pennsylvania Public Utility Commission
G-28, North Office Building
P.O. Box 3265
Harrisburg, PA 17120

(Continued)

Tinku Khanwalkar, Esquire
Pennsylvania Power & Light Co.
Two North Ninth Street
Allentown, PA 19101

Ward L. Smith

Ward L. Smith
Counsel to Philadelphia Electric Co.
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2505

Dated: November 1, 1991

NOV 4 1991

SUPPLEMENTAL CERTIFICATE OF SERVICE

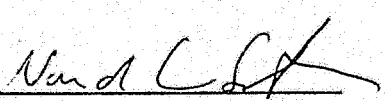
I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

Since the original certificate of service was filed we have been informed that Mr. Sugarman's address has changed. This supplemental certificate of service indicates that a copy of Philadelphia Electric Company's supplemental answers to the Office of Consumer Advocate's Interrogatories and Requests for Production of Documents and Data for the Applicants, Set II was served to the below address.

By First Class Mail

Robert J. Sugarman, Esquire
Sugarman & Associates
100 N. 17th Street
7th Floor
Philadelphia, PA 19103
(Counsel for Intervenors)

NOV 05 1991


Ward L. Smith
Counsel to Philadelphia Electric Co.
Crowell & Moring
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Dated: November 1, 1991

NOV 11 1991
FBI

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November 7, 1991

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VIA FEDERAL EXPRESS

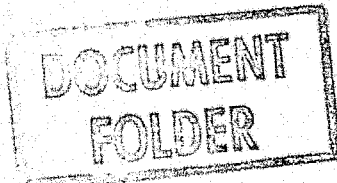
The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

RECEIVED
NOV 7 1991
SECRETARY'S OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

Dear Judge Smolen:

Enclosed are copies of the testimony of Drs. Bockman, Cole and Gelmann.
Copies have also been served on all parties this day by overnight mail.



Sincerely,

Ward L. Smith
Ward L. Smith

cc: Robert J. Sugarman, Esquire
Tanya J. McCloskey, Esquire
Patricia Krise Burket, Esquire
Tinku Khanwalkar, Esquire
Paul Bonney, Esquire
Mr. Jerry Rich
Mr. David Rosenbaum

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Public Utility Commission

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I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

By Telecopy and Overnight Mail

David Rosenbaum
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NOV 15 1991

By Overnight Mail

Tanya J. McCloskey, Esquire
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The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

Mr. Jerry Rich
Secretary
Pennsylvania Public Utility Commission
Post Office Box 3265
Harrisburg, PA 17105-3265

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Public Utility Commission

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Two North Ninth Street
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Ward L. Smith
Counsel to Philadelphia Electric Co.
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2505

Dated: November 7, 1991

APPEARANCE SHEET

ALJ HEARING REPORT

PAY

DOCKET NO. A-110550F055

CASE NAME Notification of Philadelphia
Electric Company

HEARING LOCATION Philadelphia, PA.

HEARING DATE Nov. 19, 20 & 21, 1991

ALJ Smolen

CHECK THOSE BLOCKS WHICH APPLY:

Hearing held YES ☒ NO ☐

Testimony taken YES ☒ NO ☐

Hearing concluded YES ☐ NO ☒

Further hearing needed YES ☒ NO ☐ (X)

Estimated add'l days _____

RECORD CLOSED YES ☐ NO ☒

Briefs to be filed YES ☐ NO ☐

BENCH DECISION YES ☐ NO ☐

REMARKS: (X) HEARINGS ALREADY
SCHEDULED

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DEC 03 1991

Office of A. L. J.
Public Utility Commission

DOCKETED

NAMES, ADDRESSES AND TELEPHONE NUMBERS OF PARTIES OR COUNSEL OF RECORD
PLEASE PRINT CLEARLY
INCOMPLETE INFORMATION MAY RESULT IN DELAY OF PROCESS

DEC 1 0 1991

NAME and TELEPHONE NUMBER	ADDRESS			APPEARING FOR
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X WARD SMITH	1001 Pa Ave NW			Phila. Elec. Co.
Telephone No. (202) 624-1594	City Wash	State DC	Zip 20009	
X Tom Watson	1001 Pa Ave NW			Phila Elec. Co.
Telephone No. (202) 624-2510	City Wash	State DC	Zip 20004	

CHECK THIS BOX IF ADDITIONAL PARTIES
OR COUNSEL OF RECORD APPEAR ON BACK.



Robert G. Stonaker (C.R.C.)

Reporter

X Paul Bonney Telephone No. (215) 841-4252	Address 2301 Market St. City Phila. State PA Zip 19101	Philadelphia Electric Co.
X Jesse A. Dillon Telephone No. (215) 774-5013	Address Two North Ninth Street City Allentown State PA Zip 18101	Pennsylvania Power & Light Company
X Tanya J. McCloskey Dianne E. Dusmani Telephone No. (717) 783-8444	Address 1425 Strawberry Sp. City Hbg. State PA Zip 17120	Office of Consumer Advocate
X Robert J. Sugarman Telephone No. (415) 864-2500	Address 100 W 17th St City Phila. State PA Zip 19103	
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December 5, 1991

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183:5067

VIA FEDERAL EXPRESS

The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

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DEC 5 1991

SECRETARY'S OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

Dear Judge Smolen:

Enclosed are copies of the testimony of Dr. Rosenberg, Mr. Van Dyke, and Mr. Silva. Copies have also been served on all parties this day by overnight mail.

We anticipate that Dr. Rosenberg will be available for cross-examination the morning of Monday, December 16. Mr. Van Dyke also will be available for cross-examination on Monday, December 16, and if necessary on Tuesday, December 17. Mr. Silva will be available on Tuesday, December 17.

The testimony of Mr. Van Dyke refers to certain exhibits (Exhibits CVD-2 through CVD-8) which are not included with this package. These exhibits are very large maps and aerial photographs used in Mr. Van Dyke's analysis. Given the size of the exhibits (one of the exhibits apparently exceeds 50 sq. ft. in size) we did not include copies of the exhibits with the testimony at this time.

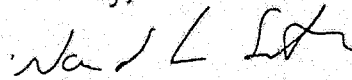
We have made provisions to have these exhibits photographically reduced, and the reduced exhibits should be available for distribution to the parties next week. If any party desires to examine the full size exhibits prior to trial, the exhibits

The Hon. Herbert S. Smolen
December 5, 1991
Page 2

are available for review. By this letter we ask that any party desiring such review contact us to request such review. In addition, the full exhibits will be available in the hearing room the morning of Monday, December 16.

Because these exhibits contain a large amount of visual information that may not be apparent in the reduced copies of the exhibits, we will ask for leave to allow Mr. Van Dyke to orally explain the exhibits at the hearing before he is turned over for cross-examination.

Sincerely,



Ward L. Smith

cc: Robert J. Sugarman, Esquire
Tanya J. McCloskey, Esquire
Patricia Krise Burket, Esquire
Jesse A. Dillon, Esquire
Paul Bonney, Esquire
Mr. Jerry Rich
Mr. David Rosenbaum

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

By Overnight Mail

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Philadelphia, PA 19130

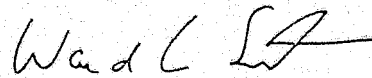
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(Continued)

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Allentown, PA 19101



Ward L. Smith
Counsel to Philadelphia Electric Co.
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2505

Dated: December 5, 1991

Philadelphia Electric Company Rebuttal Statement No. 4

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

RECEIVED

DEC 5 1991

SECRETARY'S OFFICE
Public Utility Commission

REBUTTAL TESTIMONY
OF
DR. MURRAY ROSENBERG

A110550755

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

REBUTTAL TESTIMONY OF DR. MURRAY ROSENBERG

CONTENTS

I.	Background and Qualifications	1
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	A. Ionizing Radiation	10
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	F. Power Frequency Fields	13
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IV.	Ion Cyclotron Resonance	17
V.	Conclusions	20

1 **I. Background and Qualifications**

2
3 Q Please state your name and business address.

4
5 A. Dr. Murray Rosenberg, 1445 Gortner, St. Paul, Minnesota 55108.
6

7
8 Q What is your occupation?
9

10 A. I am a biophysicist, a researcher and Professor of Genetics and Cell
11 Biology, and a medical doctor.
12

13
14 Q What is biophysics?

15
16 A. Biophysics is the study of interactions between physical forces and
17 biological material, and the physical analysis of biological systems.
18

19
20 Q Where are you employed?
21

22 A. I am a Professor of Genetics and Cell Biology at the University of
23 Minnesota, where I also have my research laboratory. My medical
24 practice is associated with the Aspen Medical Clinics in St. Paul,
25 Minnesota. I also teach as a Visiting Professor at Brown University
26 Medical School.
27

28
29 Q. Are you testifying today on behalf of the University of Minnesota or
30 any other organization?
31

32 A. No, I am testifying in my personal capacity as a physician and
33 researcher.
34

35
36 Q Please briefly describe your educational background.
37
38

1 A. My Bachelor's degree is in Math and Physics. I also hold an M.A.
2 degree in Math and Physics, a Master of Engineering Sciences degree,
3 and a Ph.D. in Applied Physics. All of these degrees are from Harvard
4 University in Boston.
5
6

7 Q Do you also have an M.D. degree?
8

9 A. Yes, I also hold an M.D. degree from Harvard Medical School.
10
11

12 Q Are you licensed to practice medicine?
13

14 A. Yes, I am licensed to practice medicine in three states and the
15 District of Columbia.
16
17

18 Q Please describe your medical training.
19

20 A. I conducted my residency at Beth Israel Hospital in Boston, which is
21 affiliated with Harvard Medical School. My medical training occurred
22 during the height of the U.S. polio epidemic -- before the discovery
23 of the Salk vaccine -- and I was selected to treat patients in the
24 polio ward.
25
26

27 Q Dr. Rosenberg, do your responsibilities include teaching duties?
28

29 A. Yes, I teach at both the University of Minnesota and at Brown
30 University Medical School. The classes that I teach include
31 Physiology and Molecular Biology and their applications to disease
32 processes, as well as Clinical Diagnosis. The students in my classes
33 are pre-med students, medical students, interns, residents, medical
34 staff, doctoral candidates, and post-doctoral fellows.
35
36

37 Q Do you also conduct research?
38

1 A. Yes. My current research involves the processes by which cells in
2 the body "communicate" with one another. In particular, I am
3 interested in the purification of certain enzymes that are important
4 in both normal cell function and in the development of cancer.
5
6

7 Q Have you been asked to consult with others or to speak about your
8 current research?
9

10 A. Yes, I am in regular contact regarding my current research with
11 scientists in Moscow, Hungary, Canada, and the United States. I
12 often travel abroad to consult with scientists in those countries
13 about my research.
14
15

16 Q Have you personally conducted biophysics research?
17

18 A. Yes.
19
20

21 Q Could you give us an example?
22

23 A. As a recent example, I conducted research in the area known as
24 "electroconfirmational coupling." We exposed certain enzymes to
25 electric and magnetic fields of different frequencies to determine
26 whether we could modify the function of the enzymes.
27
28

29 Q Did that research involve 60-Hertz frequencies?
30

31 A. Yes. We conducted research on frequencies from 0 Hertz to 1
32 megahertz. (One million Hertz.)
33
34

35 Q Have you published any other scientific papers reporting the results
36 of your own research?
37
38

1 A. Yes, I have published more than 55 papers and book chapters. My
2 curriculum vitae, which lists those papers, is attached to my
3 testimony as Exhibit MR-1.
4

5
6 Q Can you give us a few examples of the journals in which your work
7 has been published?
8

9 A. Some examples would be the Biophysics Journal, the Proceedings of
10 the National Academy of Sciences, Science, Nature, and Biochemica
11 Biophysica Acta.
12

13
14 Q Have you ever acted as a peer-reviewer for any journals in the area
15 of biophysics?
16

17 A. Yes. For example, I have acted as a peer-reviewer for Biophysics
18 Journal and Experimental Cell Research.
19

20
21 Q Are you a member of any professional organizations?
22

23 A. Yes, I am a member of a number of professional organizations,
24 including the American Association of Family Physicians, the
25 American Society for Cell Biology, the Society for Developmental
26 Biology, the Biophysical Society, and the Harvey Society (an honorary
27 biophysics society). I also was a founding member of the
28 Association of American Volunteer Physicians ("AAVP").
29

30
31 Q What is the Association of American Volunteer Physicians?
32

33 A. The AAVP is a non-profit group of physicians who volunteer their
34 time to meet medical emergencies in the world. As an example of
35 my work with the AAVP, during the Vietnam War I travelled to
36 Vietnam to treat an epidemic of bubonic plague. For about two
37 months I lived in the villages and treated the plague, tuberculosis,
38 malaria, leprosy, and other parasitic diseases. I have also travelled

1 to India and other parts of Asia and have witnessed smallpox. While
2 in India, I set up a research program and conducted clinical work.
3
4

5 Q Have you done other international consulting work during your
6 professional career?
7

8 A. Yes. For example, twice I taught medical research in Israel. I have
9 also lectured in most of the countries of both Western and Eastern
10 Europe, including the Soviet Union, Czechoslovakia, Hungary and
11 Bulgaria, on subjects including physics, biophysics and basic
12 molecular biology, and was involved in establishing health care
13 clinics in many of those countries. I also train doctors to travel to
14 Third World countries and provide medical care to native
15 populations, and served as a consultant to UNESCO in Paris on Third
16 World health care issues.
17
18

19 Q Have you been asked by the U.S. government to perform scientific
20 advisory functions?
21

22 A. Yes. For example, I served on President Kennedy's Science
23 Committee. We prepared and submitted a report to the President on
24 the future of technology in medicine.
25
26

27 Q How long have you been involved with the study of biophysics?
28

29 A. Since the late 1950's. In the mid-1950's, the federal government
30 decided that biophysics, which was being studied elsewhere in the
31 world, but not in the United States, needed a major push to get
32 started as a science in the United States. The government, in
33 collaboration with the Massachusetts Institute of Technology,
34 formed a program, known as the National Biophysical Study Program,
35 with the intention of providing that stimulus. The concept was to
36 gather some of the best physicists and biologists from around the
37 country, review the state of our knowledge, and create a core group
38 of scientists who would write a seminal set of materials describing

1 that knowledge and push biophysics forward as a new science in the
2 U.S. I was asked to be the first director of that program, and
3 performed that task for about 1 year.
4

5
6 Q Did you continue your work in biophysics after completing your
7 position with the National Biophysical Study Program?
8

9 A. Yes, I continued work and research in the area of biophysics and
10 continued to follow the developments in that field. In the early
11 1970's, the National Science Foundation ("NSF") determined that
12 there was a need to further look at issues related to the study of
13 human cells, an issue that had not received widespread or
14 coordinated attention up to that time. The NSF thus instituted a
15 program to stimulate interest in this part of biophysics. I served as
16 director of that program from 1971-1972. Since that time I have
17 maintained an active research laboratory in biophysics, focusing on
18 issues related to the biophysics of human cells.
19

20
21 Q Dr. Rosenberg, what were you asked to do in this proceeding?
22

23 A. I was asked to conduct an independent search of the scientific and
24 medical literature related to electric and magnetic fields, and to
25 provide my opinion regarding biophysics and human health issues
26 related to that research.
27

28 II. Background on the Electromagnetic Spectrum 29

30 Q Dr. Rosenberg, what is meant by the term "frequency" of an electric
31 or magnetic field?
32

33 A. One type of electric and magnetic field, known as a "sinusoidal"
34 field, alternates from positive to negative and back to positive in a
35 regular pattern. This infinitely repeating cycle is known as
36 "alternating current." The number of times that a field alternates
37 in one second is its "frequency." Frequency is measured in Hertz
38 ("Hz"). For example, power frequency fields, such as those that will

1 be associated with this transmission line, alternate 60 times per
2 second, and the "frequency" of the field is 60 Hz.
3
4

5 Q Are there frequencies other than the "power frequency" you just
6 mentioned?
7

8 A. Yes. There are a large number of other frequencies, such as
9 radiofrequency fields, microwaves, and ionizing radiation. These
10 various frequencies are organized, according to their frequency, into
11 the "electromagnetic spectrum."
12
13

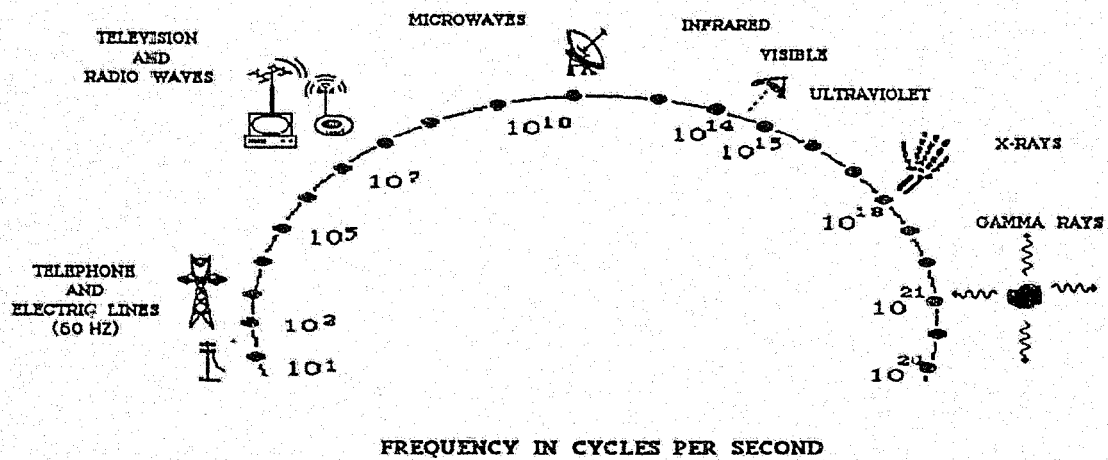
14 Q What is the electromagnetic spectrum?
15

16 A. The electromagnetic spectrum is a term used to describe the
17 organization of frequencies into different wavebands. It ranges
18 from 0 Hz at the low end of the spectrum to above 10^{25} Hz (10,
19 followed by 24 zeroes), at the high end of the spectrum. The
20 diagram attached on the following page of this testimony provides a
21 visual representation of the electromagnetic spectrum.
22
23

24 Q Could you further describe the electromagnetic spectrum using this
25 diagram as an aid?
26

27 A. At the extremely high frequency end of the spectrum, which is on the
28 far right side of the diagram, is ionizing radiation, such as gamma
29 rays and x-rays, with frequencies between 10^{18} and 10^{25} Hz. Moving
30 along the spectrum to the left, at somewhat lower frequencies are
31 the ultraviolet rays. Slightly lower still, and further to the left, is
32 visible light. Moving down the spectrum, this is followed by
33 infrared, microwaves, the AM/FM radio bands and television bands,
34 with frequencies in the millions of Hertz range, and finally, at the
35 low end of the spectrum, you have 60-Hz power frequency fields.

THE ELECTROMAGNETIC SPECTRUM



1 Each of these regions of the electromagnetic spectrum describes a
2 different type of energy, with different characteristics and unique
3 ways of interacting with biological material. In fact, the
4 classification of the electromagnetic spectrum into different
5 regions is based on the fact that the fields in each region have been
6 shown through experimentation to have very different types of
7 effects on matter.
8
9

10 Q Where would the fields from a high voltage transmission line appear
11 on this diagram?
12

13 A. At 60 Hz, near the left end of the spectrum.
14
15

16 Q Where would fields from a distribution line or an appliance appear
17 on this diagram?
18

19 A. At the same point on the far left of the diagram. All of those
20 sources of fields create 60 Hz fields.
21
22

23 Q If a power frequency field from some source was especially strong,
24 or intense, would that cause the field to move up the spectrum to a
25 higher frequency?
26

27 A. No. Intensity refers to the magnitude of field strength at a given
28 frequency. For example, one measure of 60 Hz magnetic field
29 intensity is the unit known as the "milligauss" (mG). No matter how
30 high or low the milligauss level of a 60 Hz magnetic field, it would
31 remain a 60 Hz field and its place on the electromagnetic spectrum
32 would not change. The field would retain the characteristics of its
33 frequency, and would not be converted into some other frequency.
34
35

36 Q Dr. Rosenberg, could you briefly explain the biological effects of
37 various regions of the electromagnetic spectrum?
38

1 A. Yes. It is necessary to discuss the various regions of the
2 electromagnetic spectrum separately, since each of the regions has
3 unique biological properties.
4

5 A. Ionizing Radiation 6

7 Q Please explain the biological effects of ionizing radiation.
8

9 A. Ionizing radiation is at the extremely high end of the
10 electromagnetic spectrum, and this type of field is capable of
11 transmitting very large amounts of energy sufficient to break
12 chemical bonds in the molecules of the cells. This type of radiation
13 can damage or kill the cell, and if certain types of damage to the
14 nucleus of the cell are caused, a cell may acquire the genetic
15 characteristics of cancer.
16
17

18 Q Do fields of the frequency associated with electric lines and other
19 electrical sources cause the types of effects that are caused by
20 ionizing radiation?
21

22 A. No, 60 Hz fields are vastly different than ionizing radiation. The
23 energy in power frequency fields is much less than one-trillionth of
24 that found in ionizing radiation, and power frequency fields do not
25 have sufficient energy to break chemical bonds in the cells like
26 ionizing radiation. The mechanism of interaction by which ionizing
27 radiation causes damage to tissues is dependent upon frequency and
28 cannot be effected by power frequency fields.
29
30

31 Q What is meant by the term "mechanism"?
32

33 A. "Mechanism" generally refers to the biophysical understanding of
34 the processes by which an agent interacts with biological tissue and
35 of the interactions that occur within the tissue itself.
36
37
38

B. Ultraviolet Radiation

Q What are the effects of the ultraviolet region in the electromagnetic spectrum?

A. At the extremely high end of the ultraviolet range, the fields contain sufficient energy to damage DNA similarly to x-rays and other ionizing radiation. Most of the ultraviolet range, however, has insufficient energy to break chemical bonds in molecules in the cells. Molecules exposed to ultraviolet rays can experience a local heating effect. We experience this as sunburn.

Q Could these effects result from exposure to power frequency fields? associated with 60-Hz fields?

A. Exposure to any level of electric and magnetic fields from electric lines cannot interact with biological systems in the manner of ultraviolet light. In short, you cannot get sunburn from sitting near your stereo.

C. Visible Light

Q What is the range of frequencies of visible light?

A. The very narrow band of visible light is in the range of about 10^{14} to 10^{15} Hz. This is about a trillion times higher than the fields associated with electric lines, appliances and other electrical sources.

Q What are the effects of the visible-light area of the spectrum?

A. Visible light cannot disrupt chemical bonds, but it can excite electrons in certain receptor molecules in our eyes, which allows us to see. Different bands in the spectrum correspond to different colors, as we see in a rainbow.

1 Q Can 60-Hz fields excite electrons in the same way as visible light?

2
3 A. No. The mechanism of interaction is dependent upon the frequency of
4 the light. Power frequency fields cannot cause this biological
5 effect.
6

7 **D. Infrared/Microwaves**

8

9 Q What is the range of frequencies in the infrared/microwave region?

10
11 A. This region of the spectrum spans from about a billion Hz to a
12 trillion Hz.
13

14
15 Q What are its characteristic mechanisms of interaction?

16
17 A. Energy from microwave fields cannot disrupt chemical bonds, like X-
18 rays, nor can they excite electrons in the eye, like visible light.
19 Microwaves can, however, be absorbed in ways that increase the
20 motion of molecules -- either internally, leading to a variety of
21 intramolecular bending motions, or as a whole, causing molecules in
22 a solution to move faster, which is the equivalent of an increase in
23 temperature. At sufficient intensities of microwaves, the practical
24 effect is that the biological tissue is heated.
25

26
27 Q Is this the principle by which microwave ovens cook?

28
29 A. Yes. The microwave frequency used in microwave ovens (about 2.5
30 billion Hz) interacts specifically with the water molecules in the
31 food and increases their movement. This increased movement leads
32 to an increase in temperature.
33

34
35 Q Can power frequency fields interact with biological tissue in the
36 manner of microwaves?
37
38

1 A. No, the frequencies associated with transmission of electricity are
2 far lower than microwave frequency, and the energy associated with
3 60-Hz fields is about one billionth of that associated with the
4 microwave region. Power frequency fields cannot interact with
5 living systems in ways that are similar to microwaves.
6

7 E. Radio and Television

8

9 Q What is the frequency range of radio and television waves?
10

11 A. Radiofrequency and television waves are in the range of 10^5 to 10^9
12 Hz.
13

14
15 Q What are the biological effects of radio and television waves?
16

17 A. There are no generally accepted effects from exposure to radio and
18 television waves at environmental levels. At very high intensities,
19 however, some radiofrequency waves are used in conjunction with
20 static fields in the medical diagnostic tool known as magnetic
21 resonance imaging ("MRI"). Radiofrequency and television waves do
22 not cause the biological effects associated with higher frequencies,
23 such as microwaves and ionizing radiation.
24

25 F. Power Frequency Fields

26

27 Q Can power frequency fields effect biological tissue like the other
28 regions of the electromagnetic spectrum?
29

30 A. No. Power frequency fields do not break molecular bonds, like
31 ionizing radiation, nor do power frequency fields interact with
32 biological tissue in a manner similar to microwaves or the other
33 regions of the electromagnetic spectrum. At field strengths
34 associated with transmission lines like the Woodbourne-Heaton line,
35 there are no accepted mechanisms by which power frequency fields
36 can cause biological effects in living systems.
37
38

1 Q In an evaluation of power frequency fields, is it appropriate to rely
2 upon research using these other frequencies?

3
4 A No. Power frequency fields cannot interact with biological tissues
5 in the manner of the other regions of the electromagnetic spectrum.
6 Research using frequencies other than power frequency fields does
7 not provide appropriate information for such an evaluation.
8

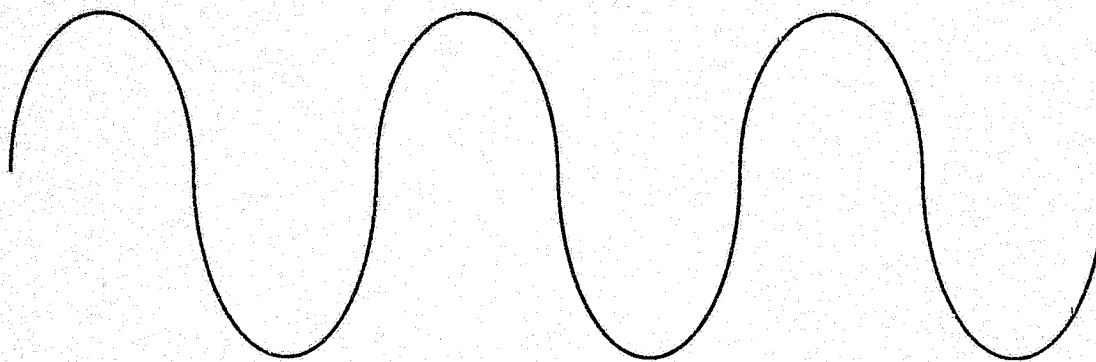
9 **III. Waveform and Shape of Fields**

10
11 Q Dr. Rosenberg, do power frequency fields have a particular shape?

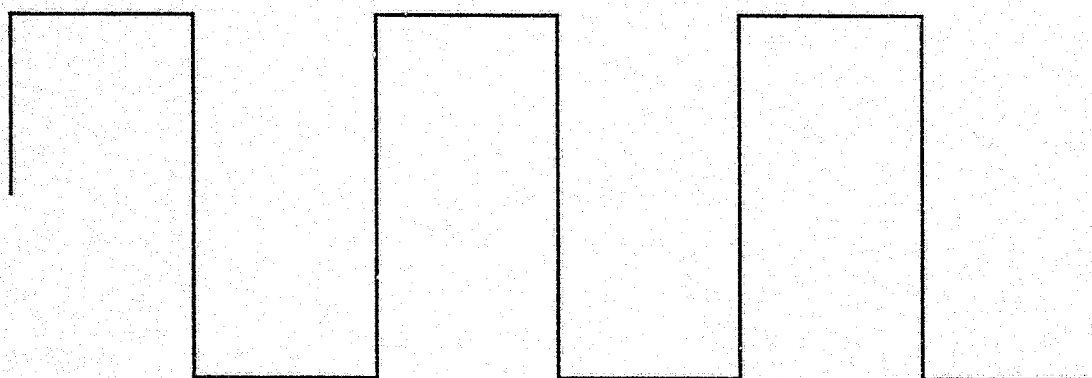
12
13 A Yes. I mentioned earlier in my testimony that these fields are
14 "sinusoidal." This term refers to the shape of the fields as they
15 alternate from positive to negative and back to positive. The
16 sinusoidal wave curves uniformly up, down, and back again in a
17 smooth, symmetrical line.
18

19
20 Q Are there other types of fields besides sinusoidal fields?

21
22 A Yes, there are a number of different types of fields other than
23 sinusoidal fields. One type of field is generally known as a "pulsed"
24 field. There are many types of pulsed fields, but each has a very
25 different shape than the sinusoidal field associated with power
26 transmission. The diagram on the next page of this testimony
27 demonstrates the difference in shape of these two types of fields.
28
29
30
31
32
33
34
35
36
37
38



SINUSOIDAL FIELD



PULSED FIELD

1 Q What is the relevance of the difference in waveform between pulsed
2 fields and sinusoidal fields?
3

4 A. In order to create the square or irregular shape of the pulsed field,
5 it is necessary to blend, or mix, many different frequencies of
6 sinusoidal fields. These fields can range as high as several thousand
7 Hz. A field that is "pulsed" 60 times a second will contain 60 Hz
8 sinusoidal fields, but it also will contain many other sinusoidal
9 fields of very different frequencies.
10
11

12 Q Do studies using pulsed fields provide information relevant to
13 determining the effects of sinusoidal power frequency fields?
14

15 A. No. Since the pulsed field contains many frequencies, if an effect is
16 observed it is not possible to determine which frequency field
17 caused that effect. Given the differences in frequency mechanisms
18 and effects discussed previously in my testimony, it is
19 inappropriate to attempt to draw conclusions about power frequency
20 fields based on a study using many frequencies. A study on a
21 particular pulsed field thus can only give information on that
22 particular pulsed field.
23
24

25 Q What is a "modulated" field?
26

27 A. A modulated field generally refers to a field at some higher
28 frequency, such as microwave or radiofrequency, that has had its
29 shape altered so that the outline of the field resembles the
30 sinusoidal wave of a lower frequency.
31

32 Q Do studies using modulated fields provide information relevant to
33 determining the effects of sinusoidal power frequency fields?
34

35 A. No. The modulated field does contain certain characteristics of the
36 lower frequency field, but it also contains the original, modulated
37 frequency. For example, a microwave field that is modulated at 60
38 Hz has some similarities to a 60 Hz field, but it will always contain

1 a microwave field. Effects observed in such studies cannot be
2 attributed to the 60 Hz component of the modulated field.

3 4 **IV. Ion Cyclotron Resonance**

5
6 **Q** Dr. Rosenberg, are you familiar with the term "ion cyclotron
7 resonance" ("ICR")?

8
9 **A.** Yes. ICR is a hypothesis which suggests that very low magnetic
10 fields enhance the movement of charged particles, called ions,
11 through channels in the cell membrane. This hypothesis is one of
12 several speculative models available in the published papers that
13 attempt to establish a mechanism for explaining how power
14 frequency fields might interact with biological tissue. (E.g., Adey
15 1981, Liboff 1985, Lednev 1991).

16
17
18 **Q** Does ion cyclotron resonance provide an understanding of
19 interactions between power frequency fields and biological tissue?

20
21 **A.** No. Dr. Liboff and his colleagues, in their writings, have suggested
22 that it might provide such an understanding. (E.g., Liboff 1985,
23 Liboff, McLeod, and Smith 1990). The ICR hypothesis, however, has a
24 number of fundamental problems of theory that demonstrate that it
25 is not an accurate description of any interaction between power
26 frequency fields and biological tissue.

27
28
29 **Q** Please give an example of a problem with the ICR theory.

30
31 **A.** Certain background on cellular biology and physics must first be
32 provided to understand the basis for my comments. As part of
33 normal cell function, some biologically important charged particles,
34 called ions, cross cell membranes through circular, or helical,
35 openings in the cell membrane known as "channels." It is those ions
36 that are referred to in the phrase "ion cyclotron resonance." In
37 physics, there is a well-understood phenomenon known as "cyclotron
38 resonance" in which it is possible to calculate the precise frequency

1 that will cause a particular particle which is travelling in a circular
2 or helical path to undergo acceleration. The best known practical
3 application of this theory is the use of very high frequency
4 electromagnetic fields to accelerate particles in the giant particle
5 accelerators that are used to study atomic structure. The cyclotron
6 resonance phenomenon only occurs when a particle or ion is
7 travelling in a circular path. It is also possible to calculate, for a
8 given ion and resonance frequency, the size of the circular path that
9 must exist for the resonance effect to be possible.

10
11 The ICR hypothesis attempts to fuse these two concepts, suggesting
12 that as ions pass through the helical openings in the cell wall the 60
13 Hz magnetic field imparts energy to the ion with each cycle of the
14 60 Hz field -- in effect "pushing" the ion 60 times each second.

15
16 The first problem with the ICR theory has to do with the size of the
17 circular path that would be necessary for a 60 Hz cyclotron
18 resonance effect to occur with biological ions. A channel
19 approximately 10 feet wide would be required to meet the theory's
20 conditions for most ions. The actual cell wall channels, however,
21 are much smaller than that -- they are submicroscopic. In an
22 opening of that size, the cyclotron resonance effect postulated by
23 Dr. Liboff simply could not take place. In fact, you would need a
24 frequency of about 6,000,000 Hz to meet the theoretical cyclotron
25 resonance conditions in the actual channels in cell membranes,
26 which is quite different from 60 Hz.

27
28
29 Q Are there any other problems with the ICR hypothesis?

30
31 A. Yes. The cyclotron resonance phenomenon can occur only if the ion
32 or other particle travels in an uninterrupted circular or helical path.
33 If the circular path is interrupted by collision with other particles,
34 the effect is nullified. This is why the giant particle accelerators
35 mentioned previously are carefully constructed to ensure that no
36 such collisions occur. When an ion passes through the membrane of a
37 human cell, however, it is in constant collision with other particles --
38 as many as a trillion per second. Any theoretical, or calculated,

1 cyclotron resonance effect would be immediately nullified by any
2 one of these collisions, each of which would affect the speed and
3 direction of the ion, interrupting its circular path.
4

5 A third difficulty with the ICR hypothesis as applied to biological
6 ions in the human cell has to do with the calculation of the
7 resonance frequencies. One element of the resonance calculation is
8 the mass of the ion. If an incorrect mass of the ion is used in the
9 calculation, the results of that calculation will be incorrect. The
10 ICR hypothesis is based on just such an incorrect calculation. The
11 calculations that have formed the basis for the ICR hypothesis use
12 an ionic mass that assumes that no other molecules are surrounding
13 the ion when it travels through the channel in the cell membrane. In
14 fact, however, ions in the body are surrounded by a shell of water
15 molecules which remain around the ion as it passes through the fluid-
16 filled channel in the cell membrane. The presence of these water
17 molecules substantially alters the effective mass of the ion, and
18 this change in mass undermines the theoretical calculations that
19 form the basis of the ICR hypothesis.
20

21 Taking into account all of the above criticisms, the problems with
22 the ICR hypothesis strip it of any explanatory power to describe a
23 mechanism of interaction between power frequency fields and
24 biological tissue.
25

26 These and other problems with the ICR hypothesis have been
27 recognized by Dr. Liboff and his co-workers in their publications on
28 this subject (e.g., Liboff 1985), and by other authors addressing the
29 ICR hypothesis. (E.g., Halle 1988). Research on the ICR hypothesis
30 has proceeded in part on the hope that these problems can somehow
31 be resolved in the future. At this point, however, the ICR hypothesis
32 must be viewed as merely a speculative attempt to establish a
33 mechanism with very good reasons for believing that this
34 mechanism does not and cannot occur in actual biological tissue.
35
36

37 Q What is your assessment of the experiments that have been
38 conducted to test the ICR hypothesis?

1 A. The body of experiments, when viewed as a whole, has not proven
2 that the ICR hypothesis is valid. Many of the attempts by
3 researchers outside of Dr. Liboff's group to experimentally confirm
4 his results have been unsuccessful. (E.g., Parkinson 1989,
5 Carstensen 1987). In one of the sets of experiments that have been
6 conducted by researchers outside of Dr. Liboff's group -- the
7 calcium efflux experiments -- the researchers have found
8 contradictory results, with one group reporting an increase in
9 calcium efflux, another group reporting a decrease in calcium efflux,
10 and a third group reporting no effect at all. (E.g. Bawin and Adey
11 1976, Blackman 1982). If the hypothesis was correct, other
12 researchers ought to be able to conduct the same experiments and
13 reach the same results, but that has not been the case. As a result,
14 one must conclude that the ICR hypothesis remains unproven.

15
16
17 Q What are the implications for human health of the ion cyclotron
18 resonance hypothesis?

19
20 A. In my opinion, the ICR hypothesis has no implications for human
21 health.

22 23 V. Conclusions

24
25 Q Dr. Rosenberg, could you please summarize the conclusions of your
26 testimony?

27
28 A. Power frequency fields, such as those that will be associated with
29 the Woodbourne-Heaton line, exist along a range of energy
30 frequencies known as the electromagnetic spectrum. These power
31 frequency fields are very different from other types of fields, such
32 as ionizing radiation, microwaves, and radiofrequency waves. In
33 addition, the specific waveform or shape of the sinusoidal power
34 frequency fields makes them very different from pulsed fields or
35 modulated fields. With regard to the ion cyclotron resonance
36 hypothesis, that theory is inconsistent with the way ions actually
37 act in the human body, and there are numerous theoretical and
38 practical objections to the theory from a physics point-of-view.

1 Q In your opinion, would exposure to 60 Hz fields from the Woodbourne-
2 Heaton line result in an ion cyclotron resonance effect in the human
3 body?
4

5 A. I see no persuasive evidence of such an effect, and would find it very
6 difficult to believe that such an effect could occur.
7
8

9 Q Have you reached any conclusion regarding whether exposure to 60
10 Hz fields causes adverse health effects in humans?
11

12 A. Yes. At the molecular level, the theories such as ion cyclotron
13 resonance that attempt to explain a mechanism for such an
14 interaction are highly speculative at best. Based on my knowledge
15 and understanding of biophysics, medicine, and the research
16 publications on power frequency fields, there are very good reasons
17 to believe that exposure to power frequency fields does not cause
18 any significant biological effects, and it is my opinion that exposure
19 to electric and/or magnetic fields from the Woodbourne-Heaton 230
20 kV line will not result in adverse health effects in humans.
21

22
23 Q Does this conclude your testimony?
24

25 A. Yes, it does.

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**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT MR-1
OF
DR. MURRAY ROSENBERG**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

BIOGRAPHICAL SKETCH

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University of Minnesota, St. Paul, Professor
1967-69 New England Institute, Connecticut, Visiting Professor
1969-1970 Volunteer Physician for Vietnam, Physician
1970-1976 Program in Human Sexuality, University of Minnesota,
Physician
1970-1973 Planned Parenthood of Minnesota, Physician
1971-1972 Biology of Human Cells,
National Science Foundation, Washington, D.C.
Program Director
1972-1973 Family Practice - St. Paul-Ramsey Hospital
1973-1978 Drug Rehabilitation Center, St. Paul, Minnesota, Physician
1973-1977 West Side Community Clinic, St. Paul, Minnesota, Physician
1975-1977 Ramsey Health Plan, St. Paul, Minnesota, Physician
1980 Weizmann Institute of Science, Rehovot, Israel;
Visiting Professor
1980 Hungarian Academy of Sciences, Szeged, Hungary;
Consultant
1983 Curriculum Development, Family Health foundation of America;
AAFP, Kansas City, Missouri, Principal Investigator
1984 Afton Family Physicians Clinic, St. Paul, Minnesota,
Physician
1985 Sundance Medical Clinics and St. Francis Hospital,
Shakopee, Minnesota, Physician
1985 University of Sherbrooke, Canada, Visiting Professor
1986-Present Aspen Medical Clinics; St. Paul, Minnesota, Physician

1987. Brown University Medical School
 1988-1989 Department of Family Practice, Providence, Rhode Island
 1990 Visiting Professor

AWARDS, FELLOWSHIPS

National Scholarship fund
 Harvard Scholarship Awards
 Phi Beta Kappa
 Gordon McKay Fellowship
 Sigma Xi
 1962-1965 Health Research Council Career Scientist, New York City
 1963-1966 Macaulay Non-resident Fellow, University of Edinburgh,
 England
 1963-1968 Examiner, University of Calcutta
 1970 American Medical Association, Certificate for Humanitarian
 Service
 1972-Present Dansforth Associate
 1973 Dean's Lectureship, Duke University Medical School
 1973-Present American Medical Association, Physicians Recognition Award
 1976 Sesquicentennial Medal, College of Medicine,
 Medical University of South Carolina
 1985 Special Fellow, National Research
 Council of Canada

SEMINAR CHAIRMANSHIPS AND INVITED LECTURESHIPS

1965 India Cancer Research Center, Invited Speaker
 University of Bombay
 University of Calcutta
 University of New Delhi
 Hyderabad Regional Research Institute
 1963-1967 Annual Conferences on Cellular Dynamics, Chairman
 1966 Gordon Conference on Cell Surface and Malignant
 Transformation, Chairman
 1967 CIBA Foundation, Cell Differentiation, Invited Speaker
 1967 Wistar Institute, Symposium Speaker
 1973 3M Central Research Laboratories, Invited Speaker
 1973 Society for Developmental Biology, Cell Surface Changes,
 Chairman
 1974 Harvard Medical School, Invited Speaker
 1974 Princeton University, Invited Speaker
 1975 Soviet Academy of Sciences, Invited Speaker
 1976 Bulgarian Academy of Sciences, Invited Speaker
 1978 International Membrane Symposium, New Zealand, Speaker
 1978 Gustavus Adolphus College, Invited Speaker
 1980 Hungarian Academy of Sciences, Invited Speaker
 1982 University of Delaware, Invited Speaker
 1982 University of Kansas, Invited Speaker
 1983 Medical University of South Carolina, Invited Speaker

1985 University of Sherbrooke, Canada, Invited Speaker
 1985 Hungarian Academy of Sciences, Invited Speaker
 1987-1990 Brown University, Medical School, Providence, Rhode Island,
 Invited Speaker
 1990 HUNGARIAN ACADEMY OF SCIENCES, LECTURER

CONSULTANTSHIPS

1957-1958 NIH Biophysics Study Section
 1961-1967 National Science Foundation, Consultant
 1963 Rockefeller Foundation; Health Research Council of New York
 Committee
 1963-1965 LINC Medical Computer Committee
 1963-1967 NSF Division of Biological and Medical Services, Fellowship
 Committee
 1963-1967 NAS-NRC Fellowship Committee
 1963-1968 NIH Cell Biology Study Section
 1963-1965 Office of Science and Technology - White House, Life
 Sciences Panel
 1963-1972 UNESCO, International Cell Res.,
 Committee Member and Consultant
 1965 Public Health Service, Advisory Committee on Scientific
 Publications, Reviewer
 1967 Veteran's Administration, Department of Medicine and
 Surgery, Ad Hoc Reviewer
 1969, 1970 National Institute of Health, Ad Hoc Reviewer
 1969-1982 State of Minnesota - Medical Advisory Committee
 1974 NIH Fellowship Committee
 1976, 77, 80 Hungarian Academy of Sciences, Consultant
 1970 National Institute of Health, Ad Hoc Study Section
 1971-1976 Bioengineering - Biomedical Engineering Task Force,
 University of Minnesota
 1977 March of Dimes, Grant Reviewer
 1981 Minority High School Summer Research Program
 1981-1982 University of Minnesota, Committee on Equal Employment
 Opportunity for Women
 1984-1985 Nobel Lecture Comm., Gustavus Adolphus College
 1984-Present Ad Hoc Reviewer, Biophysical Journal
 1985-Present Research Committee, Minnesota Academy Family Physicians
 1990-PRESENT Ad Hoc REVIEWER, EXPERIMENTAL CELL RESEARCH

MILITARY SERVICE

World War II, Captain USAAF

MEDICAL LICENSURE AND RECORDS

Diplomate, National Board of Medicine
 Diplomate, American Board of Family Practice, Recertified
 Fellow, American Academy of Family Physicians
 Charter Member, Association of American Volunteer Physicians

Fellow, Massachusetts Medical Society
Licensed in Massachusetts, New York, Washington, D.C. Minnesota
ACLS Certification (current)
CME Credits (current)
Member, Minn. Academy of Family Physicians
ATLS Certification (current)

RESEARCH INTEREST

Our present research concerns the control of neurotransmitters. The principal ones are ATP and adenosine that serve as intercellular messengers and effectors. Two enzymes on the surfaces of almost all nucleated cells degrade extracellular ATP to AMP and adenosine. These enzymes, called ectoenzymes, are a nucleotide diphosphohydrolase and 5'-nucleotidase. We have purified the former enzyme over 3500- fold and have prepared antibodies. There is great interest in this enzyme since it is a major control in signaling among cells via the ATP/adenosine ratio. The enzyme and the subsequent signals are important in neurotransmission, reproduction, tissue development and cell transformation. The enzyme is altered by many pathological states such as certain malignancies, infection and epilepsy, and by pharmacological agents such as certain antidepressant agents.

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2. Rosenberg, M.D. (1952) Pulsations and growth of gas-filled bubbles in sound fields. Harvard Acoust. Res. 25:1-34.
3. Rosenberg, M.D. (1953) Gaseous-type cavitation in liquids. Harvard Acoust. Res. 25:1-67. (Same volume as #2?)
4. Rosenberg, M.D. (1955) Paraboloidal functions and the design of focusing systems. Harvard Acoust. Res. Int. Rep. pp. 1-55.
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10. Rosenberg, M.D. (1964) Book review on micromanipulators and micromanipulation. Rev. Sci. Instrum. ?
11. Rosenberg, M.D. (1964) Cell surface interactions and interfacial dynamics. IN: Cellular Control Mechanisms and Cancer. Elsevier Press. pp. 146-164.
12. Rosenberg, M.D. (1964) The living cell. IN: The Molecular Designing of Materials and Devices. MIT Press. pp. 197-210.
13. Rosenberg, M.D. (1965) Some applications of surface physics to cell biology. Proc. Seminar Int. Cell Biol., India Cancer Inst. ?
14. Rosenberg, M.D. (1965) The growth of cells at saline-hydrocarbon interfaces. IN: Tissue Culture (C.V. Ramakrishnan, ed.). W. Junk Publishers, The Hague, Netherlands.
15. Rosenberg, M.D. (1966) Interaction between lipid monolayers and biological surfaces. IN: Histochemie et Cytochimie des Lipides (A.I. Hadjioloff, ed.). Sophia.
16. Rosenberg, M.D. (1966) Intracellular transport fluxes. IN: Intracellular Transport. Academic Press, New York. pp. 45-69.
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Philadelphia Electric Company Rebuttal Statement No. 5

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY
OF
CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

RECEIVED
DEC 5 1991

SECRETARY'S OFFICE
Public Utility Commission

A110550755

DEC 5 1991

December 1991

REBUTTAL TESTIMONY OF CARTER VAN DYKE

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1 I. Background and Qualifications

2
3 Q Please state your name and business address.

4
5 A. Carter Van Dyke, 40 Garden Alley, Doylestown, Pa., 18901
6
7

8 Q What is your occupation?
9

10 A. I am a land use planner and landscape architect. A summary of my
11 professional qualifications is attached to this testimony as Exhibit
12 CVD-1.
13
14

15 Q What is land use planning?
16

17 A. Land use planning is the discipline involved with the orderly growth
18 and development of cities, suburban areas, and rural areas. One
19 primary purpose of land use planning is to develop integrated
20 communities which can provide services, including utility services,
21 to the population in a manner that does not disrupt the patterns of
22 development in the community.
23
24

25 Q Where are you employed?
26

27 A. I am President of Carter Van Dyke Associates, which is a consulting
28 firm specializing in land use planning and landscape architecture.
29
30

31 Q What is your educational background?
32

33 A. I received my Bachelor's degree from Rutger's University. I also
34 have a Master of Landscape Architecture Degree from the University
35 of Pennsylvania.
36
37

38 Q Are you a member of any professional organizations?

1 A. Yes. For example, I am a member of the American Institute of
2 Certified Planners, the American Institute of Architects, and the
3 Urban Land Institute.
4

5
6 Q Are you a Licensed Professional Planner?
7

8 A. Yes, I am a Licensed Professional Planner in the state of New Jersey.
9 I would note that the Commonwealth of Pennsylvania does not
10 require licensure for land use planners. Membership in the American
11 Institute of Certified Planners, however, requires a comprehensive
12 examination on planning issues and is equivalent to national
13 licensure for those states, such as Pennsylvania, which do not have
14 individual state licensing requirements.
15

16
17 Q Are you a registered landscape architect?
18

19 A. Yes, I am a registered landscape architect in the states of
20 Pennsylvania and New Jersey.
21

22
23 Q Please give some examples of land use planning projects on which
24 you have worked.
25

26 A. A few examples of work that I have conducted in this area are that I
27 have prepared or assisted in the preparation of township land use
28 codes and comprehensive plans, the development of highway linear
29 facility guidance documents, preparation of a guidance handbook for
30 use by the NJ Department of Transportation for use in developing
31 linear highway facilities, development of open space plans, and
32 development of residential housing projects.
33

34 Q What were you asked to do with regard to this proceeding?
35

36 A. I was asked to identify and evaluate the land use implications
37 reasonably associated with energization of the Philadelphia Electric
38 Company Woodbourne-Heaton 230 kV transmission line.

1 II. Land Use Assessment of the Woodbourne-Heaton 230 kV
2 Transmission Line
3

4 Q Mr. Van Dyke, what materials and other resources did you consult to
5 conduct your land use assessment?
6

7 A. My assessment was based on numerous resources, including all
8 United States Geological Survey ("USGS") maps that contain a
9 portion of the right-of-way of the Woodbourne-Heaton line, 1990
10 aerial photographs, prepared by the Delaware Valley Regional
11 Planning Commission ("DVRPC"), that contain information on land
12 uses and natural features near the right-of-way, Federal Flood
13 Insurance maps of that same area, and comprehensive plans and
14 zoning maps of the municipalities through which the transmission
15 line passes. I also have personally viewed and photographed
16 substantially the entire route of the transmission line to conduct a
17 visual inspection of the adjacent land uses and natural features.
18
19

20 Q Please generally describe your approach to the assessment of the
21 land use implications of energizing the Woodbourne-Heaton 230 kV
22 transmission line.
23

24 A. My assessment addresses the land use implications of using an
25 existing rail utility corridor, known as the "Trenton Cutoff," as the
26 route for a 230 kV transmission line to interconnect the Woodbourne
27 substation in Bucks County with the Heaton substation in
28 Montgomery County. The assessment contains several elements,
29 including: (1) definition of the geographic scope of two study areas,
30 the Regional Study Area ("RSA"), and the Corridor Study Area
31 ("CSA"), (2) an inventory of existing land uses within the RSA, (3)
32 an analysis of whether any alternative routes for a transmission
33 facility between the Woodbourne and Heaton substations exists in
34 the RSA, (4) an inventory of existing land uses within the CSA, and
35 (5) an assessment of the potential land use impacts of the
36 Woodbourne-Heaton line.
37
38

1 **A. Identification of the Geographic Study Areas**

2
3 **Q** What geographic study areas did you include in your land use
4 assessment?

5
6 **A.** Two study areas were defined, the Regional Study Area ("RSA"), and
7 the Corridor Study Area ("CSA").

8
9 The Regional Study Area was defined as all areas 2.5 miles on either
10 side of the right-of-way for the Trenton Cutoff. The Woodbourne and
11 Heaton substations are approximately 12.5 miles apart; the RSA thus
12 covers a geographic area of approximately 60 square miles. The
13 location of the Woodbourne and Heaton substations was an integral
14 component in defining the geographic scope of the RSA. Exhibit CVD-
15 2 is a composite of the USGS maps of the areas surrounding the
16 Woodbourne and Heaton substations, as well as the region located
17 between those two substations. The location of the two substations
18 and of the RSA are marked on Exhibit CVD-2.

19
20 The Corridor Study Area was defined as all areas 400 feet on either
21 side of the right-of-way of the Trenton Cutoff. The total area of the
22 CSA is approximately 1,212 acres. The CSA is delineated on Exhibit
23 CVD-8, which is a composite of several DVRPC 1990 aerial
24 photographs of the area immediately adjacent to the Trenton Cutoff.
25 Exhibit CVD-8 also contains photographs of areas near the line taken
26 by me during a recent inspection of the line.

27
28 **B. Inventory of Existing Land Uses Within the Regional**
29 **Study Area**

30
31 **Q** What existing land uses did you include in your inventory of the
32 Regional Study Area?

33
34 **A.** I conducted an inventory of three general types of land uses: (1)
35 utility facilities and corridors, (2) natural features, and (3) urban
36 development.
37
38

1 Q Please describe your inventory of the existing utility facilities and
2 corridors within the Regional Study Area.

3
4 A. The Regional Study Area contains numerous utility facilities and
5 corridors, including arterial roadways, electric transmission and
6 distribution facilities, and utility pipelines. These utility facilities
7 and corridors are identified on Exhibit CVD-3, which is comprised of
8 the USGS composite maps introduced as Exhibit CVD-2 covered with
9 a transparent overlay showing the location of these corridors and
10 facilities.

11
12
13 Q Please describe your inventory of the natural features within the
14 Regional Study Area.

15
16 A. Two types of natural features were identified: (1) streams,
17 waterways, and floodplains, and (2) undeveloped woodlands. The
18 streams and waterways in the RSA are identified on Exhibit CVD-4,
19 which is comprised of the USGS composite maps introduced as
20 Exhibit CVD-2 covered with a transparent overlay showing the
21 location of these streams and waterways. The undeveloped
22 woodlands in the RSA are identified on Exhibit CVD-5, which is
23 comprised of the USGS composite maps introduced as Exhibit CVD-2
24 covered with a transparent overlay showing the location of these
25 undeveloped woodlands.

26
27
28 Q Please describe your inventory of the urban development within the
29 Regional Study Area.

30
31 A. Urban development was defined as areas with primarily moderate to
32 high density residential development and associated service
33 commercial facilities. The urban developments in the RSA are
34 identified on Exhibit CVD-6, which is comprised of the USGS
35 composite maps introduced as Exhibit CVD-2 covered with a
36 transparent overlay showing the location of these urban
37 developments.

1 **C. Analysis of Alternative Routes**

2
3 **Q** Did you conduct an evaluation of whether there are alternative
4 routes that could be used for a transmission facility to interconnect
5 the Woodbourne and Heaton substations?
6

7 **A.** Yes. The question of whether alternative routes are available is an
8 important factor in evaluating the land use implications of a utility
9 facility such as a transmission line. As I noted earlier in my
10 testimony, one primary purpose of land use planning is to develop
11 integrated communities which can provide services, including utility
12 services, to the population in a manner that does not disrupt the
13 patterns of development in the community. This coordination of
14 utility services with urban growth forms the fundamental basis for
15 sound land planning and development.
16

17 Analysis of whether alternative routes are available for the utility
18 facility is a necessary step in determining whether this
19 coordination has been achieved. Simply put, if no alternative routes
20 are available, other than routes that would disrupt the development
21 of the community, and if the chosen route does not disrupt the
22 development pattern of the community, then one can conclude that
23 the chosen route is consistent with sound land planning and
24 development.
25

26
27 **Q** What were the results of your analysis of whether alternative
28 routes are available to interconnect the Woodbourne and Heaton
29 substations?
30

31 **A.** No reasonable alternative routes are available in the Regional Study
32 Area.
33

34
35 **Q** What is the basis for that conclusion?
36

37 **A.** The Woodbourne and Heaton substations are in an east-to-west
38 relationship, with the Woodbourne substation approximately 12.5

1 miles to the east, and slightly north, of the Heaton substation. Any
2 route to interconnect these two substations thus must have a
3 substantial east-to-west component.
4

5 Analysis of the pattern of urban development in the Regional Study
6 Area reveals that there are no other existing primarily east-west
7 utility corridors that could be used to interconnect the Woodbourne
8 and Heaton substations. This fact limits the further analysis of
9 alternative routes to establishment of an entirely new utility
10 corridor through the Regional Study Area.
11

12 I evaluated the urban development in the Regional Study Area to
13 determine whether a new east-west corridor could be established
14 without disrupting the existing urban development. (The existing
15 pattern of urban development can be seen by reference to Exhibit
16 CVD-6, which was previously described in my discussion of the
17 Regional Study Area inventory.) The urban development in the
18 Regional Study Area is intermittent, with some open areas
19 juxtaposed with the urban development. The geographic pattern of
20 the urban development, however, does not allow the establishment
21 of any linear or near-linear east-west route that would not pass
22 through, and thus disrupt, existing urban development.
23

24 It is possible to describe an irregular line around existing urban
25 development that would eventually allow interconnection of the
26 substations. The irregular nature of such of a route would increase
27 the length of the line and the amount of land through which the
28 transmission facility would need to pass, thus increasing the cost of
29 the facility and introducing a new utility use to a large amount of
30 the Regional Study Area. Furthermore, this approach would require
31 establishment of an entirely new utility corridor. When compared to
32 the near-linear route of the Trenton Cutoff right-of-way on an
33 existing utility corridor, such an irregular route cannot be classified
34 as reasonable from a land use planning viewpoint.
35

36
37 Q What do you conclude with regard to your analysis of alternative
38 routes?

1 A. No reasonable routes are available in the Regional Study Area. The
2 theoretical alternatives that can be described are either directly
3 disruptive of existing urban development or would require costly
4 irregular routes that would introduce an entirely new land use into
5 large segments of the Regional Study Area. The Trenton Cutoff, on
6 the other hand, describes a near-linear route along an existing
7 utility corridor and use of that corridor does not require the
8 introduction of any new uses into the Regional Study Area. I
9 conclude that the chosen route along the Trenton Cutoff is the best
10 and only reasonable route available within the Regional Study Area,
11 and is thus consistent with sound land planning and development.
12

13
14 **D. Inventory of Existing Land Uses Within the Corridor**
15 **Study Area**
16

17 Q Mr. Van Dyke, please generally describe your inventory of existing
18 land uses in the Corridor Study Area.
19

20 A. My inventory included: (1) existing zoning in the CSA, (2) existing
21 land uses in the CSA, and (3) residential density and population
22 within the CSA.
23

24 Q Please describe your inventory of the existing zoning within the
25 CSA.
26

27 A. Existing zoning in the Corridor Study Area was identified by
28 reviewing local zoning maps of the jurisdictions in the Corridor
29 Study Area. That review reveals the following breakdown of current
30 zoning in the CSA:
31
32
33
34
35
36
37
38

Existing Zoning in the Corridor Study Area

Open Space	7.2%
Non-residential Development	44.6%
Industrial	37.4%
Commercial	4.2%
Institutional	3%
Residential Development	48.2%
High Density	0%
Moderate Density	39%
Low Density	9.2%

The zoning classifications within the CSA are identified on Exhibit CVD-7, which is comprised of the USGS composite maps introduced as Exhibit CVD-2 covered with a transparent overlay showing the zoning classifications near the Trenton Cutoff.

Q Please describe your inventory of the existing land uses within the Corridor Study Area.

A. Actual existing land uses in the Corridor Study Area were identified by visually reviewing 1990 aerial photographs for the entire area of the CSA and classifying all visible land uses within that area. That review reveals the following breakdown of land uses in the CSA:

Existing Land Uses in the Corridor Study Area

Open Space	33%
Non-residential Development	31%
Industrial	22%
Transportation	3%
Commercial	3%
Utility	2%
Institutional	1%
Residential Development	22%
High Density	0%
Moderate Density	1%
Low Density	21%
Vacant Land	14%

The existing land uses within the CSA can be seen by reference to Exhibit CVD-8, which is a composite of several DVRPC 1990 aerial photographs of the area immediately adjacent to the Trenton Cutoff.

Q. Please describe your inventory of the existing population within the Corridor Study Area.

A. I have identified 289 dwelling units in the CSA. A blended persons-per-household factor was applied to this number to determine the approximate population of the CSA as 867 persons. The estimated density of the CSA is approximately 0.238 dwelling units per acre, or 0.715 persons per acre.

1 Q Were you able to estimate potential future population and residential
2 density growth in the Corridor Study Area?
3

4 A. Yes. Based upon the natural features and existing zoning
5 classifications within the CSA, I estimate that approximately 82
6 additional housing units possibly could be constructed within the
7 CSA, to house approximately 246 additional persons. If that
8 potential development were fully realized, the CSA would have
9 approximately 0.306 dwelling units per acre, and 0.918 persons per
10 acre.
11

12 High density urban development is generally considered to be in the
13 range of 8-16 dwelling units per acre and 18-29 persons per acre.
14 Therefore, the Corridor Study Area is not generally categorized as a
15 high density urban area, nor is it expected to reach that
16 categorization even if the CSA becomes fully developed.
17

18 It should be noted that the CSA does contain small concentrations of
19 urban residential development. The CSA as a whole, however,
20 generally displays low overall density.
21

22 E. Impact Assessment of the Woodbourne-Heaton 230 kV 23 Transmission Line 24

25 Q Mr. Van Dyke, have you conducted an assessment of the potential land
26 use impacts of energizing the Woodbourne-Heaton transmission
27 line?
28

29 A. Yes. I assessed the potential impacts of energizing the line on both
30 existing and projected future land uses.
31

32 1. Impact Assessment of Existing Land Uses 33

34 Q What factors did you evaluate in your assessment of potential
35 impacts from energizing the line on existing land uses?
36

37 A. I assessed the potential impact on zoning patterns, existing land
38 uses, and property valuation within the Corridor Study Area.

1 Q What is your assessment of the potential impact on zoning patterns?

2
3 A. The existing zoning designations of the Corridor Study Area are
4 compatible with an adjacent utility use, and I would not expect any
5 change in zoning to result from energization of the transmission
6 line.

7
8 Certain zoning designations, including Industrial, Commercial,
9 Institutional, and Open Space, are generally considered as per se
10 compatible with an adjacent utility use. Other zoning designations,
11 including Residential, should be analysed on the facts of the
12 situation to determine whether they are compatible with an
13 adjacent utility use. Compatability should be understood in the
14 context of of the basic land use policy that utility services must be
15 provided in coordination with urban growth. Thus, while it is
16 appropriate to review the compatability of individual zones in a
17 zoning impact analysis of a linear utility use such as a transmission
18 line, compatability of the corridor as a whole should be given
19 greater weight in determining zoning compatability.

20
21 Review of the zoning in the Corridor Study Area indicates that 51.8%
22 of the existing zoning falls in the compatible categories of
23 Industrial, Commercial, Institutional, or Open Space.

24
25 Analysis indicates that the Residential zoned areas of the Corridor
26 Study Area are also compatible with an adjacent utility use. The
27 Trenton Cutoff has been a utility corridor for most or all of this
28 century, and until the mid-1980's it contained an electrified
29 railway. The existing Residential zoning designations should thus
30 generally be understood to have been chosen as appropriate for
31 proximity to a utility corridor, and in some cases specifically for
32 proximity to a utility corridor with electrical facilities. Given the
33 site-specific history of the Corridor Study Area, replacement of the
34 previous electric utility function with an electric transmission
35 function after a short hiatus is compatible with the existing
36 Residential zoning.

1 I thus would not expect that any changes in zoning will occur as a
2 result of energization of the Woodbourne-Heaton transmission line.
3
4

5 Q What is your assessment of the potential impact on existing land
6 uses along the Woodbourne-Heaton transmission line?
7

8 A. As demonstrated in the inventory of existing land uses within the
9 Corridor Study Area, approximately 78% of the CSA is currently used
10 for Industrial, Transportation, Commercial, Utility, Institutional,
11 Open Space, or Vacant Land purposes. Low Density Residential use
12 accounts for essentially all of the remainder of the uses. The
13 existing land uses thus show a pattern of greater per se
14 compatability with adjacent utility use than the zoning designations
15 would suggest.
16

17 While compatability with an adjacent land use provides strong
18 support for the conclusion that no adverse impacts will result from
19 the adjacent land use, it is also appropriate to review potential
20 specific effects to determine whether an impact is possible. In this
21 case, I would like to address of whether energization of the
22 transmission line will affect residential property values.
23
24

25 Q What is your assessment of the potential impact of energization of
26 the line on residential property values?
27

28 A. I am not a real estate appraiser, and I have not conducted an
29 appraisal of market values in this geographic area. My comments
30 therefore are limited to an evaluation of the available land use
31 planning information as it relates to property values.
32

33 The land use inventory demonstrates that approximately 22% of the
34 Corridor Study Area is presently used for residences, almost
35 exclusively low density residences. The residential uses within the
36 CSA were developed in the immediate context of the existing rail
37 utility corridor, on which transmission line poles and wires already
38 existed and which until recently contained an electrified railway.

1 Past and current market valuations for property in the CSA therefore
2 already include market effects for proximity to a utility corridor.
3

4 Current uses of the utility corridor include an active high speed
5 freight railway. Recent uses of the utility corridor included an
6 electrified railway. It would be expected that the market for
7 residential property in the CSA would already have compensated for
8 these current and recent utility corridor uses. In addition, it is my
9 understanding that this utility corridor has had transmission poles
10 and conductors since the 1930's. The market would also be expected
11 to have compensated for these factors.
12

13 From a land use planning perspective, it would not be expected that
14 re-energization of electric facilities after a short hiatus, as is
15 contemplated here, would cause further market compensation. This
16 is especially true when the current utility use is highly intrusive, as
17 is the case with the existing high speed freight railway. I thus
18 would not expect any effect on market values from energization of
19 the Woodbourne-Heaton line.
20

21
22 Q It has been suggested in this proceeding that fear of health effects
23 from electric and magnetic fields ("EMF") associated with the
24 Woodbourne- Heaton line will cause a decrease in market value in
25 homes proximate to the transmission line. Can you comment on this
26 suggestion?
27

28 A. In my opinion, this suggestion does not take into consideration the
29 specific facts of this utility corridor and the region surrounding it.
30

31 The Regional Study area already contains numerous utility functions
32 and corridors, including electric facilities. (These utility functions
33 and corridors can be seen by reference to Exhibit CVD-3.) My
34 assessment of the region did not reveal any adverse effects on land
35 use, zoning, or property values in the areas adjacent to those utility
36 uses. In addition, the fact that numerous utility functions and
37 corridors already exist in the RSA suggests that the existence of a
38 utility function, especially when placed on an existing utility

1 corridor, should not be viewed as a unique or unusual event for this
2 region. I therefore would not expect any unique or unusual impacts,
3 such as a decrease in property values, to occur after energization of
4 the Woodbourne-Heaton line.

5
6 Virtually every residential area contains some feature that will
7 dissuade some prospective purchasers. For example, lack of
8 proximity to schooling, or close proximity to a commercial use,
9 might have that effect. Some prospective purchasers in the Corridor
10 Study Area may consider the EMF issue, among many other issues, in
11 deciding whether to purchase in the area. This does not suggest,
12 however, that the market or the market value will be affected, but
13 rather only that the issue might be considered. And as I have
14 indicated, my analysis of this region does not reveal any impacts on
15 land use, zoning, or property values that would suggest that such
16 consideration of the EMF issue, if it is occurring, has had any effect
17 on these land use factors.

18 19 2. Impact Assessment of Potential Future Land Uses

20
21 Q What is your assessment of the potential impact of energizing the
22 Woodbourne-Heaton line on future land uses?

23
24 A. I would not expect any impact on future land uses. As I have stated,
25 it is my opinion that the land uses and zoning patterns that currently
26 exist in the Corridor Study Area will continue after energization of
27 the transmission line. Also, my analysis of potential future
28 residential growth in the CSA shows a very limited growth potential
29 whether or not the line is energized. This provides strong reason to
30 believe that my comments on the existing residential areas will be
31 equally applicable to future uses, and I therefore expect no impacts
32 on future land uses.

33 34 III. Conclusions

35
36 Q Mr. Van Dyke, do you have any concluding comments that you would
37 like to make?
38

1 A. Yes. There is a fundamental relationship between growth and
2 development, and the need for providing essential utility services.
3 Electric service has historically, and continues to be, a fundamental
4 "quality of life" element in the United States and the
5 Commonwealth. Sections 301(2) and 301(4) of the Pennsylvania
6 Municipalities Planning Code establish the obligation for
7 municipalities that develop Comprehensive Plans and associated
8 land use regulations to coordinate land use activities with the
9 planned delivery of utility service. That is, when growth occurs or is
10 planned to be encouraged by local land use and zoning, utilities,
11 including the transmission and distribution of a reliable source of
12 electricity, is required to be coordinated with that growth. This
13 coordination of utility services with urban growth forms the
14 fundamental basis for sound land planning and development.

15
16 The Woodbourne-Heaton 230 kV transmission line is an excellent
17 example of a proper implementation of that coordination. The choice
18 of an existing utility corridor as the route for the Woodbourne-
19 Heaton line allows coordination of this utility use with an area that,
20 by definition, already has been coordinated with utility use, and
21 avoids any necessity of creating a new, disruptive corridor. Due
22 largely to this fundamental compatibility with adjacent uses, I view
23 the possibility of adverse land use impacts from energization of the
24 transmission line to be minimal at most, and most likely to be
25 inconsequential.

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT CVD-1
OF
CARTER VAN DYKE**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

Resume
CARTER VAN DYKE, ASLA, AICP

EDUCATION

University of Pennsylvania, Graduate School of Fine Arts, Landscape Architecture and
Regional Planning, 1970-1973, Master of Landscape Architecture
Rutgers University, Art History, 1966-1970, BA

PLANNING/LANDSCAPE ARCHITECTURAL EXPERIENCE

President, Carter van Dyke Associates, Inc. 1980 - present
Senior Planner, Bucks County Planning Commission, 1975 - February 1984
Principal, Interface Environmental Consultants, 1973-1975

PROFESSIONAL QUALIFICATIONS & AFFILIATIONS

Registered Landscape Architect: Pennsylvania, New Jersey, Delaware
Licensed Professional Planner, New Jersey, PP L104952
Member, American Institute of Certified Planners, AICP
Associate Member, American Institute of Architects, AIA
Member, Urban Land Institute, ULI
Member, National Pool and Spa Institute, NPSI

AWARDS

1990 & 1989 - Excellence in Architecture and Design Award, Bucks County Chapter AIA & Bucks
County Chamber of Commerce
1989 - Annual Planning Award: Publication, New Jersey Federation of Planning Officials
1989 - Annual Planning Award: Land Use Code, New Jersey Federation of Planning Officials
1989 - Outstanding Planning Activity, Pennsylvania Planning Association
1988 - Somerset County N.J. Annual Planning Award
1984 - National Merit Award, American Society of Landscape Architects
1980 - National Award for Design Excellence, sponsored jointly by the U.S. Department of
Transportation and the National Endowment For The Arts

LECTURER AT PROFESSIONAL CONFERENCES AND COLLEGES

Carter van Dyke is a frequent lecturer at regional conferences on subjects such as: performance zoning, transportation master planning, scenic corridors, garden design, preserving historic landscapes and historic garden restoration, and the use of perennials within the landscape. He is a visiting lecturer at the Bucks County Community College. He is also a judge at the Philadelphia Horticultural Society annual flower show.

PUBLICATIONS

Managing Transportation in Your Community, New Jersey Department of Transportation, 1989
Performance Streets, A Concept and Model Standards for Residential Streets, Bucks County Planning Commission, 1980

PROFESSIONAL PLANNING AND LANDSCAPE ARCHITECTURE PROJECTS (Partial)

Land Use Ordinances:

- Newtown Joint Municipal Zoning Ordinance, Bucks County, PA
- Union Township Zoning Ordinance, Hunterdon County, New Jersey

Master Planning:

- Glen Gardner Borough, Hunterdon County, New Jersey
- West Amwell Township, Hunterdon County, New Jersey

Urban Design/Landscape Architecture

- Port Imperial, West New York, New Jersey
- Montgomery Village, Mixed Use Development, Somerset County, New Jersey

Park and Recreation

- Washington Valley Plan, Somerset County, New Jersey
- Radnor Township Park and Recreation Master Plan, PA (In progress)

Philadelphia Electric Company Rebuttal Statement No. 6

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY
OF
J. MICHAEL SILVA

RECEIVED

DEC 5 1991

SECRETARY'S OFFICE
Public Utility Commission

A110550755

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

REBUTTAL TESTIMONY OF J. MICHAEL SILVA

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1 I. Background and Qualifications

2
3 Q Please state your name and business address.

4
5 A. My name is James Michael Silva. My business address is ENERTECH
6 Consultants, Campbell, California.
7

8
9 Q What is your occupation?

10
11 A. I am a research engineer, specializing in assessing exposure to
12 extremely low frequency (ELF) electric and magnetic fields (EMF).
13

14
15 Q Please describe your educational background.

16
17 A. I have a Bachelor of Science degree in Engineering from the
18 University of Alabama and a Master of Science in Engineering from
19 Auburn University.
20

21
22 Q Are you a registered professional engineer?

23
24 A. Yes, I am a registered professional engineer in five states, including
25 the state of Pennsylvania.
26

27
28 Q Please describe your work experience.

29
30 A. I worked at the Southern Company for about 8-1/2 years in electric
31 transmission line design. As supervising engineer, I was responsible
32 for the detailed design of 115 kV to 500 kV high voltage electric
33 lines on the Southern Company's electric transmission system in
34 Alabama, Mississippi, and Florida. This included the engineering
35 design details and specifications necessary for construction of
36 these lines. I was also responsible for conducting a variety of
37 technical and research studies of the electric environment in the
38 vicinity of high voltage electric lines and substations.

1 Q Do you have personal experience with high voltage transmission
2 lines, particularly 230 kV lines?
3

4 A. Yes, I have designed many high voltage lines and conducted a number
5 of technical and research studies related to high voltage lines
6 including their design and operation. This has included a number of
7 230 kV transmission line projects.
8
9

10 Q Please continue the description of your work experience.
11

12 A. In 1977, I was appointed Project Manager of the Alternating Current
13 and Direct Current Research Program for the Electric Power
14 Research Institute (EPRI) in Palo Alto, California. I was responsible
15 for transmission line research at several facilities located across
16 North America. These research projects included design
17 considerations for electric lines, evaluations of electric and
18 magnetic fields, field induction, spark discharge and corona studies,
19 instrumentation for field measurements, and many other technical
20 areas.
21

22 From 1979 to early 1982, I worked at a consulting firm in
23 Pittsburgh, Pennsylvania. My duties included managing and
24 conducting several transmission line projects and various
25 transmission line design and engineering jobs nationwide.
26

27 About 10 years ago I started ENERTECH Consultants.
28
29

30 Q What is your position at ENERTECH Consultants?
31

32 A. I am President of ENERTECH Consultants.
33
34

35 Q What is ENERTECH Consultants?
36

37 A. ENERTECH Consultants is a scientific consulting firm that
38 specializes in applied research projects, engineering, exposure

1 assessment, and the development of electric and magnetic field
2 measurement instrumentation and computer software. We have
3 about 20 employees and are involved in a variety of research and
4 consulting projects for different clients throughout the world.
5

6
7 Q What do you mean by the term "exposure assessment?"
8

9 A. Exposure assessment means the evaluation of people's exposure to
10 electric or magnetic fields through measurement, modeling,
11 calculations, or other techniques.
12

13
14 Q Please describe some of ENERTECH's projects related to electric and
15 magnetic fields.
16

17 A. We perform work related to electric and magnetic fields in three
18 areas.
19

20 First, we conduct applied research projects involving electric and
21 magnetic field exposure assessment. In this area we are working on
22 several major projects, including studies conducted by researchers
23 for the Johns Hopkins University, the University of North Carolina,
24 the Electric Power Research Institute, the California Department of
25 Health Services, and the National Cancer Institute.
26

27 Second, we develop instrumentation for evaluation of electric and
28 magnetic fields and we conduct a variety of measurement programs
29 throughout the world.
30

31 Third, we develop computer software for calculating field levels and
32 for modeling electric and magnetic field environments and exposure.
33

34
35 Q Could you provide more detail on some of your applied research that
36 is currently underway?
37
38

1 A. Yes. We are the co-principal investigator, along with Dr. David
2 Savitz of the University of North Carolina, on a study of electric
3 utility workers. Our role has been to conduct field measurements to
4 characterize the magnetic field exposure encountered by these
5 electric utility workers. In a new EPRI nationwide residential
6 study, we are evaluating magnetic fields in 850 homes in 22 utility
7 service areas. For the California Department of Health Services, we
8 recently completed detailed measurements in 81 homes from the
9 original residential study by Dr. Savitz in Denver. In the National
10 Cancer Institute study, our research team is involved in the effort to
11 measure magnetic fields in homes in six states as part of a large
12 childhood epidemiological study.
13

14
15 Q Have you published any papers reporting the results of your research
16 on electric and/or magnetic fields?
17

18 A. Yes. While the research just described is ongoing, I have published a
19 number of papers and research reports on my previous research
20 work. A brief biographical sketch and description of some of my
21 research which includes those papers and research reports is
22 appended to my testimony as Exhibit JMS-1.
23
24

25 Q What kind of instrumentation systems have you developed for
26 measuring electric and/or magnetic fields?
27

28 A. For measuring fields and conducting exposure assessment, our
29 research team has developed portable instrumentation known as the
30 EMDEX system. EMDEX stands for Electric and Magnetic Digital
31 EXposure meter. It is a portable instrument that can be worn on the
32 belt for measuring and recording magnetic fields. It contains a
33 magnetic field meter circuit and a small onboard computer which
34 stores, in digital form, the values of the measured field.
35 Measurements can be taken over a period of time and the results
36 stored for several hours up to day. Later, a graphic computer
37 printout of the magnetic fields can be produced. The result is
38 perhaps the best data available to document a person's exposure to a

1 variety of magnetic field levels and sources and to identify the wide
2 variety of fields that people can encounter. We also developed
3 DATACALC, which is the computer software package that is used
4 with the EMDEX system.

5
6 The EMDEX system is used extensively in the United States and
7 overseas. In our research laboratories, we have recently completed
8 development of the new EMDEX II, a smaller version of the original
9 EMDEX for personal exposure assessment that can fit into a shirt
10 pocket. We have also developed the new EMCALC computer software
11 package that is used with the EMDEX II.

12
13
14 Q Have you measured actual electric and magnetic fields from electric
15 power lines, appliances and other electrical sources in the past?

16
17 A. Yes, I have conducted extensive measurements of power frequency
18 fields throughout the United States and in other countries. My work
19 has ranged from applied research projects to measurements and
20 calculations.

21
22
23 Q Other than the DATACALC and EMCALC software, have you developed
24 any other computer software for evaluating electric and magnetic
25 fields?

26
27 A. Yes. We also designed and developed the computer software
28 EXPOCALC, which is used for calculating electric and magnetic
29 fields from electric power lines and also for exposure modeling.
30 EXPOCALC was developed under my supervision for EPRI, and is
31 currently used throughout the world. We also assisted the High
32 Voltage Transmission Research Center with the development of
33 ENVIRO, another computer program for modeling electric
34 environments, and we have started work on a new research grant to
35 develop an EMF workstation, a comprehensive software package that
36 includes a variety of computer programs for EMF calculations and
37 modeling.

1 Q Have you calculated electric and magnetic fields from electric
2 power lines in the past?

3
4 A. Yes, numerous times for lines in many locations throughout the
5 United States and in other countries. These calculations were
6 performed using computer software, such as EXPOCALC and ENVIRO,
7 to model the electric and magnetic fields near electric power lines.
8
9

10 Q Are you a member of any professional organizations?

11
12 A. Yes. I am a senior member of the Institute of Electrical and
13 Electronics Engineers (IEEE). Within that organization, I served for
14 about ten years as the Secretary of the Power Engineering Society's
15 Corona & Field Effects Subcommittee. I am also a member of the
16 IEEE Design and Environmental Considerations Working Group, and the
17 AC Fields Working Group.
18

19 I am also a member of the International Conference on Large High
20 Voltage Electric Systems (CIGRE), an international organization
21 located in Paris that is composed primarily of electric power
22 systems engineers. I am also a full member of the
23 Bioelectromagnetic Society (BEMS).
24
25

26 Q Have you served on any other technical committees or acted as an
27 advisor or consultant concerning electric transmission lines?

28
29 A. Yes. For example, I have served as a member of the National
30 Electrical Safety Code (NESC) Committee of the Southeastern
31 Electric Exchange. The Committee is responsible for ongoing review
32 of proposed technical revisions and future recommendations for the
33 NESC.
34

35 I have been an advisor on U.S. Department of Energy transmission
36 line research projects, and I participated in the United States -
37 Soviet Union technical exchange program on electric and magnetic
38 fields, including transmission line fields, as a U.S. representative in

1 two sets of meetings with Soviet scientists arranged by the United
2 States Department of State.

3
4 I have also participated in the World Health Organization
5 International Association for Research in Cancer (IARC) meeting in
6 Lyon, France to discuss and plan coordination of research projects
7 involving electric and magnetic field exposure assessment.
8
9

10 Q Have you received any special recognition for your work involving
11 electric power lines and exposure assessment?
12

13 A. Yes. At the University of Southern California, I was the Lloyd Hunt
14 Distinguished Lecturer in Power Engineering. I have also been a
15 guest lecturer at the Ohio State University Electrical Engineering
16 Colloquium - Distinguished Lecture Series, and I was invited as a
17 guest lecturer at the University of Texas at Austin at the Power
18 System Seminar Lecture Series and the Power Distribution
19 Conference. I have also received recognition awards for my work on
20 IEEE and CIGRE technical papers.
21
22

23 Q Could you identify some of the organizations for whom ENERTECH
24 has acted as a consultant for field measurements and exposure
25 assessments?
26

27 A. Yes. We have conducted work related to exposure assessment,
28 including magnetic field measurements, for a number of electric
29 utilities in the United States, Australia, and Canada and a wide
30 variety of other clients, including the California Department of
31 Health Services, the U.S. Department of Justice, Stanford University,
32 the Montecito and Selma Unified School Districts in California, the
33 Jefferson County School District in Colorado, Mesa School District in
34 Arizona, Kaiser Permanente Hospitals, Bay Area Rapid Transit, the
35 Metropolitan Water District in Los Angeles, the Wisconsin Public
36 Service Commission, the Cancer Control Agency of British Columbia,
37 the Roadway Powered Electric Vehicle Project, and others.
38

1 Q What were you asked to do in connection with this case?

2
3 A. I was asked to conduct an independent evaluation of common
4 magnetic field levels that people encounter in their everyday lives
5 in Philadelphia and at some locations near the route of the
6 Woodbourne-Heaton 230 kV transmission line. I was asked to
7 generally compare the measured magnetic field levels in
8 Pennsylvania to those that people can routinely encounter from a
9 variety of sources.

10
11 I was also asked to evaluate the design and exposure assessment
12 aspects of the Woodbourne-Heaton 230 kV project to ascertain
13 which features of this project, if any, are consistent with the
14 concept of prudent avoidance described, among other places, in a
15 1989 paper published by the U.S. Office of Technology Assessment
16 (OTA).

17
18
19 **II. Background on Electric and Magnetic Fields**

20
21 **A. Characteristics of Electric and Magnetic Fields**

22
23 Q By way of background, what are electric and magnetic fields?

24
25 A. A field is a space or region in which an influence can be said to
26 exist. For example, a temperature field is said to exist in the space
27 around a hot or cold object. Two types of fields are produced by 60
28 Hertz (Hz) devices: electric fields and magnetic fields. All electric
29 devices, including electric power lines and even household
30 appliances, can produce these fields.

31
32 The earth itself has a static or DC electric field of about 0.15 kV/m.
33 Static electric fields can also result from taking off a sweater or
34 walking across a carpet. Induced body voltages as high as 4,000 to
35 8,000 volts (and higher) have been measured for walking across a
36 carpet. In addition to an electric field, the earth has a static
37 magnetic field. In Southeastern Pennsylvania the earth's magnetic
38 field is about 560 milligauss. It should be noted that since the

1 earth's fields are primarily static fields rather than alternating
2 fields, they do not necessarily compare directly with 60 Hz AC
3 fields.
4

5
6 Q You mentioned 60 Hertz (Hz) - what is a Hz?
7

8 A. Hz is a unit of frequency - frequency relates to the number of
9 alternations or cycles of a wave during a period of time. The term
10 60 Hz means 60 cycles per second. For alternating current (AC)
11 electric power lines like the one at issue here, the voltage and
12 electric current reverse polarity, or direction, at a rate of 60
13 complete alternations or cycles per second. If there are no
14 alternations, this is said to be direct current (DC), or static. For a
15 static field, the frequency is 0 Hz.
16

17
18 Q What is the frequency at which electric transmission lines in the
19 United States operate?
20

21 A. AC (alternating current) electric power transmission lines in the
22 United States operate at 60 Hz.
23

24
25 Q Please generally describe 60 Hz electric fields.
26

27 A. A 60 Hz electric field is the field associated with the voltage on the
28 conductors (energized wires) of a electric power line or device. The
29 units commonly used to describe an electric field are volts per
30 meter (V/m) or kilovolts per meter (kV/m). One of the
31 characteristics of a 60 Hz electric field is that it decreases with
32 distance away from the source. Electric fields are also easily
33 shielded by objects such as trees.
34

35
36 Q What factors influence the electric fields from an electric source?
37
38

1 A. In general, electric fields are a function of the voltage on the line,
2 phasing, the geometry or configuration of the device, and distance
3 away from the source of the fields.
4

5
6 Q Please generally describe 60 Hz magnetic fields.
7

8 A. A 60 Hz magnetic field is the field associated with the flow of
9 electric current (or amperes) on electric lines or devices. The most
10 common unit used by engineers for describing magnetic fields
11 (actually the magnetic flux density) is the Gauss (G). Often a much
12 smaller unit, the milligauss (mG), is used. One milliguass equals one
13 one thousandth of a Gauss. (1 mg = .001 G). One of the
14 characteristics of a 60 Hz magnetic field is that it decreases with
15 distance away from the source. Magnetic fields are not easily
16 shielded by objects such as trees.
17

18
19 Q What factors influence the magnetic fields from an electric source?
20

21 A. In general, magnetic fields are a function of the current (loading in
22 amperes), phasing, the geometry or configuration of the device, and
23 distance away from the source of the fields.
24

25 26 B. Sources of Electric and Magnetic Fields

27
28 Q What are some common sources of 60 Hz electric and/or magnetic
29 fields?
30

31 A. Electric and magnetic fields are created whenever there is a flow of
32 electricity. Household wiring, electric transmission and
33 distribution facilities, lighting, appliances, and office equipment
34 are all common sources of electric and magnetic fields. The 60 Hz
35 field is higher close to the source of the field and attenuates
36 (decreases) with distance from the source; the fields attenuate
37 more quickly with distance away from household appliances than
38 from power lines.

1 Q Have you studied and conducted measurements of the magnetic fields
2 from common household appliances?
3

4 A. Yes, many times. The results of some of these measurements have
5 been reported in the peer-reviewed literature.
6
7

8 Q Do you have an exhibit to illustrate the level of magnetic fields that
9 are associated with common household appliances?
10

11 A. Yes. Exhibit JMS-2 attached to my testimony illustrates these field
12 levels. For this exhibit, I used data from my published paper,
13 "Power Frequency Magnetic Fields in the Home." The exhibit gives
14 some examples of the kinds of appliances found in a typical home.
15 For each appliance I have given a range of measured field values (in
16 milligauss) associated with normal use of the appliance and a
17 maximum for the region next to the appliance. The range reflects
18 variations in the field levels among different brands of appliances
19 and also variations depending on how far away the appliance is from
20 the measuring point during normal use. Thus, an appliance used near
21 the head region would give a higher exposure to the head and a lower
22 exposure at waist level, with the maximum value being where the
23 appliance is touched.
24

25
26 Q Would you explain that by using the electric shaver as an example?
27

28 A. If you were holding an electric shaver in your hand and shaving your
29 face, you could experience fields as high as about 6800 milligauss at
30 your hand and face. The rest of your body would experience fields
31 anywhere from 300 milligauss at your head near the shaver to 50
32 milligauss or less somewhere near your waist.
33

34
35 Q What is shown by Exhibit JMS-2?
36

37 A. The exhibit demonstrates the variety of magnetic field exposures
38 associated with normal use of appliances and that some level of

1 exposure is associated with any number of everyday activities.

2
3
4 Q Are people exposed to electric and magnetic fields from appliances
5 for only a few minutes or hours a day?

6
7 A. Many appliances are only used for a relatively short length of time,
8 and the field level does quickly decrease with distance away from
9 the appliance. However, each activity and each location can have its
10 own sources of electric and magnetic fields that people encounter.
11 People do move from place to place and from one activity to the
12 next, and this can cause a continuous or almost continuous range of
13 exposures in a typical day.

14
15
16 **C. Magnetic Fields in Philadelphia and Langhorne Borough**

17
18
19 Q Have you measured fields that individuals experience as they go
20 about their everyday lives?

21
22 A. Yes. I conducted a measurement program in which we took over
23 1000 measurements of fields in about 90 homes located in six
24 states. I have also conducted a study in which I took measurements
25 in homes located both near and away from electric lines and we have
26 taken a variety of exposure measurements at typical locations
27 across North America. As I mentioned earlier, we have almost
28 completed a program that will collect data from 850 homes
29 (including Pennsylvania).

30
31
32 Q Was your firm asked to conduct any magnetic field measurements in
33 preparation for your testimony in this proceeding?

34
35 A. Yes, in preparation for these proceedings, we were asked to make
36 some magnetic field measurements in Southeastern Pennsylvania. In
37 September, 1991 we took a series of measurements at locations in
38

1 Southeastern Pennsylvania, using the EMDEX II meter described
2 previously in my testimony.
3
4

5 Q Where in Southeastern Pennsylvania did you take these EMDEX II
6 measurements?
7

8 A. Continuous EMDEX II measurements were made during a routine walk
9 through several common locations in the city of Philadelphia and
10 also during a walk through various locations in and around Langhorne
11 Borough, which is near the Woodbourne-Heaton line.
12
13

14 Q Have you prepared exhibits to illustrate the measurements that were
15 made in Philadelphia and Langhorne Borough?
16

17 A. Yes. As I noted earlier, the EMDEX II collects and stores the
18 measurement data and allows production of a graphic computer
19 printout of the magnetic fields encountered. Exhibit JMS-3 is a copy
20 of the actual printout from the data recorded by the EMDEX II during
21 the walk through Langhorne Borough. It shows a continuous plot of
22 magnetic field levels encountered during a walk around some typical
23 locations in the vicinity of Langhorne Borough. Exhibit JMS-4 is a
24 copy of the actual printout from the magnetic field measurement
25 data recorded during the walk around Philadelphia.
26
27

28 Q Could you briefly summarize for us the magnetic fields recorded
29 during the walk around Langhorne Borough and presented in Exhibit
30 JMS-3?
31

32 A. Exhibit JMS-3 shows a continuous plot of the measurement results
33 recorded at 1.5 second intervals during a 3-1/2 hour walk through
34 various locations in the Langhorne Borough area. The field levels in
35 a local grocery store and another convenience store range from about
36 1-12 mG. Magnetic fields in a nearby shopping mall range from a
37 fraction of 1 mG to 30 mG. In a nearby amusement park the fields
38 ranged from less than 1 mG to over 60 mG.

1 Q Can you please summarize the magnetic fields recorded during the
2 walk around Philadelphia and presented in Exhibit JMS-4?
3

4 A. Exhibit JMS-4 shows a continuous plot of the magnetic field levels
5 recorded at 1.5 second intervals during a 4 hour walk around various
6 locations in Philadelphia. The fields are generally in the range of
7 less than 1 mG to tens of mG, with some locations up to 100-250
8 mG, and one location in a shopping mall with a reading of 760 mG.
9

10
11 Q Do you know the sources of all the different magnetic field levels
12 recorded during these walks?
13

14 A. No. Frequently it is not possible without a more detailed
15 investigation to identify the variety of sources encountered in
16 everyday life.
17

18
19 Q How do the levels of fields that were measured in Southeastern
20 Pennsylvania compare with those in other locations across the
21 United States?
22

23 A. These values are similar to levels I have measured at other
24 locations in towns across the United States.
25

26
27 Q What are your conclusions regarding the EMDEX II measurements in
28 Southeastern Pennsylvania?
29

30 A. Exposure to magnetic fields results from a variety of situations and
31 sources routinely encountered in everyday life. Although no precise
32 measure of exposure has been identified, it is apparent that any
33 individual's total exposure will be composed of the many common
34 exposures at home, at work, at businesses, at school, at recreation,
35 and at other locations. Some of the exposures to appliances and
36 other electric devices can have a significant temporal component.
37 For example, a clock radio, fan or even water pipes (with ground
38 currents) located near the bed or a living room chair can bring people

1 near everyday field sources for longer than a brief period. I should
2 add, however, that we do not know whether brief exposures or longer
3 term exposures are important, if in fact either type of exposure is
4 important. A number of typical employment and other locations, for
5 example, near a cash register, service counter, display case, or video
6 games, could result in a range of field exposures. In summary, the
7 EMDEX II measurements provide a context for understanding total
8 magnetic field exposure and the relative contribution and variety of
9 sources encountered in everyday activities.

12 III. Prudent Avoidance

15 Q Are you familiar with the concept known as "prudent avoidance"?

17 A. Yes. This concept was described by researchers at Carnegie-Mellon
18 University most recently in a 1989 report sponsored by the
19 Congressional Office of Technology Assessment (OTA) and a brochure
20 distributed by Carnegie-Mellon University.

23 Q Please briefly describe the concept of prudent avoidance.

25 A. Prudent avoidance has been suggested as one possible framework for
26 analyzing exposure to electric and magnetic fields, and for
27 considering actions that might alter exposure to electric and
28 magnetic fields. Prudent avoidance incorporates several
29 assumptions from exposure assessment. For example, we do not
30 know which aspect of exposure, if any, is important in discussions
31 of EMF and health. A measure of magnetic field "dose" does not
32 exist; it is not clear if exposure on one day can be added, in some
33 manner, to exposure on another day, or whether short-term high
34 levels of exposure are different from long-term lower levels of
35 exposure. Prudent avoidance also is based on the assumption that
36 health effects from exposure to electric and magnetic fields have
37 not been demonstrated. Prudent avoidance is a concept that
38 recognizes that a scientific determination cannot be made that

1 changes in EMF levels will have any effect on health, and thus
2 prudent avoidance advocates only a modest effort in making such
3 changes.
4

5
6 Q When applying the concept of prudent avoidance to transmission
7 facilities, is it appropriate to evaluate design features of the
8 transmission facility?
9

10 A. Yes. The design features of a transmission facility can affect the
11 electric and magnetic fields that are associated with the facility.
12 To evaluate whether a transmission facility is consistent with the
13 concept of prudent avoidance, a person thus should have a good
14 understanding of transmission line design, what engineering factors
15 affect fields, and the relative feasibility, reliability, and cost of
16 different engineering options. In addition, calculation and
17 measurement experience is necessary to properly evaluate field
18 levels and provide a context for understanding what effect, if any,
19 prudent avoidance strategies will have on exposure.
20

21
22 Q Are there aspects of a transmission line other than design that are
23 relevant to a discussion of prudent avoidance?
24

25 A. Yes. For example, routing of the transmission line should be
26 considered. In addition, it is appropriate to consider whether the
27 transmission facility meets existing field standards that are
28 "similarity-based."
29

30
31 Q Have you evaluated the Woodbourne-Heaton 230 kV project with
32 respect to prudent avoidance?
33

34 A. Yes. I reviewed and evaluated the design, routing, and field levels
35 for this transmission line. Each of these elements has features that
36 are consistent with the concept of prudent avoidance.
37
38

1 Q What is your evaluation of the design of the Woodbourne-Heaton 230
2 kV transmission line.
3

4 A. The design for this 230 kV project is a compact delta (or triangular)
5 configuration. This type of line configuration is known to produce
6 fields that are generally lower than other typical configurations. As
7 discussed in Mr. Boeggeman's testimony in this proceeding, use of
8 other design configurations for the Woodbourne-Heaton line would
9 result in comparable or higher fields than those associated with the
10 compact delta configuration. Also, the phase transpositions (rolls)
11 used to mitigate induction effects on the railroad tracks and signal
12 equipment will result in more balanced (equal) phase currents (little
13 or no net current), thereby producing lower magnetic fields as a
14 function of distance due to almost equal cancellation of the balanced
15 phase currents. These design considerations result in lower field
16 levels at modest effort, and are consistent with the concept of
17 prudent avoidance.
18
19

20 Q What is your evaluation of the routing of the Woodbourne-Heaton 230
21 kV transmission line?
22

23 A. The 230 kV project uses an existing right-of-way (ROW), previously
24 used by an electric railroad and currently used by a diesel railroad,
25 that follows a near-linear route between the Woodbourne and Heaton
26 substations. This use of an existing utility corridor that was
27 previously used for an electrified railway also avoids the creation
28 of a new utility corridor. An additional feature of this route choice
29 is that it allows re-use of the existing poles on the ROW previously
30 used for electric power supply by the railroad, which is an important
31 factor leading to use of the compact delta configuration and phase
32 rolls, which themselves are consistent with prudent avoidance.
33 Taking these factors into consideration, I view the routing of this
34 transmission line as consistent with the concept of prudent
35 avoidance.
36
37
38

1 Q What is your evaluation of the field levels from the Woodbourne-
2 Heaton transmission line?

3
4 A. As I previously discussed, the concept of prudent avoidance
5 incorporates the assumption that we do not know which aspect of
6 exposure, if any, is important in discussions of EMF and health. One
7 approach to prudent avoidance, known as the "similarity-based"
8 approach, recognizes this assumption by suggesting that EMF from
9 transmission lines be similar to the levels from other transmission
10 lines. This approach was used in developing the field standards in
11 New York State and Florida, for example.

12
13 The fields that will be associated with the Woodbourne-Heaton 230
14 kV project are not materially different from other 230 kV
15 transmission lines already in operation in Pennsylvania and
16 throughout the United States. The fields that will be associated the
17 Woodbourne-Heaton line also are lower than the New York and
18 Florida standards. These feature are consistent with the similarity-
19 based approach to prudent avoidance.

20
21
22 Q Are there specific procedures or efforts that always must be
23 followed for a project to be consistent with prudent avoidance?

24
25 A. No. The concept of prudent avoidance is a general framework that
26 has not been codified. It suggests modest efforts to reduce field
27 exposure, and should be understood to be oriented toward that
28 result, rather than toward any required method of achieving that
29 result. The question of what is "modest" will vary depending upon
30 the specific project. Where, as here, the design and routing of the
31 transmission line result in lower fields at modest cost consistent
32 with prudent avoidance, the concept of prudent avoidance does not
33 require that any specific decisional or temporal process must be
34 followed in achieving that result.

35
36
37 Q Does prudent avoidance require waiting for the results of ongoing or
38 future research?

1 A. No. Prudent avoidance is a concept that allows us to act and move
2 forward while research continues. The authors of the OTA Report
3 have consistently stated that prudent avoidance is designed to help
4 guide action given the current state of scientific knowledge.
5 Delaying projects because of the current state of scientific
6 knowledge thus runs contrary to the basic assumptions of prudent
7 avoidance. To my knowledge, no utility regulatory commission that
8 has evaluated the concept of prudent avoidance has concluded that it
9 requires waiting for further research results.

10
11
12 Q What are your conclusions regarding your evaluation of the
13 Woodbourne-Heaton 230 kV transmission line project?

14
15 A. In comparison to other, similar transmission lines, there is nothing
16 unique or unusual about the fields associated with the Woodbourne-
17 Heaton 230 kV transmission line. The electric and magnetic fields
18 that will be associated with the Woodbourne-Heaton line are in the
19 same range as levels from other similar 230 kV lines. The magnetic
20 field levels associated with the 230 kV line are within the range
21 that people routinely encounter in everyday life from a variety of
22 sources. The 230 kV project will meet existing field standards in
23 other states, and it has design and routing features consistent with
24 the concept of prudent avoidance.

25
26
27 Q Does this conclude your testimony?

28
29 A. Yes.

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT JMS-1
OF
J. MICHAEL SILVA**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

RESUME

J. Michael Silva, BSE, MSE

Mr. Silva is the President of Enertech Consultants. He has almost 20 years of experience related to electric power facilities, project management and applied research projects. Early in his career, at the Southern company, he supervised an electric transmission line design group (1970-76) and worked as a loaned employee at the Electric Power Research Institute (1977-78). He has also worked as the manager of a variety of applied research projects at GAI (1979-81). In 1982, he founded Enertech Consultants and has focused on: applied research on EMF exposure assessment, hardware and software development and scientific consulting. He has authored numerous articles and papers on power frequency electric and magnetic field exposure assessment. He has served as principal investigator on a variety of EMF exposure studies, including some of the original work on using computers to model exposure and development of new hardware to measure exposure.

Mr. Silva has served as a past advisor to DOE on various research projects, participated in the U.S. Technical Exchange Program on EMF with the Soviet Union, and delivered a number of lectures and training seminars on EMF issues. He was the 1979 Lloyd Hunt Distinguished Lecturer in Power Engineering at the University of Southern California and an invited lecturer in programs at Ohio State University and the University of Texas. He also participated in the 1988 World Health Organization - IARC Meeting in Lyon, France on EMF exposure assessment. He is a senior member of IEEE and a member of CIGRE and BEMS. Mr. Silva is also a registered professional engineer in five states.

LIST OF PUBLICATION & PRESENTATIONS

JAMES MICHAEL SILVA

Lectures at University of Texas Power System Seminar - "Current Research Projects Relating to HV/EHV/UHV Transmission Lines", Austin, Texas, February 28, 1978.

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**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT JMS-2
OF
J. MICHAEL SILVA**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

MAGNETIC FIELD ENVIRONMENT

Summary of Domestic Appliance Magnetic Field Measurements

<u>Appliance Type</u>	<u>Body Location</u>	<u>Magnetic Field - mG</u>	
		<u>Typical Range</u>	<u>Maximum Value</u>
Range	Belt	1-80	175-625
Refrigerator	Chest	1-8	12-187
Microwave Oven	Belt	3-40	65-812
Can Opener	Belt	30-225	288-2750
Oven	Belt	1-8	14-67
Toaster	Belt	2-6	9
CoffeeMaker	Chest	1-2	4-25
Freezer	Head	1-3	4-6
Mixer	Belt	2-11	16-387
Clothes Dryer	Belt	1-24	45-93
Dishwasher	Belt	1-15	28-712
Garbage Disposal	Belt	1-5	8-33
Ceiling Fan	Head	1-11	125
Electric Blanket	Belt	3-50	65
Waterbed Heater	Belt	1-9	20-27
Blow Dryer	Head	1-75	112-2125
Computer	Belt	1-25	49-1875
Typewriter	Belt	1-23	38
Make-Up Mirror	Chest	1-29	44-125
Shaver	Head	50-300	500-6875
Aquarium	Belt	1-40	50-2000
Sewing Machine	Chest	1-23	26-1125
Electric Drill	Chest	56-194	300-1500
Circular Saw	Belt	19-48	84-562

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT JMS-3
OF
J. MICHAEL SILVA**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

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**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT JMS-4
OF
J. MICHAEL SILVA**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

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December 11, 1991

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VIA FEDERAL EXPRESS

The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

RECEIVED

DEC 11 1991

SECRETARY'S OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

Dear Judge Smolen:

Enclosed in this package are photographic reproductions of the Exhibits
referred to in Philadelphia Electric Company Rebuttal Statement No. 5, Rebuttal
Testimony of Carter Van Dyke.

With regard to Exhibit CVD-8 (aerial photographs of the area surrounding the
Trenton Cutoff), we have included photographic reproductions on two scales: one
photograph showing the entire exhibit, followed by three photographs on a larger
scale to show further detail of the Exhibit.

Exhibit CVD-4 (containing identification of streams and waterways) and
Exhibit CVD-5 (containing identification of woodlands) are jointly reproduced in a
single photograph.

**DOCUMENT
FOLDER**

The Honorable Herbert S. Smolen
December 11, 1991
Page 2

Copies of these reduced-size reproductions of the Exhibits are being served on all parties today by overnight mail.

Sincerely,



Ward L. Smith

cc: (Via Federal Express)
Robert J. Sugarman, Esquire
Tanya J. McCloskey, Esquire
Patricia Krise Burket, Esquire
Jesse A. Dillon, Esquire
Paul Bonney, Esquire
Mr. Jerry Rich
Mr. David Rosenbaum

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

By Overnight Mail

David Rosenbaum
Risk Analysis Corp.
Suite 202
6723 Whittier Avenue
McLean, VA 22101
(OCA Consultant)

Tanya J. McCloskey, Esquire
Assistant Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120

The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

Mr. Jerry Rich
Secretary
Pennsylvania Public Utility Commission
North Office Building
North Street and Commonwealth Avenue
Harrisburg, PA 17105-3265

(Continued)

Robert J. Sugarman, Esquire
Sugarman & Associates
7th Floor, Robert Morris Building
100 N. 17th Street
Philadelphia, PA 19103
(Counsel for Intervenors)

Patricia Krise Burket, Esquire
Pennsylvania Public Utility Commission
G-30, North Office Building
Law Bureau
North Street and Commonwealth Avenue
Harrisburg, PA 17120

Jesse A. Dillon, Esquire
Pennsylvania Power & Light Co.
Two North Ninth Street
Allentown, PA 19101


Ward L. Smith
Counsel to Philadelphia Electric Co.
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2505

Dated: December 11, 1991

ENLARGEMENTS

Show off your best!

REC. EXHIBITS CVD-2
THROUGH CVD-8

A-110550F055

12/16/91 ... 12/1

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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

EXHIBIT CVD-2
OF
CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

**OVERSIZE
DOCUMENT(S)**

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

EXHIBIT CVD-3
OF
CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

**OVERSIZE
DOCUMENT(S)**

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

EXHIBIT CVD-4
OF
CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

**OVERSIZE
DOCUMENT(S)**

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT CVD-5
OF
CARTER VAN DYKE**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

**OVERSIZE
DOCUMENT(S)**

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

**EXHIBIT CVD-6
OF
CARTER VAN DYKE**

**ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY**

December 1991

**OVERSIZE
DOCUMENT(S)**

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

EXHIBIT CVD-7
OF
CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

**OVERSIZE
DOCUMENT(S)**

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

EXHIBIT CVD-8
OF
CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

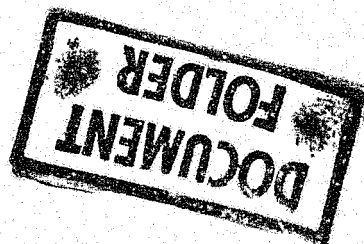
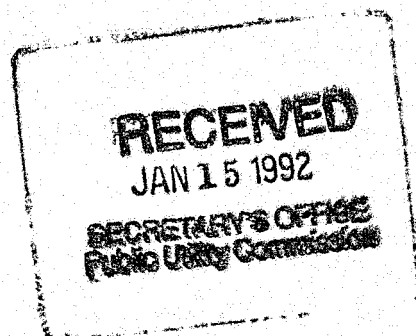
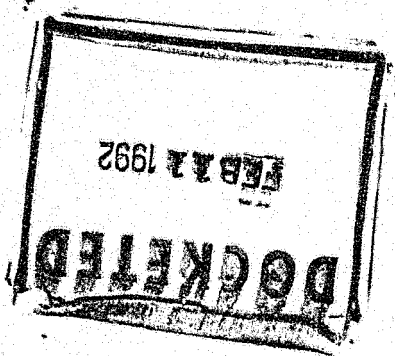
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12-16-91 A-110550F055
Phila, PA. R95



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REC-0 EX. CVD-8

15-10-01 A-1102205022

Phil, 6A.
202

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P.O. BOX 3265, HARRISBURG, PA 17105-3265
December 18, 1991

In Re: A-110550F055

(see letter of 10/21/91)

Letter of Notification of Philadelphia Electric Company relative to reconstructing and rebuilding of the existing 138 kv line to operate as a Woodbourne-Heaton 230 kv line in Montgomery and Bucks Counties.

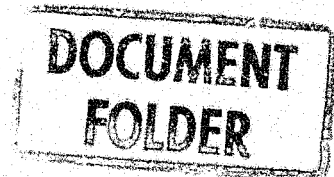
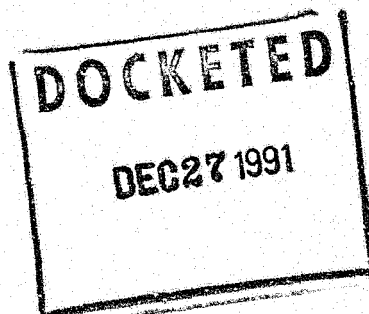
NOTICE

This is to inform you that further hearings on the above captioned case will be held Thursday and Friday, January 23 and 24, 1992 and Monday, January 27, 1992 at 10:00 a.m. in Room 1306, Philadelphia State Office Building, Broad and Spring Garden Streets, Philadelphia, Pennsylvania.

The presiding officer in this proceeding is Administrative Law Judge Smolen. Judge Smolen can be contacted at 1302 Philadelphia State Office Building, Broad and Spring Garden Streets, Philadelphia, Pennsylvania 19130; telephone (215) 560-2105.

cc: Judge Smolen
Mr. Bramson
Consumer Advocate
Law Bureau
Mrs. Kelly
Mrs. Howell
Docket Room

Certified Mail
Receipt Requested and
Regular Mail to Complainant



11/21

ORIGINAL

SUGARMAN & ASSOCIATES

ATTORNEYS AT LAW

7TH FLOOR, ROBERT MORRIS BUILDING

100 NORTH 17TH STREET

PHILADELPHIA, PENNSYLVANIA 19103

215-864-2500 • FAX 215-864-2501

ROBERT J. SUGARMAN

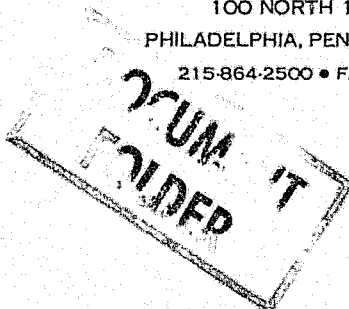
ALAN M. KAPLAN

SUSANNE I. GIENDL*

KEVIN M. STACK

LEGAL ASSISTANT

*NOT ADMITTED TO PRACTICE
IN PENNSYLVANIA



December 16, 1991

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DEC 18 1991

SECRETARY'S OFFICE
Public Utility Commission

Mr. Jerry Rich, Secretary
Pennsylvania Public Utility
Commission
Room G-18, North Office Building
Harrisburg, PA 17120

Re: Application of Philadelphia Electric Company
No. A-110650 F055

Dear Mr. Rich:

I enclose herewith Protestants Petition to Enforce Discovery
and for Sanctions in the above matter.

Thank you for your consideration.

Sincerely,

Robert J. Sugarman

RJS:er
Enclosures

cc: Honorable Herbert Smolen
Tanya J. McCloskey, Esquire
David Rosenbaum, Esquire
Patricia Krise Burket, Esquire
Tinku Khanwalkar, Esquire
Paul R. Bonney, Esquire

pldngs91\Pause.ptn

2002

ORIGINAL

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

IN RE: LETTER OF NOTIFICATION
OF PHILADELPHIA ELECTRIC
COMPANY UNDER 52 PA
CODE 57.72(d) RE: PROPOSED
230 KV WOODBOURNE
TRANSMISSION LINE

DOCKET NO. A-110⁵50-F055

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DEC 18 1991

SECRETARY'S OFFICE
Public Utility Commission

200A
FOLDER

PETITION FOR DISCOVERY AND SANCTIONS

DOCKETED

DEC 30 1991

This is a Petition to compel that the Office of Special Assistants respond to and to implement the Commission's Order directing that certain materials be available to the Protestants herein. Protestants have no written documentation confirming the existence of the Order, but have been informed by members of the press and Commission staff that the Order was adopted. Despite repeated telephone calls and correspondence, the Office of Special Assistants has adamantly refused to turn over any of the documentation. In the meantime, the record is being closed, or may be closed without Protestants having an opportunity to review the documents to which the Commission has held they are entitled.

WHEREFORE, Protestants move that the Commission enter sanctions against the Office of Special Assistants, in the form of counsel fees to Protestants in the amount of \$3,000, and direct that the documents be made available, and that the hearings be held

open in order to consider whatever may arise as a result of the release of the documents.



ROBERT J. SUGARMAN
Counsel for Protestants

OF COUNSEL:

SUGARMAN & ASSOCIATES
7th Floor, Robert Morris Building
100 North 17th Street
Philadelphia, PA 19103
(215) 864-2500
p1dngs91\pause.ptn

CERTIFICATE OF SERVICE

I, Robert J. Sugarman, certify that I have mailed a copy of the foregoing Petition for Discovery and Sanctions by first class mail postage pre-paid to the following:

Paul R. Bonney, Esq.
Assistant General Counsel
Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

Tanya J. McCloskey, Esq.
Asst. Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120

Patricia Krise Burket, Esq.
Penna. Public Utility Commission
G-28, North Office Bldg.
P.O. Box 32265
Harrisburg, PA 17120

David Rosenbaum, Esq.
Risk Analysis Corp.
Suite 202, 6723 Whittier Avenue00X

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DEC 18 1991.

U.S. OFFICE
Commission



APPEARANCE SHEET

ALJ HEARING REPORT

RAY

DOCKET NO. A-110550F055

CASE NAME Letter of Notification of
Philadelphia Electric Co.

HEARING LOCATION Philadelphia

HEARING DATE December 16 and 17, 1991

ALJ Smolen

CHECK THOSE BLOCKS WHICH APPLY:

Hearing held YES ☒ NO ☐

Testimony taken YES ☒ NO ☐

Hearing concluded YES ☐ NO ☒

Further hearing needed YES ☒ NO ☐

Estimated add'l days 3 DAYS *

RECORD CLOSED YES ☐ NO ☒

Date

Briefs to be filed YES ☐ NO ☐

Date

BENCH DECISION

YES ☐ NO ☐

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DEC 19 1991

Office of A. L. J.
Public Utility Commission

REMARKS:

1/23/92

1/24/92

1/27/92

PER PAT Y.

NAMES, ADDRESSES AND TELEPHONE NUMBERS OF PARTIES OR COUNSEL OF RECORD
PLEASE PRINT CLEARLY
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DOCKETED
JAN 2 1992

NAME and TELEPHONE NUMBER	ADDRESS			APPEARING FOR
Paul R. Bonney	2301 Market St.			Philadelphia Electric Co.
Telephone No. (215) 841-4222	City Phila	State PA	Zip 19101	
Tom Watson	1001 Pa. Ave NW			Phila Elec.
Telephone No. (202) 624-2510	City Wash	State DC	Zip 20004	
WAIRD SMITH	1001 Pa Ave NW			Phila Elec.
Telephone No. (202) 624-2594	City Wash	State DC	Zip 20004	

CHECK THIS BOX IF ADDITIONAL PARTIES
OR COUNSEL OF RECORD APPEAR ON BACK.



Robert D. Stander cpe
Int.

Reporter

Patricia Krise Burkett Telephone No. (717) 783-2800	Address City Hbg State PA Zip 17125-3265	Commission Law Bureau Prosecutory Staff
Jesse A. Dillon Telephone No. (215) 774-5073	Address Two North N. 4th St. City Allentown State PA Zip 18101	Pennsylvania Power Light Company
TANYA J. McCLOSKEY Telephone No. (717) 783-5048	Address 1425 Strawberry Sq. City Hbg State PA Zip 17120	Office of Consumer Advocate
Robert T. Szymura Telephone No. ()	Address 100 W Broad St City Allentown State PA Zip 18103	Protestants
Telephone No. ()	Address City State Zip	
Telephone No. ()	Address City State Zip	
Telephone No. ()	Address City State Zip	
Telephone No. ()	Address City State Zip	
Telephone No. ()	Address City State Zip	
Telephone No. ()	Address City State Zip	

CROWELL & MORING
1001 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20004-2595

(202) 624-2500

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1 SERJEANTS' INN

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DOCKETED

JAN 7 1991

December 20, 1991

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DOCUMENT
FOLDER

VIA TELECOPIER

Tanya J. McCloskey, Esquire
Assistant Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120

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DEC 23 1991.

SECRETARY'S OFFICE
Public Utility Commission

Robert J. Sugarman, Esquire
Sugarman & Associates
100 N. 17th Street
7th Floor
Philadelphia, PA 19103

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550.F.055

Dear Tanya and Bob:

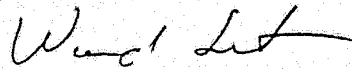
At the December 17, 1991 hearing you both indicated that you intend to call witnesses in surrebuttal. We subsequently discussed, at His Honor's suggestion, the possibility of having all additional witnesses available in the hearing room for any additional testimony that may be needed.

Tanya is attempting to confirm the availability of OCA's surrebuttal witnesses for January 27. Bob has not yet been able to contact his witnesses to discuss availability, but has indicated that he may be able to contact them next week.

Tanya J. McCloskey, Esq.
Robert J. Sugarman, Esq.
December 20, 1991
Page 2

As you know, scheduling particular dates for expert witnesses can be difficult, but is facilitated if one can make an early request to the witness. It would be most helpful if you can follow through on this issue next week so that we can contact witnesses regarding availability as soon as possible.

Sincerely,



Ward L. Smith

cc: (By regular mail)
Hon. Herbert S. Smolen
Jesse A. Dillon, Esquire
Paul Bonney, Esquire
Mr. Jerry Rich
Mr. David Rosenbaum
Patricia Krise Burket, Esquire



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P. O. BOX 3265, HARRISBURG, Pa. 17120

January 6, 1992

IN REPLY PLEASE
REFER TO OUR FILE

AMH

John G. Alford
Acting Secretary
Pennsylvania Public Utility Commission
P.O. Box 3265
Harrisburg, PA 17105-3265

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JAN 6 1992

Re: Application of Philadelphia Electric
Company, A-110550, F.055

SECRETARY'S OFFICE
Public Utility Commission

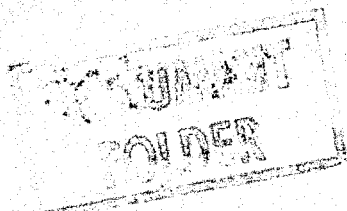
Dear Acting Secretary Alford:

Enclosed please find an original and two copies of the
Answer of the Prosecutory Staff to Protestants' Petition for
Discovery and Sanctions in the above captioned proceeding. A
certificate of service is also enclosed.

Very truly yours,

Patricia Krise Burket

Patricia Krise Burket
Assistant Counsel
Prosecutory Staff



cc: ALJ Herbert Smolen
All parties

ORIGINAL

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION :
OF PHILADELPHIA ELECTRIC :
COMPANY RELATIVE TO :
RECONSTRUCTING AND REBUILDING :
OF THE EXISTING 138 kv LINE : A-110550,F.055
TO OPERATE AS A WOODBOURNE- :
HEATON 230 kv LINE IN :
MONTGOMERY AND BUCKS COUNTIES :

DOCKETED
JAN 10 1992

ANSWER OF THE PROSECUTORY STAFF
TO PROTESTANTS' PETITION
FOR DISCOVERY AND SANCTIONS

RECEIVED
JAN 6 1992

SECRETARY'S OFFICE
Public Utility Commission

Pursuant to 52 Pa. Code §5.61, the Public Utility Commission Law Bureau Prosecutory Staff (Prosecutory Staff) files its Answer to the Protestants' Petition for Discovery and Sanctions. The Prosecutory Staff requests that Protestants' petition be dismissed and in support thereof avers the following:

1. At Public Meeting on October 24, 1991, the Public Utility Commission (Commission) adopted a motion in connection with the above-captioned proceeding directing the Prosecutory Staff to respond to Protestants' discovery requests for materials on electromagnetic fields (EMF) and prudent avoidance (Appendix A). The motion further directed the Commission's Office of Special Assistants (OSA) to draft the Commission order.

2. On December 12, 1991, the Commission entered an order (drafted by OSA) that directs the Prosecutory Staff to provide Protestants with a list of its materials on EMF and prudent

avoidance (Appendix B). No time period in which the Prosecutory Staff was required to comply with this order was stated. The Prosecutory Staff was served with a copy of this order on December 16, 1991.

3. On December 16, 1991, Protestants filed the instant petition to enforce discovery and for sanctions (Appendix C). In its petition, Protestants mistakenly requested that the Commission direct OSA to produce the requested EMF discovery materials. The Protestants further requested that the Commission enter sanctions against OSA in the form of counsel fees to the Protestants in the amount of \$3,000.

4. The Prosecutory Staff believes that the Protestants' instant petition should be dismissed for the following reasons:

a) The Commission's motion adopted at the October 24, 1991 Public Meeting directed the Prosecutory Staff and not OSA to produce a list of pertinent discovery materials for the Protestants.

b) The Commission's December 12, 1991 order is consistent with the adopted October 24, 1991 motion requiring the Prosecutory Staff to provide a list of pertinent discovery materials to the Protestants.

c) OSA is not a participant in the Woodbourne-Heaton proceeding, and the Commission rules do not provide for the entering of sanctions against a non-participant. 52 Pa. Code §5.371.

d) The Commission regulation at 52 Pa. Code §5.372 does not provide for the award of attorney's fees as a sanction against a participant in a Commission proceeding.

e) The Judicial Code, 42 Pa. C.S. §2503, does not authorize the Pennsylvania Public Utility Commission to award attorney's fees. See Duquesne Light Company v. Pa.P.U.C., 117 Pa. Commonwealth Ct. 28, 543 A.2d 196 (1988), appeal granted, 521 Pa. 632, 558 A.2d 533 (1989). See also Pleasant Valley School District v. Department of Community Affairs, 127 Pa. Commonwealth Ct. 85, 560 A.2d 935 (1989).

5. As a basis for their request for sanctions in the instant petition, the Protestants aver that unless they receive the discovery materials on EMF and prudent avoidance immediately, they will not have a chance to review the information before the record in the above-captioned proceeding is closed. The Prosecutory Staff believes there is no danger of this happening. The Administrative Law Judge issued an order on December 18, 1991 which sets three hearing dates in January 1992, the latest being January 27. Moreover, at the December 17, 1991 hearing in an off-the-record discussion (N.T. 1363), the Administrative Law Judge indicated a willingness to allow the Protestants and the other parties as much hearing time as was necessary for the record to be completed.

6. Finally, to insure no prejudice to the Protestants, and to timely comply with the Commission's December 13, 1991 order, the Prosecutory Staff has attached to this Answer as Appendix D a list of the documents on EMF and prudent avoidance. As further instructed in the Commission's December 13, 1991 order, the Prosecutory Staff will make available to the Protestants copies of the materials which Protestants do not possess or cannot obtain.

Conclusion

For all the aforementioned reasons, the Prosecutory Staff respectfully requests that the Commission dismiss the Protestants' Petition for Discovery and Sanctions.

Respectfully submitted,



Patricia Krise Burket
Assistant Counsel
Prosecutory Staff

Pennsylvania Public Utility
Commission
P.O. Box 3265
Harrisburg, PA 17105-3265
(717) 783-2810

DATED: January 6, 1992

APPENDIX A

Motion of Commissioner Joseph Rhodes, Jr.,
October 24, 1991 at Docket No. A-110550, F.055.

PENNSYLVANIA
PUBLIC UTILITY COMMISSION
HARRISBURG, PA. 17120

Petitioners Request for
Production of Documents

Public Meeting
October 24, 1991
Docket No. A-110550, F055
OCT-91-0SA-172

MOTION OF COMMISSIONER JOSEPH RHODES, JR.

On September 3, 1991, Petitioners filed a Request for Production of Documents. This Petition follows and repeats a previous Request for Production of Documents made on May 31, 1991.

Both discovery requests sought five categories of documents: 1) "EMF studies available to the Commission"; 2) "safety standards for 238 KV transmission lines being constructed new in 1991"; 3) "Transcripts or best available compilation of data presented at Commission sponsored seminars on EMF, 1985-1991"; 4) "All documents received and/or distributed by the Commission at the EMF seminars, 1985-91"; and 5) "All economic studies available to the Commission relating to the costs of adjusting electrical facilities standards to deal with EMF, and/or the potential liabilities of not avoiding EMF exposure." ALJ Smolen ordered that Commission prosecutory staff provide Petitioners with the documents described in Numbers 3 and 4. Apparently, Petitioners already have received such material. Consequently, those requests are satisfied.

As the remainder of Petitioners' Request for Production of Documents makes clear, Petitioners seek these documents to learn the evidentiary basis for the Commission's Order adopted on March 6, 1991 in this proceeding. Adopted 3-2, with Commissioner Rolka and I dissenting, the March 6, 1991 Order stated:

Although the Commission has not independently investigated the issue of EMF, it is well apprised of current scientific thought on this subject. We, therefore, cannot agree with the Petitioners' conclusion that EMF from high voltage transmission lines represents an acknowledged health risk. The overwhelming consensus in the technical community, after review of available epidemiological and scientific studies, is that there is no conclusive evidence of the adverse health effects associated with EMF from electric transmission lines.

This section of the order constitutes a finding on the merits of the issue about the safety of EMF. Such a finding was premature in my opinion.

It is basic to a fair proceeding that decisions should be limited to the record and, if evidence beyond the record is relied upon, decision-makers should take judicial notice of that evidence. The purpose of these rules is to make sure that all parties know fully what evidence influenced the outcome of their case. In his March 6th Dissenting Opinion, Commissioner Rolka suggested that references to scientific and other literature on EMF were in the nature of official or judicial notice of these documents, and our regulations at 52 Pa Code 5.408 entitled the Petitioners to notice and opportunity to respond to these documents.

While Petitioners have a right to know what evidence has been considered by the Commission, Petitioners do not have a right to staff advisory reports or to the deliberations of the Commission beyond that which appears in the opinions of individual Commissioners and the orders of the Commission. Petitioners' Request for Production of Documents, however, does not seem to request such privileged advisory reports or deliberative materials.

Speaking for myself, at the time of the March 6, 1991 Order, I tried to separate the substance of the EMF controversy from the decision on whether Petitioners had a right to a hearing. The merits of the EMF controversy were not addressed in my March 6, 1991 Dissenting Opinion. Having said that, beyond the one study specifically mentioned in my Dissenting Opinion of March 6, 1991, I wish to inform all parties that I have reviewed the October 1990 Environmental Protection Agency Report entitled "Evaluation of the Potential Carcinogenicity of Electromagnetic Fields."

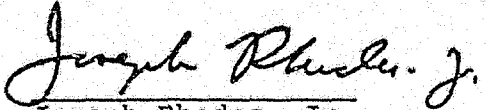
In their March 6th statements, Chairman Smith and Commissioner Holland also identified various materials that they reviewed on the EMF subject. This disclosure was appropriate and should be mandatory at the staff level as well.

THEREFORE, I MOVE THAT:

1. Prosecutory staff comply with Petitioners' Requests for Production of Documents Numbers 1, 2, and 5;
2. Compliance with ordering paragraph 1 shall be sufficient upon provision of a bibliography of reports and studies about EMF that are in the prosecutory staff's possession and by making available copies of only those reports or studies that Petitioners do not possess or cannot obtain;

3. Prosecutory staff shall not provide any advisory memoranda or reports on EMF or any other subject that may have been prepared by advisory staff;
4. OSA draft the appropriate order.

10/23/91
Date



Joseph Rhodes, Jr.
Commissioner

APPENDIX B

In re: Application of Philadelphia Electric Company,
order entered December 12, 1991
at Docket No. A-110550, F.055.



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P. O. BOX 3265, HARRISBURG, Pa. 17120
December 12, 1991

IN REPLY PLEASE
REFER TO OUR FILE

A-110550, Folder 55

TO ALL PARTIES

In re: Application of Philadelphia Electric Company

To Whom It May Concern:

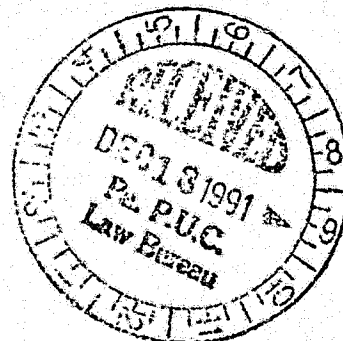
This is to advise you that the Commission at Public Meeting held October 24, 1991 adopted an Opinion and Order in connection with the above entitled proceeding.

A copy of the Opinion and Order is enclosed for your records.

Very truly yours,

Jerry Rich, Secretary

JZ
Encls.
Certified Mail
Receipt Requested



PENNSYLVANIA
PUBLIC UTILITY COMMISSION
Harrisburg, PA 17120

Public Meeting Held October 24, 1991

Commissioners Present:

William H. Smith, Chairman
Joseph Rhodes, Jr., Vice-Chairman
Wendell F. Holland, Concurring & Dissenting in part
David W. Rolka

In re: Application of Philadelphia
Electric Company

A-110550, Folder 55

OPINION AND ORDER

BY THE COMMISSION:

Before the Commission for consideration is the self-styled, Petition of Protestants for Discovery From the Commission, filed on September 3, 1991 in the above-captioned matter. There are no recorded responses to said petition.

History of the Proceeding

On November 21, 1989, Philadelphia Electric Company ("PECO") initiated proceedings pursuant to our regulations at 52 Pa. Code Sections 57.72(d), et seq. relating to letter notification in lieu of application, for the siting and construction of electric transmission lines. Through this request, PECO proposed to reconductor and rebuild an existing high voltage 138kv transmission line to operate as the Woodbourne-Heaton 230kv line within Montgomery and Bucks County.

By Order entered February 9, 1990, we granted approval to rebuild the above-described Woodbourne-Heaton line.

On September 14, 1990, Robert Small, Frank English and Diane Koerper, on behalf of themselves and others similarly situated, filed an Emergency Petition of Non-Noticed Property Owners to Intervene For Reopening and To Suspend Approval of our

February 9, 1990 Order.¹

The Emergency Petition... averred, among other things, that Robert Small, et al. ("Protestants" hereafter) did not receive actual notice of PECO's letter notification and that their property rights would be adversely affected by the reconstruction. It was also averred that had Protestants been permitted the opportunity to intervene they would present the following issues: (1) whether the proposed line was needed, (2) whether the line would create a health risk because of the intrusion of electromagnetic fields (EMF) generated by the line on Protestants' property through encroachment on their airspace, and (3) whether the proposed line would negatively affect aesthetics, would cause interference with television or radio reception, would heighten the potential for destructive fires, and would depreciate their property values. Protestants subsequently alleged that PECO erroneously used the letter notification procedure because of certain misstatements of fact.

On September 18, 1990, PECO filed an Answer to the Emergency Petition..., essentially arguing that Protestants had no property rights which would be adversely affected by the reconstruction and that it properly utilized the letter notification procedures in this matter. PECO also argued that Protestants had not alleged any new or novel evidence that they would present, if given the opportunity.

On January 3, 1991, the Office Of Consumer Advocate ("OCA") filed a Notice of Intervention and statement in support of the Emergency Petition. The OCA took no position on the merits of Protestants' allegations, but supported their procedural request for a hearing. The OCA also raised the issue of whether the difference between a 138kv line and the proposed 230kv line is substantial. PECO replied to OCA's statement.

By Order entered March 8, 1991, we denied the Emergency Petition.

On April 2, 1991, Protestants filed a Petition for Review with the Commonwealth Court requesting that the Court set aside the Commission Order denying reopening and remand the matter for a hearing. On April 26, 1991, Protestants also filed with the

¹ Robert Small, Frank English and Diane Koerper, et al. are members of a Pennsylvania non-profit corporation, Parents Against an Unsafe Environment (PAUSE).

Court a Petition for Stay Pending Review which Petition requested that construction of the Woodbourne-Heaton line be delayed pending review.

On May 24, 1991, the Commonwealth Court, per Judge Palladino, issued a Memorandum Opinion and Order (unreported) which remanded the matter to the Commission for a hearing on the question of whether Protestants will be adversely affected by the reconductoring of the high tension electrical line at issue. See No. 761 C.D. 1991.

Discussion

In the proceedings on remand, Protestants, by cover letter dated August 27, 1991, filed a Petition pursuant to Section 334 of the Public Utility Code, requesting the Commission to make disclosure of certain documents.² The averments in support of the request are reprinted below:

1. This Commission has already adopted a substantive decision with respect to the EMF issue which is before the ALJ at this time, based on non-record considerations.
2. While various Commissioners and public statements, and the Commission in its decision, alluded to various studies, there is no indication that the Commissioners and the staff may have considered other literature and other sources of information.
3. Since the question will be coming before the Commission again, and since the ALJ should have the benefit of all available information which the Commissioners considered persuasive or influential, it is appropriate, and necessary, in the interest of full disclosure, that all sources considered are made available to the Commission be known to the Protestants.
4. There is no other possible means by which the information could be made available other than disclosure by the Commissioners themselves and by the staff which wrote the

² Interrogatories to the Commission are properly requested under Section 333(d) of the Public Utility Code, 66 Pa. C.S. Section 333(d).

Commissions' opinion based on the meeting of March 6, 1991.

5. The attached interrogatories request that the information, except for that available through seminars, which is being furnished to the Protestants as a result of the Order of the ALJ upon the Prosecutorial Staff. These interrogatories were served upon Prosecutorial Staff, which has declined to act on them pursuant to Section 334, because the Law Bureau is now acting as Prosecutorial Staff, and it would be inappropriate for the said Prosecutorial Staff to advise the Commission in responding to these interrogatories.

WHEREFORE, Protestants petition that the Commission release the information sought in the interrogatories pursuant to Section 334 of the Public Utility Code.

Through this request, Protestants seek production of the following documents from the Commission:

1. All EMF studies available to the Commission.
2. Applicable safety standards for 238 KV transmission lines being constructed new in 1991.
3. Transcripts or best available compilation of data presented at Commission sponsored seminars on EMF, 1985 -1991.
4. All documents received and/or distributed by the Commission at the EMF seminars, 1985 - 91.
5. All economic studies available to the Commission relating to the costs of adjusting electrical facilities standards to deal with EMF, and/or the potential liabilities of not avoiding EMF exposure.

The pertinent section of the Public Utility Code pertaining to interrogatories addressed to the Commission is found at 66 Pa. C.S. Section 333(d). That section states as follows:

...Interrogatories directed to the commission shall be allowed only upon an order of the commission based upon a specific finding that the interrogating party is seeking significant, unprivileged information not discoverable by alternative means...

Further, we are bound by the Right-to-Know Law, 65 P.S. Section 66.1, et seq., and the Sunshine Act, 65 P.S. Section 271, et seq., with regard to our taking official action. Additionally, 66 Pa. C.S. Section 335(d) of the Code, pertaining to release of documents, requires us to make part of the public record and release publicly, documents relied upon in reaching a determination on an investigation of an act or practice of a public utility.³

On consideration of the request of the Protestants, we shall, hereby, grant said request subject to the considerations more fully explained below.

Generally, there are two means by which a party may seek access to internal Commission documents. A party may serve interrogatories upon an appropriate Commission official so designated for the preparation of answers. This method would be part of a formal, ongoing proceeding and such a request would have to comport with the conjunctive criteria that the information sought is significant, unprivileged and not discoverable by alternative means. 66 Pa. C.S. Section 333(d). See Re Tristate Household Goods Tariff Conference, Inc., Agent, 59 P.U.C. 301 (1985); Pennsylvania Public Utility Commission v. West Penn Power Company, Docket No. R-901609 (Order entered July 20, 1990); Pennsylvania Public Utility Commission v. Pike County Light and Power Company, 57 P.U.C. 529 (1983).

In addition to interrogatories addressed to the Commission pursuant to 66 Pa. C.S. Section 333(d), a party may proceed in accordance with our regulations at 52 Pa. Code Section 1.71-1.77, pertaining to public access to Commission records. Staff reports, investigative materials and all other materials not subject to public disclosure requirements are placed in our files under "Report Folder." Materials in our Report Folder are not available for public inspection except as provided for on petition made to the Commission. 52 Pa. Code Section 1.74.

³ Documents protected by legal privilege, proprietary information, and information which could operate to the prejudice or impairment of one's reputation or subject one to retaliation are excluded.

The subject of EMF was the focal point of extensive comment at our Public Meeting of March 6, 1991. Chairman William H. Smith, Vice-Chairman Joseph Rhodes, Jr. and Commissioners Wendell F. Holland and David W. Rolka submitted prepared statements which were entered into the record.

Chairman Smith's statement and comments of March 6, 1991 reference ten studies, and/or reports. None of the studies and/or reports cited by Chairman Smith are materials outside of the public domain.

Likewise, Commissioner Holland, who cited a potential National Association of Regulatory Utility Commissioners study, a site visit to the affected area of the proposed transmission line, and decisions of the Maryland and New Jersey Public Service Commissions along with two Orders of this Commission which reference the issue of EMF, alluded to no authority not discoverable with the exercise of reasonable diligence.

Also, Commissioners Rhodes and Rolka, in their prepared statements, acknowledged materials and/or studies and reports available to the public.

To date, this Commission has not formally adopted a substantive position on EMF, contrary to the averment of Protestants in their petition.⁴ Our Order of March 6, 1991 was clear in stating the following: "Although the Commission has not independently investigated the issue of EMF, it is well apprised of current scientific thought on this subject. We, therefore, cannot agree with the Petitioners' conclusion that EMF from high voltage transmission lines represents an acknowledged health risk." Slip op. at page 13.

The Protestants' request seeks those documents by which they may learn the evidentiary basis for our Order adopted on March 6, 1991 in this proceeding.⁵ While Protestants have a right to

⁴ Individual statements of Commissioners are not binding upon the Commission. 52 Pa. Code Section 1.96.

⁵ The Presiding Administrative Law Judge has ordered that the Prosecutory Staff provide Protestants with the documents described in Paragraph Nos. 3 and 4 of their Petition. Consequently, those requests are satisfied,

know what evidence has been considered by the Commission, they do not have a right to staff advisory reports or to the deliberations of the Commission beyond what appears in the opinions of individual Commissioners and the orders of the Commission. The instant request does not seem to request such privileged advisory reports or deliberative materials.⁶

Notwithstanding that our March 6, 1991 Order had the practical effect of dismissing Protestants' claims without a hearing on the issues they alleged, our determination would be no less subject to the protection of the deliberative process privilege were it implicated in this request.

Based on the foregoing, we will direct our Prosecutory Staff to comply with the Protestants' request for the production of documents identified in Paragraph Nos. 1, 2, and 5 of their Petition.

Compliance with Paragraph No. 1 shall be sufficient upon provision of a bibliography of reports and studies about EMF that are in the Prosecutory Staff's possession and by making available copies of only those reports or studies that Protestants do not possess or cannot obtain.

Prosecutory Staff shall not provide any advisory memoranda or reports on EMF or any other subject that may have been prepared by advisory staff.

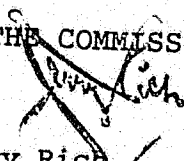
The subject of EMF, and its health effects, will be a material issue in the instant proceeding. To the extent parties would have the Commission take official notice of facts not appearing in the evidence, or exercise judicial notice of any material facts, they should be cognizant of 66 Pa. C.S. Section 332(e) and our regulations at 52 Pa. Code Section 5.408; THEREFORE,

⁶ The deliberative process privilege protects the Commission from the disclosure of its mental processes derived from staff reports. As an administrative agency, our decisional process should be free from public or private inquisition as would judicial proceedings. Pennsylvania v. Pennsylvania Public Utility Commission, 17 Pa. Commonwealth Court 351, 331 A. 2d 598 (1975).

IT IS ORDERED:

1. That the Petition of Protestants for Discovery From the Commission be, and is hereby, granted to the extent delineated within the body of this Order.

BY THE COMMISSION


Jerry Rich,
Secretary

(SEAL)

ORDER ADOPTED: October 17, 1991

ORDER ENTERED: DEC 12 1991

APPENDIX C

Protestants' Petition to Enforce Discovery
dated December 16, 1991,
Docket No. A-110550,F.055.

SUGARMAN & ASSOCIATES

ATTORNEYS AT LAW

7TH FLOOR, ROBERT MORRIS BUILDING

100 NORTH 17TH STREET

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ROBERT J. SUGARMAN

ALAN M. KAPLAN

SUSANNE I. GIENDL

KEVIN M. STACK

LEGAL ASSISTANT

NOT ADMITTED TO PRACTICE
IN PENNSYLVANIA

December 16, 1991

Mr. Jerry Rich, Secretary
Pennsylvania Public Utility
Commission
Room G-18, North Office Building
Harrisburg, PA 17120

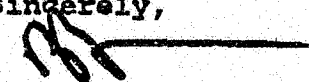
Re: Application of Philadelphia Electric Company
No. A-110S50 F055

Dear Mr. Rich:

I enclose herewith Protestants Petition to Enforce Discovery
and for Sanctions in the above matter.

Thank you for your consideration.

Sincerely,


Robert J. Sugarman

RJS:er
Enclosures

cc: Honorable Herbert Smolen
Tanya J. McCloskey, Esquire
David Rosenbaum, Esquire
Patricia Krise Burket, Esquire
Tinku Khanwalkar, Esquire
Paul R. Bonney, Esquire

pldngs91\paua.ptn

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

IN RE: LETTER OF NOTIFICATION	:	DOCKET NO. A-110850-F055
OF PHILADELPHIA ELECTRIC	:	
COMPANY UNDER 52 PA	:	
CODE 57.72(d) RE: PROPOSED	:	
230 KV WOODBOURNE	:	
TRANSMISSION LINE	:	

PETITION FOR DISCOVERY AND SANCTIONS

This is a Petition to compel that the Office of Special Assistants respond to and to implement the Commission's Order directing that certain materials be available to the Protestants herein. Protestants have no written documentation confirming the existence of the Order, but have been informed by members of the press and Commission staff that the Order was adopted. Despite repeated telephone calls and correspondence, the Office of Special Assistants has adamantly refused to turn over any of the documentation. In the meantime, the record is being closed, or may be closed without Protestants having an opportunity to review the documents to which the Commission has held they are entitled.

WHEREFORE, Protestants move that the Commission enter sanctions against the Office of Special Assistants, in the form of counsel fees to Protestants in the amount of \$3,000, and direct that the documents be made available, and that the hearings be held

open in order to consider whatever may arise as a result of the release of the documents.



ROBERT J. SUGARMAN
Counsel for Protestants

OF COUNSEL:

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CERTIFICATE OF SERVICE

I, Robert J. Sugarman, certify that I have mailed a copy of the foregoing Petition for Discovery and Sanctions by first class mail postage pre-paid to the following:

Paul R. Bonney, Esq.
Assistant General Counsel
Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

Tanya J. McCloskey, Esq.
Asst. Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120

Patricia Krise Burket, Esq.
Penna. Public Utility Commission
G-28, North Office Bldg.
P.O. Box 32265
Harrisburg, PA 17120

David Rosenbaum, Esq.
Risk Analysis Corp.
Suite 202, 6723 Whittier Avenue 00X

A handwritten signature, likely of Robert J. Sugarman, is written in dark ink. It consists of a stylized, cursive 'R' followed by a horizontal line extending to the right.

APPENDIX D

Materials Related to Electromagnetic Fields
(EMF) and Prudent Avoidance.

LISTING OF COMMISSION MATERIALS RELATED TO ELECTROMAGNETIC
FIELDS (EMF) AND PRUDENT AVOIDANCE*

BOOKS AND REPORTS

1. Brodeur, Paul, Currents of Death: Power Lines, Computer Terminals and the Attempt to Cover Up Their Threat to Your Health, Simon & Schuster, New York, 1989.
2. Young, Louise B., Power Over People, Oxford University Press, New York, 1973.
3. Sheppard, Ph.D., Asher R., and Eisenbud, Sc.D., Merrel, Biological Effects of Electric and Magnetic Fields of Extremely Low Frequency, New York University Press, 1977.
4. Biological Effects of Transmission Line Fields, Carstensen, Ph.D., Edwin L., Elsevier Science Publishing Co., Inc., New York, 1987.
5. Dr. Selwyn, Murray R., Dr. Anderson, Jennifer and Dr. Maletskos, Constantine, Biostatistical Review of Selected Literature on the Biological Effects of Radiofrequency Electromagnetic (RFEM) Energy, Electromagnetic Energy Policy Alliance, 1987.
6. Leonard, M.D., Ph.D., Alvin, Electric and Magnetic Fields: Measurements and Possible Effects on Human Health, Special Epidemiological Studies Program, California Department of Health Services, 2151 Berkeley Way, Berkeley, CA.
7. Hidy, George "Presentation of Preliminary Results of U.S.C. Childhood Leukemia Study", EPRI Memorandum, February 7, 1991.
8. Report of the [Pennsylvania] House Conservation Committee Study of Electromagnetic Fields Pursuant to House Resolution 38, November 30, 1990.

* This listing may inadvertently contain citations for pamphlets and articles on EMF and prudent avoidance which were distributed at the Commission's "EMF Seminars" held April 22, May 6 and May 20, 1991. These materials have already been provided to the Protestants.

9. Potential Health Effects of Electric and Magnetic Fields, Report to California State Legislature by the California Public Utility Commission in Cooperation with the California Department of Health Services, September 15, 1989.
10. Dr. Johnson, Gary B., "Residential Magnetic Field Sources", EPRI High Voltage Transmission Research Center, paper presented at 1990 IEEE/PES Summer Power Meeting, Minneapolis, MN, July 17, 1990.
11. Lee, Jr. (Chair) Jack M., A Review - Electrical and Biological Effects of Transmission Lines, Bonneville Power Administration, U.S. Department of Energy, June 1989.
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13. EEPA Newsletter, vol. 3, no. 1, Winter 1991.
14. Duchine, A. S., IRPA [International Radiation Protection Association] Guidelines on Protection Against Non-Ionizing Radiation, Pegamon Press, no date.
15. Banks, Robert S. Associates, Inc., Cluster Analyses Do Not Support Calamity on Meadow Street Claims, Electric Power Research Institute, Minneapolis, MN, 1990.
16. Morgan, M. Granger, Electric and Magnetic Fields from 60 HZ Electric Power: What do we know about possible health risks, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA 15212, 1989.
17. Schwan, Herman P., "RF Interactions and Biological Systems: Electrical Properties and Biophysical Mechanisms", Proceedings of the IEEE, vol. 68, No. 1, January 1980, p. 104.
18. Electric Power Research Institute, Electric and Magnetic Field Health Effects Research Abstract, 1989 Annual Report, Report No. EN-7066, October 1990.
19. Mahmoud, Aly A. and Zimmerman, Dean, Effects of 345KV High Voltage Transmission Lines on Cross-Bred Swine, Iowa Test and Evaluation Facility, High Voltage Research and Demonstration, College of Engineering, Iowa State University, August 1982, Report No. ISU-ERI-Ames-83064.

20. Electric Power Research Institute, Electric and Magnetic Field Health Effects Research Abstracts, 1990 Annual Report, EPRI EN-7460, July 1991.
21. Electric Power Research Institute, An Alternative Hypothesis for Association Between Distribution Wiring Configurations and Cancer: Planning Phase, EPRI EN-6863, Project 2966-2, Interim Report, June 1990.
22. Silva, J. M., AC Field Exposure Study: Human Exposure to 60 HZ Electric Fields, Electric Power Research Institute, EPRI EA-3993, Project 799-16, Interim Report, April 1985.
23. Croasey, W. A., and Goldberg, R. B., Extremely Low Frequency Electric and Magnetic Fields and Cancer: A Literature Review, Electric Power Research Institute, EPRI EN-6674, Project 2965-12, Final Report, December, 1989.
24. Roth, H. D., An Evaluation of Published Studies Analyzing the Association of Carcinogenesis With Exposure to Magnetic Fields, Electric Power Research Institute, EPRI EA-3904, Project 1824-03, Final Report, March 1985.
25. Greenberg, Bernard, Kunich, John C., Bindokas, Vytautas, P., The Effects of High Voltage Transmission Lines on Honey Bees, Electric Power Research Institute, EPRI, Project 934-1, Interim Report, October 1978.
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27. Electric Power Research Institute, Health Effects of High Voltage Direct Current Transmission Lines - An Environmental Briefing, EPRI EN-3013.3.90, March 1990.

MISCELLANEOUS PUBLICATIONS

28. "West Texas Utilities Company Uses PC-Based Transmission Line Routing Method", Transmission and Distribution, November 1991, p. 90.
- FACT SHEET No. 1, Electromagnetic Energy Policy Alliance, "Understanding Electromagnetic Energy", May 1986.
- FACT SHEET No. 2, Electromagnetic Energy Policy Alliance, "Radio and Television Broadcasting - Electromagnetic Energy - Serving Listeners and Views", no date.

- FACT SHEET No. 3, Electromagnetic Energy Policy Alliance,
"Video Display Terminals (VDTs) - Electromagnetic Energy",
no date.
- FACT SHEET No. 4, Electromagnetic Energy Policy Alliance,
"Cellular Radio - Cellular Telephone - Mobile
Communications Through Electromagnetic Energy", no date.
- FACT SHEET No. 5, Electromagnetic Energy Policy Alliance,
"Automatic Electric Blankets -- Comfort and Value through
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29. Cunningham, Ann Marie, "Electromagnetic Fields: In Search
of the Truth", Popular Science, December 1991, p. 87.
30. Brodeur, Paul, "Danger in the Schoolyard", Family Circle,
September 25, 1990, p. 61.
31. "Electromagnetic Waves: How Real a Hazard?", Harvard
Medical School Health Letter, March 1990, p. 1.
32. Morgan, M. Granger, "Expose Treatment Confounds
Understanding of a Serious Public Health Issue: A Review
of Paul Brodeur's Death: Power Lines, Computer Terminals
and the Attempt to Cover Up Their Threat", Scientific
American, April 1990, p. 118.
33. Brodeur, Paul, "Annals of Radiation I (Power Lines)", The
New Yorker, June 12, 1989, p. 51.
34. Brodeur, Paul, "Annals of Radiation - The Hazards of
Electromagnetic Fields II (Radar)", The New Yorker,
June 19, 1989, p. 47.
35. Brodeur, Paul, "Annals of Radiation III (Video Display
Terminals)", The New Yorker, June 26, 1989, p. 39. "The
Writings of Paul Brodeur", Source unknown, D-1.
36. Hazen, Earl, "EMF - How Dangerous?", Transmission and
Distribution, June 1991, p. 5.
37. "D.C. Debate Perks Over EMF Exposure", Environment Today,
March 1991, p. 3.
38. Jauchyem, James J., "Electromagnetic Fields and Cancer",
Letter, Science, November 9, 1990, p. .
39. Murphy, John, "PP&L Shifting EMFs Into Reverse", Scranton
Sunday Times, February 17, 1991.

40. "EMF Effects on Humans? Question Calls for More than 'Details at Eleven'", Tom Hughes, Power Transmission, November 1990, p. 37.
41. "Exploring Options for Magnetic Field Management", Taylor Moore, EPRI Journal, October/November 1990, p. 5.
42. "Electric Blankets Pose Dangers", Pittsburgh Press, October 10, 1990.
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44. Pool, Robert, "Is There An EMF Cancer Connection?", Science, vol. 249, September 7, 1990, p. 1096.
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46. Pool, Robert, "Flying Blind: The Making of EMF Policy", Science, vol. 250, October 5, 1990, p. 23.
47. "British EE's: EM Radiation Not A Risk", Electrical Engineering Times, November 4, 1991, p. 100.
48. Line Items, A Newsletter for Neighbors of the GPU-DOE Transmission Project, June 1991.
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56. Harunuzzaman, Mohammad, "Overview of Scientific Research on Electromagnetic Fields and Human Health", NRRI Quarterly Bulletin, vol. 11, no. 3, p. 247.

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CASES

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 69. In the Matter of Public Service Company of Colorado to Have Upgrades in Douglas County, Docket No. 89A-028E, December 20, 1989.
 70. Application of West Penn Power for Authorization to Locate and Construct the Warfordsburg Loop 138 kV Transmission Line in Fulton County, Initial Decision, entered April 26, 1988 at Docket No. A-111250F010.
 71. Intervenor Vendehei Developers: Fekany Enterprises, Inc., Mary Ann Tensley and Kenneth Tensley v. Public Service Commission of Wyoming and Cheyenne Light, Fuel and Power, April 25, 1990, No. 89-199.
 72. Re Jersey Central Power and Light Co., New Jersey Board of Public Utilities, Docket No. EE89020154, 115 PUR 4th 542, July 12, 1990.
 73. Application of West Penn Power Company for Authorization to Locate and Construct the Kiski Valley - North Washington 138 kV Transmission Line Located in Westmoreland County, PA, ALJ order issued September 17, 1991 at Docket No. A-111250F035.
- Course Notes and Article Handouts, "Management of Electromagnetic Energy Hazards - Relevant Strategies", Electromagnetic Policy Alliance, Cook College, New Brunswick, NJ, October 24-26, 1990.
- A. Course Notes, "Review of ELF Bioeffects - Epidemiology Studies and Animal In Vitro Studies", Kenneth R. Foster, Ph.D., University of Pennsylvania and Sol M. Michaelson, Ph.D., University of Rochester.
 - B. Course Notes, "Review of Microwave/RF Biologic Effects", W. Gregory Lotz, Ph.D., Naval Aerospace Medical Research Laboratory.

- C. Course Notes, "Review of Microwave/RF Thermoregulation", Eleanor R. Adair, Ph.D., John B. Pierce Laboratory.
- D. Article, "Thermophysical Effects of Electromagnetic Radiation", Eleanor R. Adair, IEEE Engineering in Medicine and Biology, March 1987, p. 37.
- E. Article, "On the Thermoregulatory Consequences of NMR Imaging", Eleanor R. Adair and Larry G. Berglund, Magnetic Resonance Imaging, v. 4, pp. 321-333, 1986.
- F. Course Notes, "The Challenge of Public Education about Electromagnetic Energy", John M. Osepchuk, Ph.D., Raytheon Research Division.
- G. Course Notes, "Electromagnetic Physics Tutorial", Carl H. Durney, Ph.D., University of Utah.
- H. Course Notes, "EM Hazards", John Osepchuk, Ph.D., Raytheon Research Division.
- I. Course Notes, "Instrumentation and Measurements", Richard A. Tell, Ph.D., Richard A. Tell Associates, Inc., Las Vegas, NV.
- J. Course Notes, "Hands-on Session with Instrumentation", Richard A. Tell, Ph.D., Richard A. Tell Associates, Inc., Las Vegas, NV, Ronald C. Peterson, AT&T Bell Laboratories.
- K. Article, "Thermophysiological Effects of Electromagnetic Radiation", Eleanor R. Adair, Biological Effects and Medical Applications of Electromagnetic Energy, ch. 11, O.M. Ghandi, ed.
- L. Course Notes, "Safety Standards and Prudent Avoidance", Max M. Weiss, Ph.D., AT&T Bell Laboratories (retired).
- M. Article, "What the Public Thinks About Environmental Data", David B. McCallum and Vincent T. Covello, EPA Journal, May/June 1989, p. 22.
- N. Course Notes, "Legal Aspects - Litigation and Prudent Avoidance", Ralph H. Johnson, Esq., Schmeltzer, Aptaker & Sheppard, Washington, DC.

Date: January 6, 1992

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document on the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code §1.54:

By First Class Mail

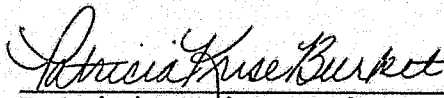
Robert J. Sugarman, Esq.
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Allentown, PA 19101


Patricia Krise Burket
Assistant Counsel
Prosecutory Staff

Pennsylvania Public Utility
Commission
P.O. Box 3265
Harrisburg, PA 17105-3265
(717) 783-2810

DATED: January 6, 1992

CROWELL & MORING
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WASHINGTON, D.C. 20004-2595

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FACSIMILE (714) 263-8414

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44-71-936-3036
FACSIMILE 44-71-936-3035

January 21, 1992

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BY OVERNIGHT MAIL

The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

RECEIVED
JAN 23 1992
SECRETARY'S OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

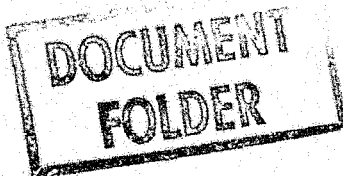
Dear Judge Smolen:

Attached is Philadelphia Electric Company's Answer to Protestant's letters of January 15 and January 16, 1992, which apparently constitute a request for an extension of time to file surrebuttal testimony by Dr. Liboff. The hearing dates of January 23 and 24 which you had previously set aside now appear not to be needed. If you determine that oral argument on Protestants' request and the Company's Answer are needed, or that the parties should confer with you to discuss scheduling, we would be happy to contact the parties to set up a conference call at your convenience.

Sincerely,

Ward L. Smith

Ward L. Smith



Enclosure

The Hon. Herbert S. Smolen
January 21, 1992
Page 2

cc: (by First-Class mail)
Mr. John Alford, Acting Secretary

(by telecopy and First-Class mail)
Tanya J. McCloskey, Esq.
Robert J. Sugarman, Esq.
Patricia Krise Burket, Esq.
Jesse A. Dillon, Esq.
Paul Bonney, Esq.

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION OF
PHILADELPHIA ELECTRIC COMPANY
RELATIVE TO THE RECONSTRUCTING
AND REBUILDING OF THE EXISTING
138 KV LINE TO OPERATE AS A
WOODBOURNE-HEATON 230 KV LINE IN
MONTGOMERY AND BUCKS COUNTIES

DOCKET NO. A-110550, F. 055

RECEIVED
JAN 23 1992

SECRETARY'S OFFICE
Public Utility Commission

ANSWER OF
PHILADELPHIA ELECTRIC COMPANY
TO

PROTESTANTS' REQUEST FOR EXTENSION OF TIME TO FILE SURREBUTTAL
TESTIMONY AND FOR DELAY OF SCHEDULED HEARING DATES

1. Philadelphia Electric Company ("PECO") by and through its undersigned counsel, files this Answer pursuant to 52 Pa. Code § 1.31 *et. seq.*, and in support states the following:

2. On December 17, 1991, ALJ Smolen ordered that January 13, 1992, was the in-hand filing date for Protestants' surrebuttal testimony. Protestants did not avail themselves of the opportunity to file surrebuttal testimony on that date. Nor did Protestants make a timely request for an extension of time for filing such testimony.

DOCKETED
JAN 29 1992

3. Instead, Protestants' counsel sent two letters:

- On January 15, 1992, stating that Dr. Liboff had not yet prepared testimony;
- On January 16, 1992, proposing that Dr. Liboff file his testimony on January 27, 1992 -- the date set aside for cross-examination -- and further proposing cross-examination of Dr. Liboff on February 17 (which is a holiday), or on February 24, 1992.

4. PECO respectfully requests that Protestants' request be denied for the reasons set forth in the following paragraphs.

**DOCUMENT
FOLDER**

5. To the extent that Protestants' request can be considered a motion for an extension of time under the Commission's Regulations, the request is in violation of those Regulations. See Section 1.15(a)(1), 52 Pa. Code § 1.15(a)(1).

- The request was not filed before the expiration of the period originally proscribed;
- The request does not contain a statement of reasonable grounds for failure to timely file a motion, and;
- The request does not contain a statement of good cause warranting an extension.

6. Furthermore, Protestants do not have reasonable grounds for failure to timely request an extension.

- Protestants have known the filing date since December 17, 1991 -- in fact, that date was reached by agreement of the parties, including Protestants. See Tr. at 1363.
- Protestants were reminded of this filing date by PECO's counsel. See, Letter from Ward L. Smith to Tanya J. McCloskey and Robert J. Sugarman, January 10, 1992.
- Dr. Liboff already has appeared in this proceeding, presented full written testimony, and undergone substantial redirect examination. See Tr. at 881-931, 936-940. Protestants also indicated that Dr. Liboff would be available for cross-examination on January 27th, and thus must have had the opportunity to assess the state of Dr. Liboff's preparation.
- Protestants cannot claim to have reasonable grounds for failure to timely request an extension when Protestants' counsel, by his own admission in his January 15 letter, had not even ascertained the status of testimony preparation until after the filing deadline.

7. Protestants also do not have good cause for an extension. Protestants cannot be heard to complain that they have not had sufficient time to prepare written testimony.

- Protestants had in-hand for nearly 70 days most of the written testimony to be addressed (by Drs. Cole, Gelmann, and Bockman);
- Protestants had in-hand for over 40 days all written testimony to be addressed (including Dr. Rosenberg's testimony);
- Protestants had nearly one month to prepare testimony, and;
- The filing date was set by agreement of the parties, including the Protestants. Tr. at 1363.

8. It should be remembered that, throughout this proceeding, Protestants have repeatedly missed filing deadlines. For example:

- Protestants did not respond to Philadelphia Electric Company's First Set of Interrogatories -- which requested routine information on Dr. Liboff's credentials and prior testimony -- until September 10, 1991, more than 75 days after those Interrogatories were filed, and more than 55 days after they were due.
- Protestants filed Dr. Liboff's written direct testimony on September 3, 1991, six days after it was due. PECO's counsel objected strenuously to that delay. See Letter from Paul Bonney to Marie Falls, August 30, 1991.

9. Protestants previously have stated that: "It is clearly in the interest of the public, the protestants, and even the applicant, to conduct these proceedings in as expeditious manner as possible . . ." Protestants' Motion to Dismiss and Deny Application, Or In the Alternative, to Move the Proceedings to Encompass All Relevant Issues, August 20, 1991 at ¶13.

Protestants nonetheless seek to delay energization of the Woodbourne-Heaton 230 kV line. In fact, Protestants' witness Mr. Turner has indicated that delay in energization of the Woodbourne-Heaton 230 kV line is

precisely the relief being sought by Protestants. See Protestants' Statement No. 1 at 8.

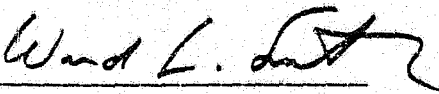
Protestants' failure to timely file Dr. Liboff's testimony by the filing deadline, simply put, allows Protestants to grant themselves the very relief that they are seeking in this proceeding -- and which they recognize to be against the public interest.

10. PECO thus respectfully requests that Protestants' request to late-file Dr. Liboff's surrebuttal testimony be denied.

11. If Protestants' request is granted, PECO respectfully requests the following alternative relief to avoid further unwarranted delay in this proceeding:

- an order that Dr. Liboff be made available for cross-examination on a date in early February, 1992;
- an order that Dr. Liboff's written surrebuttal testimony be filed in-hand by January 24, 1992, consistent with Protestants' counsel's representation of January 15, 1992, that Dr. Liboff could prepare written testimony a few days before January 27, 1992.
- an order changing the dates for cross-examination of Mr. Janes and Dr. Rosenbaum from January 27, 1992, to a date that concurs with the cross-examination of Dr. Liboff, so that the parties need not incur the added cost of appearing at two hearings for cross-examination of surrebuttal witnesses. (Counsel for OCA has verbally expressed agreement that such a change of dates would be acceptable.)

Respectfully submitted,


Ward L. Smith

Paul Bonney
Counsel for Philadelphia Electric Company
2301 Market Street
Philadelphia, Pa. 19101
(215) 841-4252

Tom Watson
Ward L. Smith
Counsel for Philadelphia Electric Company
Crowell & Moring
1001 Pennsylvania Ave. NW
Washington, D.C. 20004
(202) 624-2594

January 21, 1992.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

By Overnight Mail

The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

By First-Class Mail

Mr. John Alford
Acting Secretary
Pennsylvania Public Utility Commission
Post Office Box 3265
Harrisburg, PA 17105-3265

By Telecopy and First-Class Mail

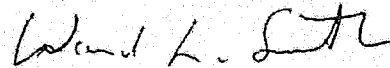
Tanya J. McCloskey, Esquire
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Robert J. Sugarman, Esquire
Sugarman & Associates
7th Floor, Robert Morris Building
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Philadelphia, PA 19103
(Counsel for Intervenors)

(Continued)

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Harrisburg, PA 17120

Jesse A. Dillon, Esquire
Pennsylvania Power & Light Co.
Two North Ninth Street
Allentown, PA 19101



Ward L. Smith
Counsel to Philadelphia Electric Co.
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2505

Dated: January 21, 1992



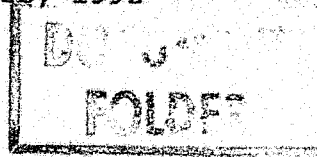
COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P. O. BOX 3265, HARRISBURG, Pa. 17120

January 22, 1992

ORIGINAL

KJR

IN REPLY PLEASE
REFER TO OUR FILE



John G. Alford
Acting Secretary
Pennsylvania Public Utility Commission
P.O. Box 3265
Harrisburg, PA 17105-3265

RECEIVED
JAN 23 1992

Re: Letter of Notification of Philadelphia
Electric Company Relative to Reconstruction
and Rebuilding of the Existing 138 kV Line
in Montgomery and Bucks Counties, Pa.,
Docket No. A-110550, F.055.

SECRETARY'S OFFICE
Public Utility Commission

Dear Acting Secretary Alford:

Enclosed please find an original and two copies of the
Answer of Commission's Law Bureau Prosecutory Staff to Protestants'
Requests for Extension of Time to File Surrebuttal Testimony and
for Delay of Hearing Schedule. A certificate is attached to
evidence service on the parties of record.

Sincerely,

Patricia Krise Burket

Patricia Krise Burket
Assistant Counsel
Law Bureau Prosecutory Staff

Enclosure

cc: ALJ Smolen
parties of record

ORIGINAL

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION OF
PHILADELPHIA ELECTRIC COMPANY
RELATIVE TO RECONSTRUCTING AND
REBUILDING OF THE EXISTING
138 kV LINE TO OPERATE AS A
WOODBOURNE-HEATON 230 kV LINE
IN MONTGOMERY AND BUCKS
COUNTIES

DOCKET NO. A-110550, F.055

FOLDER

RECEIVED
JAN 23 1992

SECRETARY'S OFFICE
Public Utility Commission

ANSWER OF COMMISSION'S LAW BUREAU
PROSECUTORY STAFF TO PROTESTANTS' REQUESTS
FOR EXTENSION OF TIME TO FILE SURREBUTTAL
TESTIMONY AND FOR DELAY OF HEARING SCHEDULE

DOCKETED
JAN 27 1992

The Commission's Law Bureau Prosecutory Staff (the Prosecutory Staff) pursuant to 52 Pa. Code §5.61 files its Answer joining Philadelphia Electric Company (PECO) in its opposition to the Protestants' Requests for an Extension of Time to File Surrebuttal Testimony and for Delay in the Hearing Schedule. Accordingly, the Prosecutory Staff adopts the arguments raised in the Answer of Philadelphia Electric Company dated January 21, 1992 filed at the above captioned docket, and requests that relief requested by Protestants (filing the surrebuttal testimony of Dr. Abraham R. Liboff on January 27, 1992 -- the hearing date for cross-examination of this witness) be denied. The Prosecutory Staff also opposes Protestants' proposal that the cross-examination of Dr. Liboff be deferred until February 24, 1992. This proceeding has already lasted well over five months. Considering that Protestants have not shown good cause to support their requests for

extension, the Prosecutory Staff does not believe it is in the public interest to further delay this lengthy proceeding.

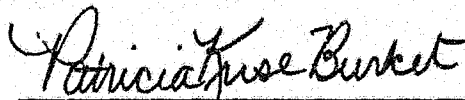
WHEREFORE, the Prosecutory Staff respectfully requests that:

1. Protestants be ordered to file the surrebuttal testimony of Dr. Abraham R. Liboff on or before January 27, 1992.

2. Protestants be ordered to make Dr. Abraham R. Liboff available for cross-examination in early February, 1992.

3. A hearing be scheduled in early February, 1992, for the purpose of cross-examining the surrebuttal testimony of Dr. Abraham R. Liboff and Office of Consumer Advocate's witnesses Mr. David Jones and Mr. David Rosenbaum.

Respectfully submitted,



Patricia Krise Burket
Assistant Counsel

Law Bureau Prosecutory Staff

Pennsylvania Public Utility Commission
P.O. Box 3265
Harrisburg, PA 17105-3265

DATED: January 22, 1992

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code §1.54:

By FAX and First Class Mail:

The Honorable Herbert S. Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
1302 Philadelphia State Office Building
Broad and Spring Garden Streets
Philadelphia, PA 19130

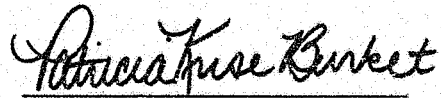
Tanya J. McCloskey, Esq.
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Assistant General Counsel
Philadelphia Electric Co.
2301 Market Street
Philadelphia, PA 19101


Patricia Krise Burket
Assistant Counsel

Law Bureau Prosecutory Staff

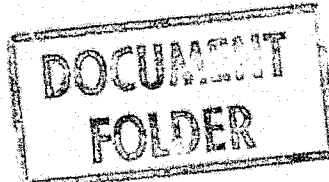
Pennsylvania Public Utility Commission
P.O. Box 3265
Harrisburg, PA 17105-3265

DATED: January 22, 1992

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P.O. BOX 3265, HARRISBURG, PA 17105-3265
January 24, 1992

In Re: A-110550F055

(see letter of 12/18/91)



Letter of Notification of Philadelphia Electric Company relative to reconstructing and rebuilding of the existing 138 kv line to operate as a Woodbourne-Heaton 230 kv line in Montgomery and Bucks Counties.

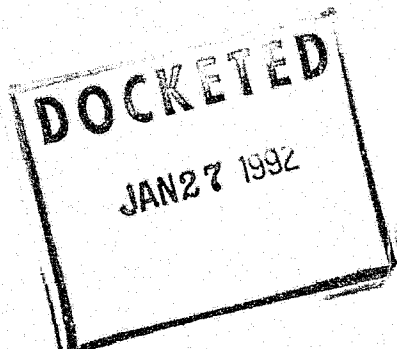
NOTICE

This is to inform you that a further hearing on the above captioned case will be held Friday, February 7, 1992 at 10:00 a.m. in Room 1306, Philadelphia State Office Building, Broad and Spring Garden Streets, Philadelphia, Pennsylvania.

The presiding officer in this proceeding is Administrative Law Judge Herbert Smolen. Judge Smolen can be contacted at 1302 Philadelphia State Office Building, Broad and Spring Garden Streets, Philadelphia, Pennsylvania 19130; telephone (215) 560-2105.

cc: Judge Smolen
Mr. Frazier - PIO
Bur. of Safety/Compliance
Law Bureau
Mrs. Lewis
Mrs. Howell
Docket Room

Certified Mail
Receipt Requested and
Regular Mail to Complainant



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JAN 24 1992
SECRETARY'S OFFICE
Public Utility Commission

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P.O. BOX 3265, HARRISBURG, PA 17105-3265
January 24, 1992

In Re: A-110550F055

Elsie Knight, Chairperson
Planning Commission
Borough of Langhorne
151 West Maple Avenue
Langhorne, PA 19047

Letter of Notification of Philadelphia Electric Company relative to reconstructing and rebuilding of the existing 138 kv line to operate as a Woodbourne-Heaton 230 kv line in Montgomery and Bucks Counties.

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The presiding officer in this proceeding is Administrative Law Judge Herbert Smolen. Judge Smolen can be contacted at 1302 Philadelphia State Office Building, Broad and Spring Garden Streets, Philadelphia, Pennsylvania 19130; telephone (215) 560-2105.

DOCUMENT
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APPEARANCE SHEET

ALJ HEARING REPORT

PAY

DOCKET NO. A-110550F055

CASE NAME Letter of Notification of
Philadelphia Electric Company

HEARING LOCATION Philadelphia

HEARING DATE January 27, 1992

ALJ Smolen

CHECK THOSE BLOCKS WHICH APPLY:

Hearing held YES ☐ NO ☐

Testimony taken YES ☐ NO ☐

Hearing concluded YES ☐ NO ☐

Further hearing needed YES ☐ NO ☐

Estimated add'l days _____

RECORD CLOSED YES ☐ NO ☐

Date _____

Briefs to be filed YES ☐ NO ☐

Date _____

BENCH DECISION YES ☐ NO ☐

REMARKS: Heavy Cancellation

JAN 28 1992
 Public Utility Commission

DOCKETED
FEB - 4 1992

NAMES, ADDRESSES AND TELEPHONE NUMBERS OF PARTIES OR COUNSEL OF RECORD
 PLEASE PRINT CLEARLY
 INCOMPLETE INFORMATION MAY RESULT IN DELAY OF PROCESS

NAME and TELEPHONE NUMBER	ADDRESS			APPEARING FOR
Telephone No. ()	City	State	Zip	
Telephone No. ()	City	State	Zip	
Telephone No. ()	City	State	Zip	

CHECK THIS BOX IF ADDITIONAL PARTIES
OR COUNSEL OF RECORD APPEAR ON BACK.

☐

Reporter _____

2/1/92

APPEARANCE SHEET

ALJ HEARING REPORT

PAY

DOCKET NO. A-110550FO55

CASE NAME Letter of Notification,

etc.

HEARING LOCATION Philadelphia, PA.

HEARING DATE Jan. 23 & 24, 1992

ALJ Smolen

CHECK THOSE BLOCKS WHICH APPLY:

Hearing held YES ☐ NO ☐

Testimony taken YES ☐ NO ☐

Hearing concluded YES ☐ NO ☐

Further hearing needed YES ☐ NO ☐

Estimated add'l days

RECORD CLOSED YES ☐ NO ☐

Date

Briefs to be filed YES ☐ NO ☐

Date

BENCH DECISION YES ☐ NO ☐

REMARKS: Hearings cancelled

**DOCUMENT
FOLDER**

RECEIVED

JAN 29 1992

**U.S. OF A. L. J.
Public Utility Commission**

**DOCKETED
FEB - 4 1992**

NAMES, ADDRESSES AND TELEPHONE NUMBERS OF PARTIES OR COUNSEL OF RECORD
PLEASE PRINT CLEARLY
INCOMPLETE INFORMATION MAY RESULT IN DELAY OF PROCESS

NAME and TELEPHONE NUMBER	ADDRESS			APPEARING FOR
Telephone No. ()	City	State	Zip	
Telephone No. ()	City	State	Zip	
Telephone No. ()	City	State	Zip	

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OR COUNSEL OF RECORD APPEAR ON BACK.

☐

Reporter



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
PHILADELPHIA STATE OFFICE BUILDING
1400 WEST SPRING GARDEN STREET
PHILADELPHIA, PENNSYLVANIA 19130

(215) 560-2105
February 11, 1992

FEB 13 1992

IN REPLY PLEASE
REFER TO OUR FILE

See Attached Service List

Administrative Law Judge
Public Utility Commission

Re: Letter of Notification of Philadelphia Electric Company
relative to reconstructing and rebuilding of the existing
138 kv line to operate as Woodbourne-Heaton 230 kv line in
Montgomery and Bucks Counties.
Docket Number 110550F055

To All Counsel:

The record in this case indicates that Briefs are to be filed. The briefing schedule is as follows: Main Briefs shall be filed no later than March 17, 1992 and Reply Briefs, if any, shall be filed no later than April 7, 1992. If Briefs are not received by the allotted due date, they shall not be accepted for filing, except by special permission of the Administrative Law Judge.

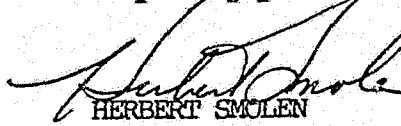
An original and nine (9) copies of each Main and Reply Brief must be filed with the Secretary of the Commission; a copy must be served on the presiding Administrative Law Judge; and three copies on each party of record.

Please note that all Briefs must comply with the Commission's Rules and Regulations promulgated at 52 Pa. Code §§5.501 and 5.502. In addition, the Briefs should contain a history of the case; a summary of testimony and evidence adduced at the hearing with appropriate record references; a statement of the questions involved; an argument citing applicable law and Commission decisions; proposed findings of fact with references to transcript pages and exhibits; proposed conclusions of law; proposed ordering paragraphs; and a conclusion.

Very truly yours,

DOCKETED

FEB 13 1992


HERBERT SMOLEN
Administrative Law Judge

DOCUMENT
FOLDER

HS:lnw

cc: Hon. Allison K. Turner, Chief Adm. Law Judge
John Alford, Secretary, PA P.U.C.
Beth Plantz

P.S. The Administrative Law Judge requests that two (2) copies of all Briefs be forwarded to him.

SERVICE LIST

Patricia Krise Burket, Esquire
Pennsylvania Public Utility Commission
G-28, North Office Building
P.O. BOX 3265
Harrisburg, PA 17120

Jesse A. Dillon, Esquire
Pennsylvania Power & Light Co.
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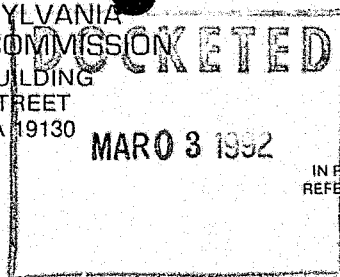
Paul Bonney, Esquire
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Philadelphia, PA 19101

Tom Watson, Esquire
Ward L. Smith, Esquire
Crowell & Moring
1001 Pennsylvania Ave. NW
Washington, DC 20004



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
PHILADELPHIA STATE OFFICE BUILDING
1400 WEST SPRING GARDEN STREET
PHILADELPHIA, PENNSYLVANIA 19130

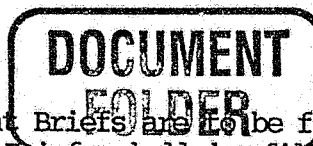
(215) 560-2105
February 11, 1992



See Attached Service List

Re: Letter of Notification of Philadelphia Electric Company
relative to reconstructing and rebuilding of the existing
138 kv line to operate as Woodbourne-Heaton 230 kv line in
Montgomery and Bucks Counties.
Docket Number 110550F055

To All Counsel:



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Very truly yours,

HERBERT SMOLEN
Administrative Law Judge

NVL

HS:lnw

cc: Hon. Allison K. Turner, Chief Adm. Law Judge
John Alford, Secretary, PA P.U.C.
Beth Plantz

P.S. The Administrative Law Judge requests that two (2) copies of all Briefs be forwarded to him.

SERVICE LIST

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Pennsylvania Public Utility Commission
G-28, North Office Building
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Pennsylvania Power & Light Co.
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Philadelphia, PA 19101

Tom Watson, Esquire
Ward L. Smith, Esquire
Crowell & Moring
1001 Pennsylvania Ave. NW
Washington, DC 20004

APPEARANCE SHEET

ALJ HEARING REPORT

PAY

DOCKET NO. A-110550F055

CASE NAME Philadelphia Electric

Company, etc.

HEARING LOCATION Philadelphia, PA.

HEARING DATE Feb. 7, 1992

ALJ Smolen

CHECK THOSE BLOCKS WHICH APPLY:

Hearing held YES ☒ NO ☐

Testimony taken YES ☒ NO ☐

Hearing concluded YES ☒ NO ☐

Further hearing needed YES ☐ NO ☒

Estimated add'l days

RECORD CLOSED YES ☒ NO ☐ 4-7-92

Briefs to be filed YES ☒ NO ☐ SEE BELOW

Date

BENCH DECISION YES ☐ NO ☒

REMARKS: BRIEFING SCHEDULE

MAIN BRIEFS - 3-17-92

REPLY BRIEFS - 4-7-92

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CHAPTER 17-274
ELECTRIC AND MAGNETIC FIELDS

PEG Ex. TURNER-CROSS #1

10/15/91

215

A-110550F055
1/11/92

Part I

- 17-274.001 Electrical Facilities; Electric and
Magnetic Fields, Intent, Findings, Basis of
Standards and Research Needs
- 17-274.200 Electrical Facilities; Electric and Magnetic
Fields, Definitions.
- 17-274.300 Electrical Facilities; General Technical
Requirements.
- 17-274.301 Electrical Facility, Deviations from Standards
and Requirements.
- 17-274.400 Electrical Facilities; General Standards.
- 17-274.450 Electrical Facilities; Electric and Magnetic Field
Standards.
- 17-274.460 Electrical Facilities; Computation and
Measurement Methodology.
- 17-274.470 Electrical Facilities; Compliance Methodology.
- 17-274.480 Electrical Facilities; Emergency, Exemptions.
- 17-274.510 Electrical Facilities; Monitoring and Reporting.
- 17-274.520 Electrical Facilities; Compliance.

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17-274.001 Electrical Facilities; Electric and Magnetic Fields; Intent, Findings, Basis of Standards, and Research Needs

(1) Intent--The intent and purpose of this chapter is to establish electric and magnetic field (EMF) standards for 60 hertz electrical transmission lines and substations rated at 69 kV or greater and to prescribe how compliance with those standards shall be determined, pursuant to sections 403.061(30) and 403.523(1) and (14), Florida Statutes, relating to the protection of public health and welfare from such electrical facilities.

(2) Findings--Based on the information available to the Department, the Department makes the following general findings:

(a) The department has reviewed the present scientific data on the potential for health effects of electric and magnetic fields. The department has also reviewed data on the existing or potential electric and magnetic field levels near electrical transmission and distribution lines and substations in Florida. Although there is no conclusive evidence that there is any danger or hazard to public health at the levels of existing 60 hertz electric and magnetic fields found in Florida, there is evidence of a potential for adverse health effects on the public. Further research is needed to determine if there are effects and the exposure levels at which effects may occur.

(b) With respect to 60 hertz EMF, reasonable measures include urging more applied research on the potential adverse human health effects of EMF and EMF mitigation techniques; initiating a comprehensive review of the state of the science and the provisions of this rule, not later than two years after the adoption of this rule; and requiring all new and modified transmission lines and substations to meet standards which are achievable through the use of available EMF reduction technology

and measures, but in no case to allow any new or modified line or substation, under normal conditions, to cause electric or magnetic field strengths greater than those that now occur for existing transmission lines and substations.

(3) Basis of EMF Standards

(a) Electric Field Strength. The electric field strength standards in this rule are based on the avoidance of the perception of an electric field at the edge of the right-of-way (ROW) or within a ROW; and on the reasonable measures and status quo cap criteria stated under paragraph (2) Findings, above.

Compliance with the National Electrical Safety Code (NESC), which applies to all electrical transmission lines and substations within Florida through rules administered by the Florida Public Service Commission (PSC), ensures that unsafe conditions will not exist in the vicinity of these facilities, but compliance with that code does not ensure that a person will not experience tingling sensation or mild, though harmless, shock within the ROW.

(b) Magnetic Field Strength. The magnetic field strength standards in this rule are based on the reasonable measures and status quo cap criteria stated under paragraph (2) Findings, above.

(c) For both electric and magnetic fields the standards apply to the maximum instantaneous field strength that occurs, or is predicted to occur by the model prescribed in this rule (whichever is greater) under any normal operating mode (all operating conditions except emergency load conditions). Under most normal load conditions the actual magnetic field strength at the edge of the ROW will be about one-half of the standards, which are to be met at the facilities maximum current rating (MCR).

(4) Additional Research Needed--Continued research is needed

on the potential adverse human health and welfare effects of 60 hertz EMF and EMF mitigation techniques because existing knowledge is inadequate to confidently conclude that no further action is needed.

(5) Electrical Facilities, Categories--This chapter sets forth three categories of major electrical facilities for regulation in regards to the electric and magnetic fields associated with these facilities.

(a) The first category is for existing electrical facilities on which construction was commenced prior to the effective date of this rule.

These facilities will be allowed to operate at up to their extant highest operating voltage or maximum current ratings.

(b) The second category of electrical facilities is for those which were certified pursuant to Chapter 403, Part Two Florida Statutes, after April 15, 1988, but before the effective date of this chapter. These facilities will be subject to specific standards moderated by the individual circumstances of the facility.

(c) The third category is for electrical facilities the construction of which commences after the effective date of this chapter.

(6) Effect of Rule--The effect of this chapter is to establish requirements to reasonably protect the public health and welfare from electric and magnetic fields associated with new electrical transmission lines, distribution lines and substations.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.200 Electrical Facilities; Electric and Magnetic Fields; Definitions.

Words, terms and phrases used in this chapter, unless otherwise indicated, shall have the meaning set forth in the Standards Dictionary of Electrical and Electronic Terms (ANSI/IEEE Standards No. 100-1984) adopted by reference in Rule 17-274.300, F.A.C. In addition, the following words or terms, when used in this Chapter shall have the following indicated meanings:

(1) "ANSI" means the American National Standards Institute.

(2) "Balanced Current" means currents in three-phase electrical systems which are equal in amplitude and separated by a phase angle of 120 degrees.

(3) "Balanced Voltage" means voltages in a three-phase system which are equal in amplitude and separated by a phase angle of 120 degrees.

(4) "Commence Construction" means, as applied to the construction of a new transmission line, or new substation supplied by a new transmission line, or new distribution line that the facility owner has begun after the effective date of this chapter a continuous program of actual on-site construction or physical modification of the electrical facility, to be completed within a reasonable period of time.

(5) "Department" means the Florida Department of Environmental Regulation.

(6) "Distribution Line" means a system of conductors used to transport electrical energy at voltages of less than 69 kV including service drops from transformers to residences or businesses.

(7) "Electrical Facility" means the components of an electrical transmission line, distribution line or substation that produce or affect electric and magnetic fields.

(8) "Facility Owner" means an owner or operator of an electrical facility.

(9) "Gauss" means the unit of magnetic flux density that will induce an electromotive force of 1×10^{-8} volt in each linear centimeter of a wire moving laterally with a speed of one centimeter per second at right angles to the magnetic flux.

(10) "Hertz" means the unit of frequency of an electrical facility equivalent to a cycle per second.

(11) "Highest Operating Voltage" means the maximum voltage value set forth for a particular transmission line on Table 1, ANSI C 84.1-1982, or ANSI C 92.2-1981, or the maximum operating voltage as established by the facility owner.

(12) "IEEE" means the Institute of Electrical and Electronic Engineers.

(13) "Kilovolts/meter" means a unit of measurement of electric field strength generally measured at a point one meter above the ground and expressed as kV/m.

(14) "Maximum Current Rating" or "MCR" means the maximum quantity of electric current, expressed in amperes, that can be continuously carried on the conductors of an electrical circuit as determined by the facility owner.

(15) "Maximum Electric Field Strength" means the amplitude (Root Mean Square) of the electric field produced by an electrical facility operating at the highest operating voltage expressed in kV/m at a height of one meter above ground level.

(16) "Maximum Magnetic Field" means the amplitude (Root Mean Square) of the magnetic flux density produced by an electrical facility operating at MCR measured in Gauss one meter above the earth's surface.

(17) "Minimum Conductor Height" means the minimum

vertical distance from the earth's surface to the geometric center of the conductor or conductor bundle at MCR.

(18) "Modified" as it relates to electrical facilities, means a transmission line or substation that is modified to operate at a higher nominal voltage or current after the effective date of this rule.

(19) "New Distribution Line" means a distribution line that commenced construction after the effective date of this rule.

(20) "New Electrical Facility" means an electrical facility which commenced construction after the effective date of this rule.

(21) "New Substation" means a substation that commenced construction after the effective date of this rule that is built to connect new transmission lines of 69 kV or larger with other electrical facilities, or a substation into which a new transmission line is built.

(22) "New Transmission Line" means a transmission line upon which construction commences after the effective date of this rule or an existing transmission line which commences construction for the purpose of reinsulating to operate at a higher nominal voltage or reconductoring to operate at a higher MCR after the effective date of this rule. This does not include transmission lines which are relocated or rebuilt unless such lines are modified to operate at a greater nominal voltage or current than previously existing.

(23) "NESC" means the National Electrical Safety Code.

(24) "Nominal Voltage" means the voltage classification as defined in Table 1, ANSI C 84.1-1982 or ANSI C 92.2-1981.

(25) "Residential, Commercial or Industrial Building" means a structure that persons use for their residence, for

commercial transactions, or for manufacturing a product. It does not include buildings visited by people for short periods of time on a non-daily basis.

(26) "Rights-of-Way" (ROW) as used herein, is a term intended to be used only for purposes of determining the appropriate points for compliance with this rule, and not for the purpose of determining a legal interest in property. Rights-of-way means any of the following, as appropriate:

(a) Land where the facility owner has a property interest, such as, but not limited to, an easement, prescriptive easement, or fee simple title, and which is used or designated for construction, operation and maintenance of transmission lines.

(b) In areas where the facility owner does not have a property interest in the land where the transmission line or distribution line will be located, the ROW will be assumed to extend to the edge of the nearest residential, commercial or industrial building in existence prior to the date the electrical facility commenced construction or applied for a permit, whichever is sooner, or 50 feet from each outside conductor, whichever is closer.

(c) In areas where the facility owner has no property interest or has less than 50 feet of property interest as described in (26)(a) and where such interest is adjacent to or within the property boundary of a linear easement of a railroad, utility pipeline, communication line, or public utility linear facility, or public road or canal the ROW will be assumed to extend to the furthestmost edge of the such property boundary or linear easement or edge of the nearest residential, commercial or industrial building in existence prior to the date the electrical facility commenced

construction or filed for a permit, whichever is sooner, or 50 feet from each outside conductor, whichever is closer.

(d) In areas where the facility owner has a property interest as described in (26)(a) and where such interest is adjacent to or within the property boundary of a linear easement of a railroad, utility pipeline, communication line, or public utility linear facility, or public road or canal, the ROW will be assumed to extend to the furthestmost edge of such property boundary or linear easement, whichever is further.

(e) In areas where the facility owner has a property interest as described in (27)(a) and where such property interest is located within property owned by federal, state, regional or local governmental agencies, the ROW will be assumed to extend to the edge of the nearest residential, commercial or industrial building in existence prior to the date the electrical facility commenced construction or filed for a permit, whichever is sooner, or 50 feet from each outside conductor, whichever is closer.

(27) "Secretary" means the Secretary of the Department of Environmental Regulation.

(28) "Substation" means the electrical facility and related property used for the connection of transmission lines or distribution lines to other such electrical facilities or electrical generating plants.

(29) "Transmission Line" means a system of conductors used to transport electrical energy at voltages of 69 kV or greater.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.300 Electrical Facilities; General Technical Requirements.

(1) The technical standards and criteria contained in the standard manuals and technical publications listed in paragraph (2) below are hereby incorporated by reference and shall be applied unless a deviation is approved, in determining whether proposed new or modified electrical facilities comply with the provisions of this chapter.

(2) Standard Manuals and Publications.

(a) Standards Dictionary of Electrical and Electronic Terms (ANSI/IEEE Standards No. 100-1984.) Copies available from American Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017.

(b) Appendix E, ANSI C 84.1-1982. Copies available from the Institute of Electrical and Electronics Engineers, Inc., 345 E. 47th Street, New York, NY 10017.

(c) IEEE Standard No. 644-1987. Copies available from the Institute of Electrical and Electronics Engineers, Inc. New York, NY 10017.

(d) ANSI C 92.2-1981. Copies available from American Institute of Electrical and Electronics Engineers, Inc.

(3) Copies of the publications listed in subsection (2) are available for inspection at the Department's Information Center, 2600 Blair Stone Road, Tallahassee, Florida, 32399-2400.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.301 Electrical Facilities; Deviations From Standards and Criteria.

(1) Deviations from the standards and criteria contained

in publications listed in Rule 17-274.300(2), F.A.C., above or equivalent methodology for the computation and measurement methodology referenced in Rule 17-274.460, F.A.C. may be approved by the department provided the applicant's engineer's report provides reasonable assurance that the proposed design, calculations or measurement methods will result in electrical facilities meeting the requirements of this rule.

(2) The department may approve deviations from the standards and criteria contained in the publications listed in Rule 17-274.300(2), F.A.C., above or equivalent methodology for the measurement for the computation and measurement of electric and magnetic fields upon a finding that conformance to them will not result in noncompliance with the remainder of this chapter or other rules of this department in accordance with the following:

(a) The owner or operator of any electrical facility subject to the provisions of this section may request in writing a determination by the Secretary or his designee that any requirement of Rule 17-274.300, or 17-274.460, F.A.C., relating to measurement or calculation of electric or magnetic fields, procedures, test equipment, methodology, or test facilities shall not apply to such electrical facility, and shall request approval of alternate standards or criteria.

(b) The request shall set forth the following information, at a minimum:

1. Specific electrical facility for which an exception is required.

2. The specific provision(s) of Section 17-274.300 or 17-274.460 from which an exception is sought.

3. The basis for the exception, including but not limited to any hardship which would result from compliance with the

provisions of Rule 17-274.300, or 17-274.460, F.A.C.

4. The alternate standard(s) or criteria for which approval is sought and a demonstration that such alternate standard(s) or criteria shall be adequate to demonstrate compliance with the field strength standards contained in this Chapter.

(c) The Secretary or his designee shall specify by order each alternate standard or criteria approved for an individual electrical facility in accordance with this section or shall issue an order denying the request for approval. The Department's order shall be the final agency action, reviewable in accordance with Section 120.57, Florida Statutes.

Specific Authority: 043.061(7), 403.523(1), F.S

Law Implemented: 403:061(30), 403.523(14), F.S

History: New _____.

17-274.400 Electrical Facilities; General Standards.

(1) No electrical facility, subject to the provisions of this chapter, shall be operated in such a way that it exceeds the standards set forth in Section 17-274.450 F.A.C., except as provided in Section 17-274.480 F.A.C.

(2) All existing electrical facilities on which construction was commenced on or prior to the effective date of this rule, and all new distribution lines shall be allowed to operate at their maximum current ratings, highest operating voltage, and emergency conditions, provided that such facilities comply with the National Electrical Safety Code (NESC) as required by the Florida Public Service Commission.

(3) Except as otherwise provided in Section 17-274.480, no facility owner shall operate a new transmission line with a nominal voltage of 230 kV or greater above the highest operating voltage or MCR such that the standards in Section

17-274.450 are amended.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.450 Electrical Facilities; Electric and Magnetic Field Standards.

(1) Existing Lines for which construction was commenced on or prior to the effective date of this rule (Reserved).

(2) Lines certified pursuant to Florida Statutes Chapter 403, Part Two, after April 15, 1988, and prior to the effective date of this rule.

(a) For the Lake Tarpon - Kathleen transmission line where the ROW width is 100 feet:

1. The maximum electric field at the edge of the ROW shall not exceed 1.56 kV/m.

2. The peak daily magnetic field at the edge of the ROW shall be limited to 35 milliGauss under normal load conditions. Under load conditions in excess of 500 MW, the peak daily magnetic field shall be limited to 229 milliGauss. Load conditions in excess of 500 MW shall occur for no more than 15 hours in any given year, except for non-permanent load conditions caused by malfunction or maintenance outages in the transmission grid or generation facilities within or outside the state of Florida. Florida Power Corporation shall report annually to the Department the amount of time during which the 500 MW normal load condition was exceeded.

(b) For the Lake Tarpon - Kathleen transmission line where the ROW width is 190 feet:

1. The maximum electric field at the edge of the ROW shall not exceed 1.90 kV/m.

2. The peak daily magnetic field at the edge of the ROW shall be limited to 24 milliGauss under normal load conditions. Under load conditions in excess of 500 MW, the peak daily magnetic field shall be limited to 154 milliGauss. Load conditions in excess of 500 MW shall occur for no more than 15 hours in any given year, except for non-permanent load conditions caused by malfunction or maintenance outages in the transmission grid or generation facilities within or outside the state of Florida. Florida Power Corporation shall report annually to the Department the amount of time during which the 500 MW normal load condition was exceeded.

(c) In no event shall any provision of this section ever be construed to place any limitation or restriction upon the Lake Tarpon-Kathleen transmission line that is not specifically required by the Final Order of the Governor and Cabinet, sitting as the Siting Board, dated May 26, 1988, certifying that transmission line, either as that Final Order is presently worded or as it may hereafter be lawfully modified or amended.

(3) New Transmission lines and Substations.

(a) The maximum electric field at the edge of the transmission line ROW or at the property boundary of a new substation shall not exceed 2.00 kV/m.

(b) The maximum electric field on the ROW of a 230 kV or smaller transmission line shall not exceed 8 kV/m.

(c) The maximum electric field on a 500 kV transmission line shall not exceed 10 kV/m.

(d) The maximum magnetic field at the edge of a 230 kV or smaller transmission line ROW or at the property boundary of a new substation serving such lines shall not exceed 150 milliGauss.

(e) The maximum magnetic field at the edge of the transmission line ROW for a 500 kV line or at the property boundary of a new substation serving a 500 kV line shall not exceed 200 milliGauss except for double circuit 500 kV lines to be constructed on ROWs existing on the effective date of this rule as identified below where the limit will be 250 milliGauss.

(d) For existing ROWs extending from the Andytown substation to the Orange River substation, Andytown substation to the Martin Generating Plant, and the Martin Generating Plant to the Midway substation, where the facility owner has acquired prior to the effective date of this rule a ROW sufficiently wide for two or more 500 kV transmission lines and has constructed one or more 500 kV transmission lines on this ROW prior to the effective date of this rule, the maximum magnetic field at the edge of the ROW or property boundary of a new or modified substation shall not exceed 250 milliGauss.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.460 Electrical Facilities; Computation and Measurement Methodology.

(1) Computations to establish compliance with standards set forth in Rule 17-274.450, F.A.C., shall be performed by the use of Bonneville Power Administration (BPA) Corona and Field Effects Program for calculating electric and magnetic fields set forth in paragraphs 17-274.470(1) and (2), F.A.C., below. When electric and magnetic field calculations are made using the BPA Corona and Field Effects Program, the following input data will be used:

(a) Magnetic field calculations:

1. The MCR currents will be used.
2. The conductor will be at its minimum clearance to the earth.

3. Currents will be assumed to be balanced in phase and in magnitude with no zero-sequence current.

(b) Electric field calculations:

1. The highest operating voltage will be used.
2. The conductor will be at its minimum clearance to the earth.
3. Voltages will be assumed to be balanced in phase and in magnitude.

The Department and the facility owner may agree on substituting other equivalent methodology to verify compliance, in accordance with Rule 17-274.301, F.A.C.

(2) On-site measurements of electric and magnetic fields, when made, shall be conducted in accordance with the procedures set forth and with instruments conforming to and calibrated in accordance with the IEEE Standard No. 644-1987. Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.470 Electrical Facilities; Compliance Methodology.

(1) New Transmission Lines for Which Construction Was Commenced After the effective date of this rule.

(a) Compliance with the electric field standards set forth in Rule 17-274.450, F.A.C., shall be determined by calculations using the highest operating voltage for a new transmission line together with lines then existing in the ROW.

(b) Compliance with the magnetic field standard set forth in Rule 17-274.450, F.A.C., shall be determined by calculations at the MCR current for a new transmission line together with lines then existing in the ROW.

(c) Measurements shall be made in conformance with the criteria of Rule 17-274.460, F.A.C., above.

(2) New Substations for Which Construction Was Commenced After the effective date of this rule.

(a) Compliance with the electric field standard set forth in Rule 17-274.450, F.A.C., shall be determined by calculations using the highest operating voltages for the entering and exiting transmission lines associated with the substation and shall be equal to the maximum edge of ROW electric field of any transmission line entering or exiting the substation property boundary.

(b) Compliance with the magnetic field standard set forth in Rule 17-274.450, F.A.C., shall be determined by calculations using the MCR current of the entering and exiting transmission lines associated with the substation and shall be equal to the maximum value of the edge of ROW magnetic field of any transmission line entering or exiting the substation property.

(3) Access.

Department employees shall have access to all electrical facilities with reasonable notice to the facility owner for the purpose of determining compliance in accordance with section 403.091 F.S.

Specific Authority: 403.061(7), 403.091, 403.523(1), F.S.

Law implemented: 403.061(30), 403.091, 403.523(14), F.S.

History: New _____.

17-274.480 Electrical Facilities; Emergency Exemptions.

An electrical facility that exceeds the maximum current rating (MCR) or highest operating voltage due to emergency conditions is exempt from the provisions of Rule 17-274.450 F.A.C., provided the facility owner exercises reasonable

practices to minimize the time the facility exceeds the MCR or highest operating voltage. The Department may consult with the Florida Public Service Commission to verify any emergency conditions. Emergency conditions mean conditions that cause the MCR or highest operating voltage to be exceeded due to unexpected, unforeseen or unanticipated events such as, but not limited to, failure of generating or electrical facilities due to natural or man-made causes beyond the control of the facility owner.

Specific Authority: 403.061(3), 403.061(7), 403.061(21), 403.081, 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.510 Electrical Facilities; Monitoring and Reporting.

(1) Monitoring for compliance shall be accomplished by including devices for measuring and recording voltage and current flow or their equivalent on all new 230 kV or greater transmission lines in accordance with this chapter.

(2) Reporting of exceedances of highest operating voltage or MCR on new 230 kV and greater transmission lines shall be made when the standards of of Section 17-274.450 are exceeded. Notification shall be made to the department in writing within 30 days of the determining of an exceedance.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

History: New _____.

17-274.520 Electrical Facilities; Compliance.

(1) No certification, as described in paragraph 2 of this section, for a new electrical facility may be issued unless the applicant gives reasonable assurance that the standards of

this rule and other rules of the department will be complied with.

(2) Any electrical facility owner seeking certification of an electrical facility under the provisions of the Florida Electrical Power Plant Siting Act or the Transmission Line Siting Act, Chapter 403, Part II, Florida Statutes after the effective date of this Rule shall include in the application for certification sufficient information to demonstrate compliance with the standards of this rule. For those electrical facility owners that have filed an application for certification prior to the effective date of this rule but which application has not proceeded to a certification hearing, the information to demonstrate compliance with this rule shall be provided at the certification hearing.

(3) Any facility owner seeking to construct a new transmission line of nominal voltage of 230 kV or larger or a new substation served by transmission lines of 230 kV or larger, which is not subject to Chapter 403, Part II, Florida Statutes, shall submit to the department a completed DER Form 17-274.901 at least 90 days prior to start of construction. The information on that form shall be of sufficient detail to show compliance with standards of Section 17-274.450. Any facility owner seeking a permit subject to the provisions of Florida Administrative Code Chapter 17-12 for new 230 kV or larger transmission lines shall include a completed DER Form 17-274.901 with the other applicable application forms.

(4) On or before March 31 of each year, any facility owner that placed in operation, during the preceeding calendar year, a transmission line of nominal voltage less than 230 kV or a substation serving transmission lines of less than 230 kV, shall submit to the Department a statement and a completed

DER Form 17-274.901 from a Florida registered professional engineer verifying that the electrical facility complies with the criteria set forth in Rules 17-274.400 and 17-274.450, F.A.C.

Specific Authority: 403.061(7), 403.523(1), F.S.

Law Implemented: 403.061(30), 403.523(14), F.S.

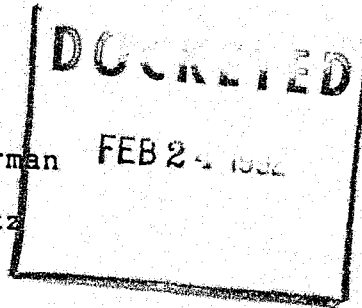
History: New _____.

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STATE OF NEW YORK
PUBLIC SERVICE COMMISSION



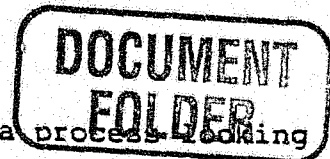
COMMISSIONERS PRESENT:
Peter Bradford, Chairman
Harold A. Jerry, Jr.
Gail Garfield Schwartz
James T. McFarland
Edward M. Kresky
Henry G. Williams

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Public Utility Commission

STATEMENT OF INTERIM POLICY
ON MAGNETIC FIELDS OF
MAJOR ELECTRIC TRANSMISSION FACILITIES

(Issued and Effective: September 11, 1990)

Background



In April 1988, the Commission began a process looking toward the adoption of an interim magnetic field standard for future major electric transmission facilities.¹ The interim standard, by analogy to the Commission's 1978 decision on electric fields,² is intended to ensure that magnetic fields at the edges of future major electric transmission facility rights-of-way will be no stronger than the fields typical of the many existing 345 kV lines operating throughout the State.

1. Cases 26529 and 26559, et al., Order Continuing Interim Transmission Line Electric Field Standard, Directing That an Interim Transmission Line Magnetic Field Standard be Developed and Directing Utilities to Undertake Studies, (Issued and Effective April 12, 1988).

2. Cases 26529 and 26559, 18 NY PSC 665, 690.

Pursuant to other provisions of the 1988 Order, the major New York State electric utilities, in consultation with the Department of Public Service staff, developed a protocol for a statewide survey of magnetic fields around operating 345 kV circuits. Following completion of the survey, the utilities presented the data at a public Technical Conference convened by staff in Albany on July 26, 1989. At the Technical Conference, the utilities explained how the data had been collected and provided statistical analyses of the magnetic field strengths observed. Questions and comments on the presentations were received both during and following the Technical Conference.

After reviewing the record of that Conference, staff developed a proposed interim policy, including an interim magnetic field standard, for consideration by the Commission at the session of March 28, 1990. The Commission issued the proposed interim policy for public comment on April 26, 1990. The nine letters of comment received were reviewed and used to revise this Statement of Policy that we now adopt.

Development of the Interim Policy

The utilities, through the Empire State Electric Energy Research Corporation, issued the results of their magnetic field survey in a June 1989 document, Magnetic Field Levels Associated with 345 kV Transmission Circuits in New York State. The 255-page report examined the accuracy of a computer model used to

calculate magnetic fields, determined the variability of measured fields along transmission line rights-of-way, and calculated fields under various operating conditions (because magnetic field varies with load) for all overhead 345 kV transmission circuits in New York State.

The conditions used for the calculations included three New York Power Pool defined loads: the winter-normal circuit rating; the winter-normal conductor rating; and the winter fifteen-minute emergency conductor rating. Although transmission circuits rarely (less than 0.1% of the time) operate at their winter-normal conductor rating, it is a particularly useful reference point for defining an interim field standard because it is the maximum the transmission wires (conductors) can tolerate for an extended time. This rating will produce the maximum magnetic field which can be sustained continuously; it is essentially a design maximum for normal operation.³

Results obtained for the 83 circuits studied showed that the average magnetic field at the edges of the rights-of-way, calculated using the winter-normal conductor rating for all circuits, was about 200 milligauss (mG). As noted above,

3. The winter-normal circuit rating is not useful for the interim standard because it can change if terminal (substation) equipment is modified; the winter fifteen-minute emergency rating is not useful because it is not a normal operating condition. Summer ratings are not appropriate because they are less than winter ratings.

however, the winter-normal conductor rating is a design maximum; transmission circuits normally produce much weaker magnetic field levels. Ninety-nine percent of the time, the magnetic field level at the edge of the right-of-way of the average 345 kV transmission circuit was less than about 55 mG, according to historical load flow data presented in the report. Ninety percent of the time, the field was less than 45 mG; 50% of the time, it was less than 30 mG; 10% of the time, it was less than 15 mG.

The report also showed that the magnetic field directly above underground 345 kV transmission circuits is on the order of 1 mG, measured one meter above ground during maximum normal power flow.

Methods for using the magnetic field survey to develop a transmission line standard were solicited in the announcement for the Technical Conference. Written comments were submitted by Doreen Banks, secretary of the East Williston Civic Association; by Adam J. Becker and Robert O. Becker, M.D. of Becker Biomagnetics; and jointly by New York State's investor-owned electric utilities and the New York Power Authority. Oral comments were presented by Doreen Banks, by Henry Nowak (a consultant and former Niagara Mohawk employee), and jointly by the utilities and the New York Power Authority.

After reviewing the record of the Technical Conference and the state of knowledge with respect to possible biological

effects of electric and magnetic fields, staff recommended the adoption of a proposed interim policy, including an interim magnetic field standard. On April 26, 1990, we issued a notice requesting comments on the proposed interim policy. Nine letters of comment were received.

Several of those commenting revisited the basic premise for the magnetic field standard. Mrs. Mary Jane L. Row stressed the need for reliable and current health effects information so that informed decisions can be made. Mr. Harry P. Bifulco, Jr. questioned the medical and scientific basis for the proposed standard. Ms. Doreen Banks objected to the idea of basing the standard on fields that are typical of existing 345 kV lines. Dr. Robert O. Becker argued that a direct causal link between magnetic field exposure and adverse health effects has been established, and that a more stringent standard is warranted to protect public health.

The Department of Environmental Conservation, W. T. Kaune and J. M. Silva (Enertech Consultants), the New York State utilities and the Power Authority were generally supportive of the proposed Statement of Policy.

Discussion of Policy and the Interim Standard

The staff recommendations in this matter proceeded from the premise that adoption now of a standard based on health effects would be unreasonable given the current state of

research; the research does not provide a basis for choosing a standard. Hasty adoption of unnecessarily strict standards would itself compromise public safety by making it more difficult and costly to provide needed energy supplies.

In these circumstances, the better approach is one of "prudent avoidance," as advocated in the May 1989 Background Paper, Biological Effects of Power Frequency Electric & Magnetic Fields, issued by the U. S. Congress, Office of Technology Assessment. That approach recognizes that while emerging evidence does not provide a basis for asserting that magnetic fields pose a significant risk, neither does it allow one to assert categorically that there are no risks. Prudence therefore suggests a degree of caution in dealing with magnetic fields until further research permits a more conclusive determination.

These considerations support an interim standard that would avoid unnecessary increases in existing levels of exposure to magnetic fields. Such a standard thus would apply only to future transmission line facilities subject to Article VII of the Public Service Law, and would not be intended to imply either "safe" or "unsafe" levels of exposure. Its function would be to restrict the design choices for future transmission facilities; designs which could produce higher magnetic fields than typical 345 kV lines are to be avoided.

The report, Magnetic Field Levels Associated with 345 kV Transmission Circuits in New York State, shows that the

average magnetic field at the edges of the rights-of-way for all 345 kV transmission circuits in the State, calculated using their winter-normal conductor ratings, is about 200 mG.⁴ This magnetic field level can therefore be considered typical of those that can be produced by the many existing 345 kV lines throughout the State, and will be the interim standard. Consistent with the use of winter-normal conductor rating for the interim standard, winter-normal conductor sag should be assumed in compliance calculations. Choice of 200 mG for the interim standard restricts the design options for future transmission facilities, thus avoiding unnecessary increases in magnetic field exposure.

When transmission lines are constructed within or across public thoroughfares, the term "right-of-way" is not directly applicable. For the purpose of this interim standard, typical right-of-way widths will be used in those circumstances: 150 feet for 345 kV circuits, 120 feet for 230 kV circuits, and 100 feet for lower voltage circuits, with the transmission line centered.

When multiple transmission circuits will exist within the same corridor, the interim standard is to apply to the combination of circuits and operating conditions which would

4. Consistent with ANSI/IEEE Standard 644-1987, maximum rms flux density is used, as opposed to the square root of the sum of the squares of three orthogonal components.

reasonably be expected to produce the highest edge of right-of-way field.

Article VII applications are required to contain a statement explaining what consideration, if any, was given to any alternate method that would fulfill the energy requirements with comparable costs. The statement must include the comparative advantages and disadvantages of any alternative considered. The interim standard requires that the levels of electric and magnetic fields produced at the edge of the right-of-way for each alternative be addressed in this context. Thus, the applicant will be required to consider magnetic fields even when the 200 mG standard may not be a limiting constraint (e.g., in applications for 115 kV vertical configuration circuits).

These interim measures are subject to modification upon a showing of significant change in the body of knowledge on this issue.

Conclusion

The Commission concludes that a prudent approach should be taken that will avoid unnecessary increases in existing levels of magnetic field exposure. Therefore, the following interim measures, applicable only to future electric transmission facilities certified under Article VII of the Public Service Law, are adopted:

1. Future Article VII transmission circuits shall be designed, constructed and operated such that magnetic fields at the edges of their rights-of-way (measured one meter above ground level) will not exceed 200 milligauss when the circuit phase currents are equal to the winter-normal conductor rating (as defined by the New York Power Pool).
2. Where there is no edge of right-of-way defined, the field level shall not exceed the value specified in paragraph 1 above at a horizontal distance of (a) 75 feet from the centerline of the structures supporting an Article VII transmission circuit operating at 345 kV, (b) 60 feet from the centerline of the structures supporting an Article VII transmission circuit operating at 230 kV, and (c) 50 feet from the centerline of the structures supporting an Article VII circuit operating at a lower voltage.
3. For overhead Article VII transmission circuit proposals where multiple transmission circuits will exist within the same corridor, the combination of circuits and operating

conditions that can reasonably be expected to produce the maximum edge of right-of-way fields shall be used in determining compliance with the interim standard.

4. In the Exhibit required by 16 NYCRR Part 86.4, which includes an evaluation of the comparative advantages and disadvantages of any alternative considered, Article VII applicants should address the levels of fields to be produced at the edge of the right-of-way for each alternative considered.

5. Opinion 78-13 established an electric field strength interim standard of 1.6 kV/m for Article VII electric transmission facilities (at the edge of the right-of-way, one meter above ground level, with the line at rated voltage). The conditions set forth in items 2-4 above are to be added to that policy.

By the Commission,

John J. Kelliher
Secretary

FILED-SESSION OF AUG 29 1990

STATE OF NEW YORK
DEPARTMENT OF PUBLIC SERVICE

August 20, 1990

TO: THE COMMISSION

FROM: THE STAFF EMF COMMITTEE

SUBJECT: Cases 26529 and 26559 - Proceeding on Motion of the Commission as to Regulations Regarding Electric and Magnetic Field Standards for Transmission Lines

RECOMMENDATION: The Commission should adopt a statement of interim policy to limit magnetic fields at the edges of future major electric transmission line rights-of-way to 200 mG.

Summary

After a review of the nine comments received in response to the Commission's proposal to establish an interim magnetic field standard for new Article VII transmission lines, staff recommends that the Commission adopt the attached statement of policy. It incorporates the basic provisions of the proposed statement with several minor revisions necessitated by the submitted comments. The policy statement provides a prudent approach that will avoid unnecessary increases in existing levels of electric and magnetic field exposure from future electric transmission facilities authorized under Article VII of the Public Service Law. The statement of policy:

1. Establishes a 200 mG edge of right-of-way magnetic field standard;
2. Clarifies application of the standard when no right-of-way exists.
3. Clarifies application of the standard to multiple circuit corridors;
4. Requires evaluation of magnetic fields for any alternative considered in an Article VII application; and,
5. Applies conditions 2-4 to the 1.6 kV/m electric field standard.

Introduction

At its session on March 28, 1990, the Commission considered the adoption of a statement of policy (including an interim standard) to limit magnetic fields at the edges of the rights-of-way of future major electric transmission facilities subject to Article VII of the Public Service Law. A notice requesting comments on the Proposed Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities (Statement of Policy) was issued April 26, 1990; comments were due May 28. Nine letters of comment were received.

Analysis of Comments

Several commentators revisited the basic premise for the magnetic field standard. Mrs. Mary Jane L. Row of Clifton Park stressed the need for reliable and current health effects information so that informed decisions can be made. Mr. Harry P. Bifulco, Jr. of Huntington Station questioned the scientific basis for the proposed standard. Ms. Doreen Banks of Williston Park objected to the idea of basing the standard on fields that are typical of existing 345 kV lines, levels which she argued are

"far greater than what is considered a threat to human health." Dr. Robert O. Becker (Becker Biomagnetics) rejected the claim in the Proposed Statement of Policy that "as yet, no studies have established a direct causal link between magnetic field exposure and adverse health effects;" he argued that the link has been established and that a more stringent standard is warranted to protect public health.

As is indicated in the Proposed Statement of Policy, the proposed standard was chosen after a thorough (and ongoing) review of the current state of knowledge with respect to possible biological effects of fields. While the biological effects research gives cause for concern (the raison d'etre for the proposed interim standard), it does not provide a basis for choosing the standard. Instead, the standard is based on the concept of "prudent avoidance"; the 200 mG standard requires the utilities to avoid certain transmission line designs which produce stronger magnetic fields than the typical or average 345 kV line. Since the question of whether or not a link has been established between magnetic field exposure and adverse health effects is a subject of continuing debate, the statement referenced by Dr. Becker has been deleted from the revised Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities attached to this memorandum.

The Department of Environmental Conservation (DEC) commented that, in addition to placing the 200 mG limit on the winter-normal conductor rating (a design standard), a 100 mG limit should be placed on the "average annual magnetic field" (an operational standard). Ms. Banks also recommended that a limit

be placed on the magnetic fields produced during normal operation.

There are several problems with imposing an operational standard. An operational standard, such as that proposed by the DEC, serves a purpose similar to that of the design standard proposed by the Commission, but at much greater cost and complexity. The design standard simply requires that future transmission lines be designed so that their magnetic fields are no greater than those that can be produced by existing lines. An operational standard, on the other hand, would require extensive monitoring of continually varying field levels to assure compliance, and would require potentially costly remedies if the monitoring were to show a violation of the "average" operational standard. The current state of knowledge of magnetic field health effects does not warrant such an effort.

The New York State utilities and the Power Authority submitted joint comments generally supportive of the Statement of Policy. Their recommended changes are primarily editorial in nature; most are incorporated in the revised Statement of Policy.

The Power Authority submitted independent comments in addition to the joint comments. Concerning the proposed requirement that "where multiple transmission circuits will exist within the same corridor, the combination of circuits producing the maximum edge of right-of-way fields shall be used in determining compliance . . .," the Authority recommended that periods of maintenance be excluded. The Power Authority's recommendation runs counter to the purpose of this requirement, which was to consider periods when one or more circuits are out-of-service for maintenance or other reasons. Without this

requirement, the magnetic field of the new line could exceed the standard when one or more circuits are taken out of service. Also, this requirement will normally cause the 200 mG standard to be applied to individual circuits, which is appropriate since the standard is based on a survey of individual circuits.

The Power Authority also points out that the "multiple circuit" requirement does not specify the condition of service of the individual circuits. The revised Policy Statement has been modified to indicate that the combination of circuits and operating conditions that will produce the maximum edge of right-of-way fields shall be used in determining compliance. As a practical matter, this condition should rarely require consideration of more than two or three circuits operating at winter-normal conductor rating (or nominal voltage for the electric field interim standard).

The Power Authority also recommended that the Statement of Policy be modified to specify the condition of sag (the ground clearance) to be used in determining compliance. Consistent with use of the winter-normal conductor rating, the revised Statement of Policy specifies that winter-normal sag be used to determine compliance.

In a second letter, Mr. Bifulco submitted a mathematical derivation showing that, contrary to the assertion in the Statement of Policy that "magnetic fields are not expected to be higher at angles than along straight runs [for underground 345 kV transmission pipelines]," the magnetic field at a right angle bend is 70% higher. Mr. Bifulco's derivation is correct, however the predicted 70% increase is applicable only at distances from the pipeline --- ~~are~~ ^{are} large compared to the radius of curvature

of the bend (which, for a 345 kV pipeline, is typically 100 feet). But the magnetic field of such a pipeline is negligible beyond about 10 feet; within 10 feet of a bend, it is more accurate to use the same magnetic field as for a straight pipeline.

W.T. Kaune and J.M. Silva (Enertech Consultants) recommend that the Statement of Policy specify whether the 200 mG is the maximum flux density, or the square root of the sum of the squares of three orthogonal measurements. Kaune and Silva point out that the second method can give varying results depending on the frame-of-reference chosen. Staff is aware of that problem; the measurements and calculations on which the proposed standard is based use the maximum flux density. For clarity, the revised Statement of Policy has been changed to specify that the 200 mG is the maximum flux density; this specification also is consistent with ANSI/IEEE Standard 644-1987, IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines.

Conclusion

After a review of the comments received in response to the Commission's Notice of Proposed Policy, staff has made several minor revisions to the proposed Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities. The

revised statement, which is attached hereto, carries forward the essential elements of the proposed statement. Staff recommends that it be adopted.

Respectfully submitted,

Frederick M. Carr
Frederick M. Carr
Principal System Planner
Power Division

John C. Crary
John C. Crary
Deputy General Counsel
Office of General Counsel

Daniel A. Driscoll
Daniel A. Driscoll
Program Research Specialist
Office of Energy Efficiency and
Environment

James de Waal Malefyt
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Assoc. Aquatic and Terr. Ecologist
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David P. Stricos
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Principal Utility Research Analyst
Power Division

APPROVED:

Laurence B. DeWitt
Laurence B. DeWitt
Director, Office of Energy
Efficiency and Environment

Gerald F. Walsh
Gerald F. Walsh
Director, Power Division

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

CASES 26529 and 26559 - Proceeding on Motion of the
Commission as to Regulations Regarding
Electric and Magnetic Field Standards
for Transmission Lines

STATEMENT OF INTERIM POLICY
ON MAGNETIC FIELD OF
MAJOR ELECTRIC TRANSMISSION FACILITIES

(Issued and Effective September 11, 1990)

ERRATA NOTICE

(Issued October 23, 1990)

The second full paragraph on page 5 of the Statement
of Policy inadvertently described certain named commenters
as "generally supportive." The paragraph is corrected
to read as follows:

The Department of Environmental
Conservation, the New York State utilities,
and the Power Authority were generally
supportive of the proposed Statement
of Policy.


JOHN J. KELLIHER
Secretary

SUGARMAN & ASSOCIATES

ATTORNEYS AT LAW

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ROBERT J. SUGARMAN

ALAN M. KAPLAN

SUSANNE I. GIENDL

KEVIN M. STACK

LEGAL ASSISTANT

*NOT ADMITTED TO PRACTICE
IN PENNSYLVANIA

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MAY 6 1992

SECRETARY'S BUREAU
Information Control Division

February 14, 1992

RECEIVED

FEB 27 1992

Public Utility Commission

FEB 27 1992

SECRETARY'S OFFICE
Public Utility Commission

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DOCUMENT
FOLDER

RE: Protestants' Exhibits, PECO Woodbourne-Heaton
Transmission Line, A-110550, F.055

To All Counsel:

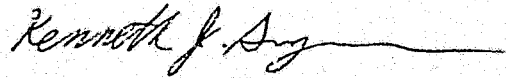
Please find enclosed Protestants' Cross-Exam Exhibit 1 and Protestants' Nos. 2, 3, 4, 5, and 6, as discussed in our February 14, 1992 telefax to Judge Smolen.

Also enclosed is Turner-5, the bibliography which was introduced, as some of you may have gotten a copy already and some of you may not have.

To All Counsel
February 14, 1992
page 2

Feel free to advise us as to any concerns or questions you may have.

Sincerely,

A handwritten signature in cursive script, appearing to read "Kenneth J. Sugarman", followed by a horizontal line.

Kenneth J. Sugarman

KJS/jmb

cc: Robert J. Stonaker, Court Reporter
With two sets of enclosures

The Honorable Herbert S. Smolen
Without enclosures

c:\jenina\feb.14

February 14, 1992

ADDENDUM:

TO ALL COUNSEL:

Please be advised that our letter dated October 22, 1991 misidentified Turner-4 as Exhibit 1.

Sorry for any inconvenience this error may have caused.



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P.O. BOX 3265, HARRISBURG, PA 17105-3265

March 4, 1992

IN REPLY PLEASE
REFER TO OUR FILE

Honorable Herbert Smolen
Administrative Law Judge
Pennsylvania Public Utility Commission
State Office Building, Room 1302
Broad and Spring Garden Streets
Philadelphia, PA 19130

RECEIVED

MAR 04 1992

SECRETARYS OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia
Electric Company relative to the reconstructing
and rebuilding of the existing 138 kV line
to operate as a Woodbourne-Heaton 230 kV line
in Montgomery and Bucks Counties,
Docket No. A-110550,F.055.

Dear Judge Smolen:

I am writing to you with two requests regarding the main briefs to be filed in the above captioned matter. By your February 11, 1992 order, these briefs are to contain a summary of the testimony and evidence adduced at hearing. The record in this case contains approximately 1500 pages in testimony in addition to 13 written statements of direct testimony and approximately 15 exhibits. It is impossible for me to adequately summarize this record in my main brief and yet stay within the limits of 60 pages as required by 52 Pa. Code §5.501(e). Therefore, I am requesting waiver of this requirement.

My second request is also related to the requirement that the testimony and evidence be summarized for the instant record in our main briefs. As of this date, the Prosecutory Staff has spent 85 hours on its first draft of the summary of this record, and we are not yet a third of the way finished. It is clear to me that there is not sufficient time between now and March 17, 1992, the in-hand service date set for main briefs, for me to adequately prepare my brief with a complete summary of the record evidence. Therefore, I respectfully request that the in-hand service date for main briefs in this proceeding be extended three weeks to April 7, 1992, and that the in-hand service date for reply briefs be changed to April 28, 1992.



DOCKETED

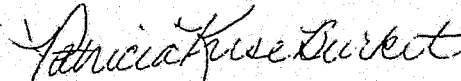
MAR 6

NVL

Honorable Herbert Smolen
Page 2

I have spoken to Ms. McCloskey, Mr. Dillon, Mr. Smith and Mr. Bonney, who do not oppose my requests. I left a detailed message explaining my requests with Mr. Sugarman's office on March 3, 1992; he has not yet indicated whether he will oppose my requests.

Respectfully yours,



Patricia Krise Burket
Prosecutory Staff

Pennsylvania Public Utility
Commission
FAX No. (717) 783-3458

cc (by facsimile
and first class
mail):

Robert Sugarman, Esq.
FAX No. (215) 864-2501
Tonya McCloskey, Esq.
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4



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
PHILADELPHIA STATE OFFICE BUILDING
1400 WEST SPRING GARDEN STREET
PHILADELPHIA, PENNSYLVANIA 19130

IN REPLY PLEASE
REFER TO OUR FILE

March 6, 1992

SEE ATTACHED SERVICE LIST

Re: Letter of Notification of Philadelphia Electric Company relative to the reconstructing and rebuilding of the existing 138 kV line to operate as a Woodbourne-Heaton 230 kV line in Montgomery and Bucks Counties - Docket No. A-110550, F.055

To All Counsel:

At the request of counsel for the Prosecutory Staff, and by agreement of all counsel, the briefing schedule in this matter is hereby modified and is now as follows:

Main Brief In-Hand Due Date - April 7, 1992
Reply Brief In-Hand Due Date - April 28, 1992

In addition, there has been a request for a waiver of the 60 page limitation on Briefs [52 Pa. Code §5.501(e)]. In view of the length of the transcript in this proceeding, the Administrative Law Judge has determined to allow a limited waiver, i.e., Briefs shall continue to be limited to 60 pages, exclusive of the Summary of Testimony. That is to say, the Summary of Testimony portion of the Briefs shall not be computed in assessing the total number of pages. In all other respects, 52 Pa. Code §5.501 shall remain in full force and effect.

Finally, the attention of all counsel is again directed to that portion of 52 Pa. Code §5.501(e) directing, inter alia, that "Briefs shall be as concise as possible . . ." The parties are urged to pay particular attention thereto.

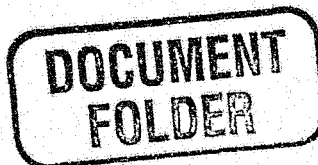
Please note also that the record closing date will now be deemed to be April 28, 1992.

Very truly yours,

HERBERT SMOLEN
Administrative Law Judge

APR 06 1992

HS/jr



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cc: Honorable Allison K. Turner
Beth Plantz



COMMONWEALTH OF PENNSYLVANIA
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PHILADELPHIA, PENNSYLVANIA 19130

IN REPLY PLEASE
REFER TO OUR FILE

March 27, 1992

DOCKETED

APR 06 1992

SEE ATTACHED SERVICE LIST

Re: Letter of Notification of Philadelphia Electric Company relative to the reconstructing and rebuilding of the existing 138 kV line to operate as a Woodbourne-Heaton 230 kV line in Montgomery and Bucks Counties - Docket No. A-110550, F.055

To All Counsel:

Upon consideration of the request of counsel for the Prosecutory Staff for an extension of the briefing schedule in this matter, and the reported responses of the parties, the briefing schedule is hereby further modified and is now as follows:

Main Brief In-Hand Due Date - April 21, 1992
Reply Brief In-Hand Due Date - May 12, 1992

Please note that the page limitation waiver as set forth in the March 6, 1992 notice remains in effect.

Please note also that the record closing date will now be deemed to be May 12, 1992.

Very truly yours,

HERBERT SMOLEN
Administrative Law Judge

DOCUMENT
FOLDER

HS/jr

FILE

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cc: Honorable Allison K. Turner
Beth Plantz



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P.O. BOX 3265, HARRISBURG, PA 17105-3265

April 20, 1992

IN REPLY PLEASE
REFER TO OUR FILE

John G. Alford
Secretary
Public Utility Commission
P.O. Box 3265
Harrisburg, PA 17105-3265

RECEIVED
APR 20 1992

Re: Letter of Notification of Philadelphia
Electric Company Relative to
Reconstructing and Rebuilding of the
Existing 138kV Line to Operate as the
Woodbourne-Heaton 230kV Line in
Montgomery and Bucks Counties, Docket
No. A-110550F055.

SECRETARY'S OFFICE
Public Utility Commission

Dear Mr. Alford:

Enclosed please find the original and nine copies of the Main Brief of the Prosecutory Staff and Appendix A in the above-captioned case. A Certificate of Service is attached to the original and each copy of the brief evidencing service on Administrative Law Judge Herbert Smolen and all other parties.



Respectfully submitted,

Patricia Krise Burket

Patricia Krise Burket
Assistant Counsel

Enclosures

cc: ALJ Smolen
All Parties

RECEIVED

APR 20 1992

SECRETARY'S BL
Information Control Division

FILE

MPK

PENNSYLVANIA PUBLIC UTILITY COMMISSION
BEFORE ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN

Letter of Notification of
Philadelphia Electric Company
Relative to Reconstructing and
Rebuilding of the Existing 138kV
Line to Operate as the Woodbourne-
Heaton 230kV Line in Montgomery
and Bucks Counties

Docket No. A-110550F055

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SECRETARY'S BUREAU
Public Utility Commission

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QUESTIONS PRESENTED

1. Have the Protestants shown that they will be adversely affected by the reconstruction of the old Conrail electric transmission line as the PECO Woodbourne-Heaton 230kV line?

Suggested answer: NO.

2. Should the Public Utility Commission adopt the concept of prudent avoidance as a policy for dealing with public concern over the alleged adverse health effects associated with exposure to electromagnetic fields from electric transmission lines?

Suggested answer: YES.

3. Are the location and design of the Woodbourne-Heaton 230kV line consistent with the concepts of prudent avoidance?

Suggested answer: YES.

STATEMENT OF THE CASE

On November 21, 1989, Philadelphia Electric Company (PECO) filed a Letter of Notification pursuant to Commission transmission siting regulations at 52 Pa. Code §57.72(d)(1) to reconstruct as the Woodbourne-Heaton 230kV line a former 138kV railroad transmission line owned by Consolidated Rail Corporation (Conrail). The railroad transmission line was located along the rail line known as the "Trenton Cut-Off Branch freight line". PECO had purchased an easement along the rail line together with the structures supporting the old 138kV line. By order entered February 3, 1990, the Commission approved PECO's letter of notification.

On September 14, 1990, the Protestants filed an Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval. In their pleading, Protestants which they alleged that they did not receive notice of the proposed reconstruction of the transmission line and that they were entitled to notice because they owned air space adjacent to the right-of-way through which electromagnetic fields (EMF) from the line could be dispersed. The Protestants argued that one of the Protestants owned property within PECO's right-of-way. They also alleged that PECO improperly used the letter of notification proceeding and requested that the proceeding be reopened so that the Protestants might address issues of local zoning, diminution of property values,

aesthetics, increased risks of fires, and the risk of EMF from the line causing cancer. Protestants are members of the group PAUSE (Parents Against an Unsafe Environment) and live along the railroad corridor.

On September 18, 1990, PECO filed an answer to the Protestants Emergency Petition. On December 27, 1990, the Protestants filed a letter supplementing their original petition. On January 3, 1991, the Office of Consumer Advocate filed a Notice of Intervention and a statement in support of the Protestants. On January 4, 1991, PECO filed a response to the Protestants' supplemental letter and on January 10, 1991, an answer to OCA's statement.

On March 8, 1991, the Commission entered an order denying Protestants Emergency Petition for Reopening and their request for stay of construction of the line. In denying their request for reopening, the Commission found PECO correctly used the letter of notification procedure because it was rebuilding an old railroad transmission line and that the Protestants did not own any property in the right-of-way and, under Commission siting regulations, were not entitled to be served with notice of the letter of notification. The Commission determined that the Protestants had not raised any novel issues which had not been raised in any other transmission line cases, and concluded that it was unnecessary to reopen a proceeding where PECO had followed all of the applicable regulations. In denying the Protestants' request for reopening and reconsideration of the

February 3, 1990 Commission order approving the line, which was included in the Emergency Petition, the Commission determined that the Protestants had not shown that they would suffer immediate, irreparable harm if the stay was not granted or that the public interest or PECO would not be harmed if the stay was granted.

On April 2, 1991, the Protestants filed with Commonwealth Court a Petition for Review of the Commission's March 8, 1991 order. Robert Small, et al. v. Pa. P.U.C., No. 761 C.D. 1991. On this same date, the Protestants filed with the Commission the Petition of Small, et al., for Stay Pending Appeal. In this filing, Protestants requested a stay of construction of the Woodbourne-Heaton line pending resolution of their appeal to Commonwealth Court. On April 15, 1991, PECO filed an answer to this petition.

On April 26, 1991, the Petitioners filed with Commonwealth Court a Petition for Stay Pending Review of the Commission's March 8, 1991 order. On May 8, 1991, the Commission entered its order denying the Petition of Small, et al. for Stay Pending Appeal. On May 13, 1991, the Commission filed its Answer to the Petition of Small, et al. for Stay Pending Appeal arguing that the Protestants had not satisfied any of the criteria for stay under Pa. P.U.C. v. Process Gas Consumers Group, 502 Pa. 545, 467 A.2d 805 (1983). Oral argument was held before Commonwealth Court Judge Madeline Palladino on May 22, 1991. At oral argument, counsel for

PAUSE, for the first time, formally requested that the Commonwealth Court remand the appeal to the Commission for hearing.

On May 24, 1991, Judge Palladino issued an order which concluded that "Petitioners [Protestants] are entitled to a hearing on the question of whether they will be adversely affected by the reconductoring of the high tension electrical line at issue in [the] case." The Judge also ordered the appeal to be remanded to the Commission to hold a hearing on this issue within 90 days of the date of the order. On May 29, 1991, Judge Palladino issued a supplemental order relinquishing jurisdiction over the appeal.

On June 14, 1991, the Commission entered an order which directed that the record be reopened for hearing and the determination of the sole issue of whether Protestants would be adversely affected by the reconductoring of the former Conrail line. On June 26, 1991, the Prosecutory Staff entered its appearance in this case.

On July 11, 1991, a telephonic pre-hearing conference was held. The first hearing was held in Philadelphia, PA on August 15, 1991 and was presided over by Administrative Law Judge Herbert Smolen. At the August 15, 1991 hearing, PECO witnesses testified about the manner in which the Woodbourne-Heaton 230kV line was designed and sited and about the electromagnetic fields (EMF) which were expected to be produced by the line.

Ten more days of hearing were held at which Protestants, PECO and OCA presented lay and expert testimony regarding the alleged health affects of EMF in general and the land use criteria which should be utilized in siting and designing high voltage transmission lines. The last hearing date was February 7, 1992. As a result of these hearings, nearly 1500 pages of testimony was generated and more than 30 separate exhibits were introduced into evidence.

On February 11, 1992, ALJ Smolen issued an order that main briefs were to be filed no later than March 17, 1992 and reply briefs were to be filed no later than April 7, 1992. On March 6, 1992, ALJ Smolen extended the briefing schedule so as to make participants' main briefs due on April 7, 1992, and reply briefs due April 28, 1992. On March 27, 1992, ALJ Smolen further extended the briefing schedule so as to make participants' main briefs due on April 21, 1992 and reply briefs due May 12, 1992.

SUMMARY OF ARGUMENT

The Protestants have not shown how they would be adversely affected by the reconstruction of the former Conrail transmission line as PECO's Woodbourne-Heaton 230kV line. The Protestants have not presented substantial evidence of any detrimental effects on human health which are attributable to 60Hz electromagnetic fields (EMF).

In fulfilling its statutory and constitutional duties inherent in considering siting applications, the Commission has authority only to consider environmental impact and safety aspects of the Woodbourne-Heaton line. The Commission has no authority to consider the effect on the market value of property by alleged or actual environmental or public safety impacts resulting from a transmission line.

Assuming, arguendo, that the Commission has authority to consider property values in siting applications, in the instant hearing the Protestants have not shown that the line, which is constructed on an active railroad freight line, is an aesthetic or safety detriment which could cause a decline in property values for property adjacent to the line. Any argument that the market value of properties located along the transmission line corridor would be decreased because of the fear of EMF or the presence of the transmission line towers on the adjacent right-of-way is simply without merit.

Prudent avoidance is a concept which involves the implementation of modest financial expenditures to achieve

reduction in EMF from electric facilities. Adoption of prudent avoidance as a Commission policy is appropriate as it allows construction and upgrading of electric lines to continue in the face of scientific uncertainty. As such, prudent avoidance permits an electric utility to fulfill its statutory duty to provide reasonable, safe and reliable service to the public.

In the context of the instant proceeding, PECO has shown that the design and placement of the 230kV transmission line on the former Conrail railroad corridor will result in reduced EMF exposure to the public and is thereby consistent with the concept of prudent avoidance. Because prudent avoidance has no temporal component, it doesn't matter if the Woodbourne-Heaton 230kV line is consistent with prudent avoidance by design or by happenstance; the important point is that it is consistent.

ARGUMENT

- I. The Protestants have not shown that they will be adversely affected by the reconstruction of the former Conrail 138kV line as PECO's Woodbourne-Heaton 230kV line.

The sole purpose of hearing in this proceeding was to allow the Protestants, adjacent property owners to the transmission line corridor, an opportunity to present evidence as to how they will be adversely affected by PECO's Woodbourne-Heaton 230kV line. Two issues were raised by Protestants in the presentation of their position: (1) whether electromagnetic fields from the Woodbourne-Heaton 230kV line would adversely affect human health and (2) whether the energization of the Woodbourne-Heaton 230kV line would adversely affect the market value of properties in the area adjacent to the line. These issues are discussed separately below.

- A. At present, there is no conclusive evidence that electromagnetic fields present any hazard to human health.

The major issue raised by Protestants is that they will suffer adverse health effects from the electromagnetic fields generated by PECO's Woodbourne-Heaton 230kV line.^{1/} This

^{1/} It is important to note that this proceeding is not the first in which the Commission considered EMF from transmission lines in a siting application. See, Application of West Penn Power Co., Initial Decision issued April 15, 1988 at Docket No. A-110250F010; Application of West Penn Power Company, Initial Decision issued September 19, 1991, at Docket No. A-11250F037; and Application of West Penn Power Company, Initial Decision issued September 17, 1991 and Order entered March 2, 1992 at Docket No. A-110250F035.

issue, thus, involves the safety of the proposed line, which under the Commission's siting regulations must be shown to "not create an unreasonable risk of danger to the health and safety of the public" before it can be approved. 52 Pa. Code §57.76(a)(2).

In the Administrative Law Judge's July 18, 1991 prehearing order, it was determined that because the proceeding involved a letter of notification, PECO would have the burden of proof on matters related to safety of the line, but that the burden would be no greater than that required under the Commission's letter of notification regulation at 52 Pa. Code §57.72(d)(4). Pre-Hearing Order entered July 18, 1991 at Docket No. A-110550F055, p. 4. The Administrative Law Judge also directed that Protestants who contended that there would be adverse health effects from the line would have the burden of proof and of going forward with the evidence to support their claim. Id., p. 4.^{2/}

^{2/} This procedural ruling is consistent with the allocation of burden of proof in rate proceedings, where the burden of proof is by statute on the utility to provide justification for the various components of the proposed rate structure. 66 Pa. C.S. §315(a). The Commission has indicated that where a party proposes an adjustment to the ratemaking claim of a utility, the proposing party bears the burden of producing some evidence or analysis tending to demonstrate the reasonableness of the adjustment. Pa.P.U.C. v. Breezewood Telephone Company, Order entered January 31, 1991 at Docket No. R-901666. See, e.g., Pa.P.U.C. v. PECO, R-891364, entered May 16, 1990, Slip op. at 42-53.

In its direct case, PECO presented testimony that the Woodbourne-Heaton 230kV line had been designed and would be operated in accordance with the National Electrical Safety Code (PECO Direct No. 1, pp. 8, 9). Moreover, modifications had to be made to the line's location and structural design to minimize interference with aviation activities at Buehl Air Field (PECO Direct No. 1, p. 10). The record also establishes that the design selected for the Woodbourne-Heaton 230 kV was the compact delta configuration which would produce lower levels of EMF than other line configurations and that phase rolls were incorporated into the design to reduce interference with Conrail's communication system (N.T. 11, PECO Direct No. 1, pp. 6-7). These phase rolls also reduced EMF generated by the line (PECO Rebuttal Statement No. 6, p. 17). The above evidence is legally sufficient to establish, prima facie, that PECO's Woodbourne-Heaton 230kV Line is not unreasonably dangerous to public safety.

Protestants argue, however, that exposure to low level electromagnetic fields may somehow be detrimental to human health. Accordingly, they had the burden of going forward with the evidence to support their claim. See Prehearing Order, entered July 18, 1991 at Docket No. A-110550F055.

At hearing, the Protestants presented the testimony of Dr. Abraham R. Liboff, a physicist. Although Dr. Liboff was not an endocrinologist, epidemiologist, ontologist,

immunologist or medical doctor, he presented EMF testimony regarding three areas: 1) in vivo or whole animal experiments; 2) in vitro studies using cells and tissues; and 3) epidemiological studies. Dr. Liboff also commented on clinical trials using electromagnetic fields in bone healing and explained his "Ion Cyclotron Resonance Hypothesis". However, the best of this evidence, when analyzed in the context of the other record evidence, is reduced to the following:

1. Transient changes in the circadian rhythm of the level of the hormone melatonin in rats on exposure to pulsed electric fields which causes no ill effects to the rats (OCA Statement No. 1, p. 8; PECO Rebuttal Statement No. 1, pp. 17-18).
2. Alterations in in vitro mitogen-exposed cell proliferation seen upon exposure to EMF, such experiments having not been replicated except where EMF of a decidedly different character is used (OCA Statement No. 1, p. 8; PECO Rebuttal Statement No. 3, pp. 16-18, 20-21; N.T. 790-793).
3. Calcium efflux experiments in which the release of calcium from dead or dying non-functional chick brain tissue is altered by exposure to certain specific combination of alternating and static electric and magnetic fields, with their being no consistent replication of experimental results (Protestants Statement No. 2, p. 6; PECO Rebuttal Statement No. 1, pp. 12-13; PECO Rebuttal Statement No. 3, p. 18; N.T. 764-765, 1002, 1009, 1010).

4. Epidemiological evidence derived from occupational studies which did not control for confounders or hidden variables, and studies on childhood leukemia which reported an association between wire code, a subjective surrogate measure of EMF exposure, and the disease, with that association growing weaker with each successive better-run study (PECO Rebuttal Statement No. 2, pp. 13-17, 24-27, 28; OCA Statement No. 1A, p. 4 (corrected at N.T. 1420), N.T. 1409, 1468-1472).

Considering that the role of the hormone melatonin is not known in humans (OCA Statement 1A, p. 2; PECO Rebuttal Statement No. 1, p. 17); that dead tissues do not function as living tissues (N.T. 1002); that people are not normally exposed to mitogens (PECO Rebuttal Statement No. 1, p. 23) and that EMF from transmission lines are not modulated or pulsed, but are sinusoidal in configuration (PECO Rebuttal Statement No 4, pp. 6-16; N.T. 769-770), the above evidence is not persuasive, standing alone or synergistically in combination, to establish that EMF causes any adverse effect on human health.

Similarly, Liboff's Ion Cyclotron Resonance Hypothesis (ICR) offers at best only a theory for the mechanism by which certain phenomena (calcium efflux) or biological effects reported to be associated with exposure to electric and/or magnetic fields occur (Protestants Statement No. 2, p. 5; PECO Rebuttal Statement No. 4, pp. 19-20; N.T. 783). The ICR, itself, is inconsistent with certain principles of

physics,^{3/} the dynamics of water molecule/ion interactions in the cell^{4/} and the realities of cellular dimensions^{5/} (PECO Rebuttal Statement No. 4, pp. 17-19; N.T. 1219-1220, 1222-1223, 1229-1235), which prevents its acceptance by a consensus of the scientific community (N.T. 425-426). At present, the witness's theory remains unproven (OCA Statement No. 1, p. 9; N.T. 426-427).

On the other hand, PECO and OCA have presented the testimony of a number of scientific and medical experts specializing in medicine, immunology, oncology, biophysics and epidemiology, who agree that while biological effects from low level EMF exposure have been observed, adverse health effects have not been conclusively demonstrated to be caused by EMF

^{3/} Cyclotron resonance occurs only when ions are traveling in a circular path. Any collision with other particles nullifies the effect. Passing through the cell membrane, a ion, like calcium (Ca++) would collide with other particles at a rate of a trillion per second (PECO Rebuttal Statement No. 6, pp. 18-19).

^{4/} At the cellular levels, ions such as calcium are surrounded by a shell of water molecules. The calculations used in the ion cyclotron resonance theory only utilize the mass of the ion itself and not that of the ion/water molecule complex (PECO Rebuttal Statement No. 6, p. 19).

^{5/} The size of the circular path necessary for most ions to undergo the ion cyclotron resonance effect is approximately 10 feet. Channels in the cellular membrane through which ions and other molecules enter and exit the cell are submicroscopic (PECO Rebuttal Statement, No. 6, p. 18).

exposure. Proposed Findings of Facts Nos. 39 through 50, infra, pp. 48-50, list record evidence in support of this proposition which the Prosecutory Staff believes unnecessary to reiterate here.

In summary, regardless of the burden of proof allocation, the record as a whole demonstrates that the Protestants have not presented evidence sufficient to rebut the substantial evidence contained therein that electromagnetic fields from transmission lines do not present an unreasonable danger to human health or public safety. Therefore, the Protestants have not shown that they will be adversely affected by electromagnetic fields from PECO's line.

- B. The Commission has no authority to consider the impact of transmission lines on the market value of property adjacent to a transmission line.

Although the Commission's March 8, 1991 remand order noted that the consideration of alleged decreases in property values is outside its jurisdiction, an argument was raised by Protestants at hearing that the reference in the Commission's siting regulations to "land use" and "landscape" at 52 Pa. C.S. §57.72(c)(7) and §57.75(e)(3) allows the Commission to consider the impact of a proposed line on property values, and in this case, on property values for land that is not even burdened with the actual physical presence of the Woodbourne-Heaton 230kV line (N.T. 104-105). As a result of this

argument, the Administrative Law Judge requested the inclusion in participants' briefs of a discussion of the applicability of the issue of the effect on property values in the context of a siting application (N.T. 105-106).

While it is true that Commission siting regulations do allow the Commission to request the inclusion of additional information as it may require in siting applications, 52 Pa. C.S. 57.72(c)(15), and further allow for the liberal exploration of issues in the hearing on a siting application, 52 Pa. C.S. §57.75(e), the Commission must still limit its inquiry into issues which are within its subject matter jurisdiction. An examination: 1) of the line of cases dealing with the 1971 environmental amendment to Pennsylvania's Constitution, Article I, Section 27 and an agency's authority under that amendment; 2) of Commission case law on siting and eminent domain applications; and 3) of the purpose and the legislative history of the siting regulations establishes that the Commission, in the context of a siting application or eminent domain proceeding related to electric transmission lines, may not consider the impact of a proposed transmission line on property values.

1. Limitation of the Commission's authority in evaluating the environmental impact of public utility projects under Article I, Section 27 of Pennsylvania Constitution.

In 1971, the voters of Pennsylvania adopted an amendment to Pennsylvania's Constitution which provided for the protection of the environment. The new Constitutional provision, Article I, Section 27, was entitled "Natural Resources and the Public Estate" and read as follows:

The people have a right to clean air, pure water, and to the preservation of the natural scenic, historic and esthetic values of the environment. Pennsylvania's natural resources are the common property of all people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.

The first test of this constitutional provision came in Shapp, et al. v. National Gettysburg Battlefield Tower, Inc., et. al., 8 Pa. Commonwealth Court 231, 302 A.2d 886 (1973), aff'd, 545 Pa. 193, 311 A.2d 588 (1973), where the Supreme Court affirmed the Commonwealth Court in upholding the denial of an injunction to block the construction of an observation tower at the National Gettysburg Battlefield. This case stands for the proposition that Section 27 of Article I of the Pennsylvania's Constitution is self-executing, i.e., that it was unnecessary for the Legislature to pass implementing legislation before the amendment could be enforced. However, in its decision, the Court provided no guidelines in regard to

the standards which were to be applied in construing this provision. These standards were later formulated by the Commonwealth Court in Payne, et al. v. Kassab, 11 Pa. Commonwealth Ct., 312 A.2d 86 (1973), aff'd, 468 Pa. 226, 361 A.2d 263 (1976).

In Payne, a group of citizens brought an equity action in Commonwealth Court to block a project of the Pennsylvania Department of Transportation (PennDOT) to improve the highway transportation system of Luzerne County. The project called for the taking of 0.59 acres (3%) of the "River Common" for highway realignment, the replacement of twenty-three trees, and the relocation of several historical markers. The River Common originally was a public common which had been created along the river in Wilkes-Barre in 1770. Later acts of the legislature dedicated these "common lands" as a "public common, and to remain as such forever." The area was then preserved from development and became in effect a public park of historical significance overlooking the river. On appeal, the plaintiffs argued that the project violated Article I, Section 27 of the Constitution.

In rejecting the plaintiffs' argument that Article I, Section 27 should be read in absolute terms, the Court reasoned that if it were read in absolute terms, it would be hard to imagine any activity which would not be violative.

We hold that Section 27 [of Article I] was intended to allow the normal development of property in the

Commonwealth, while at the same time constitutionally affixing a public trust concept to the management of public natural resources of Pennsylvania. The result of our holding is a controlled development of resources rather than no development at all.

Payne, 11 Pa. Commonwealth Ct. at 29, 312 A.2d at 94.

To resolve the conflict identified between competing environmental and social concerns, the Court laid out a three-prong standard to test decisions under review:

1. Was there compliance with all applicable statutes and regulations relevant to the protection of the Commonwealth's natural resources?
2. Does the record demonstrate a reasonable effort to reduce the environmental incursion to a minimum?
3. Does the environmental harm which will result from the challenged decision or action so clearly outweigh the benefits to be derived therefrom that to proceed further would be an abuse of discretion?

11 Pa. Commonwealth Ct. at 29-30, 312 A.2d at 94.

The court subsequently recognized that the Pennsylvania Department of Environmental Resources was not the only governmental unit that had an obligation to protect the public's natural resources and such an obligation extended to other state agencies as well as to the local government level. Delaware County Community College et al. v. Fox, et al., 20 Pa. Commonwealth Ct. 335, 358, 342 A.2d 468 (1975). However, in that same case, the court cautioned that Section 27 of the

Constitution cannot legally operate to expand the powers of a statutory agency to consider matters outside the limits of its enabling legislation and the statutes which it must enforce. 20 Pa. Commonwealth Ct. at 358, 342 A.2d at 482.

In Borough of Moosic v. Pa. PUC, 59 Pa. Commonwealth Ct. 338, 429 A.2d 1237 (1981)^{6/} the court established the limits of the Public Utility Commission's statutory authority in regard to any challenge to its orders entered pursuant to its constitutional duty under Article I, Section 27. The Borough of Moosic involved the appeal of the Commission's approval of the transfer of watershed land without subjecting the non-utility project, which was to be constructed on the transferred utility property, to the Payne test. In upholding the Commission's actions, the Court construed the PUC's authority under Article I, Section 27 as follows (emphasis added):

We view Section 27 to be self executing only as it applies to the Commission's regulation of a utility's own conduct which is within the ambit of the regulatory jurisdiction of the Commission as created by statute and directly affects the environment. Sections 501 and 1501 of the Code, 66 Pa. C.S. §§501 and 1501, read together vest in the Commonwealth [sic] the power to issue orders and regulations to assure that each public utility provides services and maintains facilities necessary or proper for the safety and convenience of the public.

59 Pa. Commonwealth Ct. at p. 343, 429 A.2d at 1240.

^{6/} Before the Commission, the case was Re: Pennsylvania Water & Gas Company, 54 Pa. PUC 344, (1980).

See also Re: Philadelphia Suburban Water Co., 54 Pa. PUC 127 (1980).^{7/}

In regard to the instant proceeding, the impact of a transmission line on the market value of property is not a direct environmental impact but an economic one, and as such, is clearly not an issue within the Commission's statutory authority as a regulator of public utilities as set forth in the Public Utility Code. For this reason, the Commission should not consider property values in evaluating harm done to the environment by construction of transmission lines.

Moreover, the Commission has not been given authority under any other statute to assess damage to private property value caused by the activities of a public utility. Even in eminent domain cases, a situation in which a utility's action directly impacts on private property by its taking, assessment of damages caused by the taking is to be made by the Court of Common Pleas and not the Public Utility Commission under the Eminent Domain Code, 26 P.S. §§1-101, et seq. The Commission's role in the eminent domain proceeding is limited solely to

^{7/} This ruling is consistent with the decision reached in Philadelphia Electric Co. v. Human Relations Commission, 5 Pa. Commonwealth Ct. 329, 290 A.2d 699 (1972), where the court stated that although the Commission does have regulatory power over public utilities, that power extends only to utilities covered by the Public Utility Code and subjects covered by that law.

determine whether the utility facility for which land is to be condemned is for service necessary or proper for the accommodation, convenience or safety of the public. 15 Pa. C.S. §1511(c).

The above analysis is consistent with case law involving other instances where the assessment and/or award of damages has been requested by persons alleging unreasonable public utility service or facilities under 66 Pa. C.S. §1501. The Courts have determined that the Commission has no authority to award damages, Feingold v. Bell Telephone Co. of Pa., 477 Pa. 1, 383 A.2d 791 (1977); Elkin v. Bell Telephone Co. of Pa., 49 Pa. 123, 420 A.2d 371 (1980), but have recognized that they should defer to the Commission in matters requiring its special expertise such as determining the reasonableness of utility service, Elkin v. Bell Telephone Co. of Pa., 491 Pa. 123, 420 A.2d 371 (1980). The courts have also recognized that such deference is not needed in situations where special expertise of the Commission, such as determining that there is a complete lack of utility service. DeFrancesco v. Western Pa. Water Co., 499 Pa. 374, 453 A.2d 595 (1982).

Because the Commission has no authority to award damages and no special expertise to assess property values, or diminution of property values caused by construction of public utilities, the Commission should not undertake an unnecessary evaluation which has no legal significance. Such an evaluation is wasteful of the Commission's limited administrative

resources. Any alleged damage to property is properly brought by the instant Protestants before a civil tribunal and not this Commission.

2. Commission case law involving eminent domain and siting applications.

That the Commission has no jurisdiction over money damages resulting from a proposed electric transmission's impact on property burdened with the physical presence of the line or property adjacent to the line is supported by Commission case law. Prior to the adoption of its siting regulations, which became effective May 19, 1978, it had been the practice of the Commission to review the siting of a proposed transmission line only when certification was sought for the exercise of the power of eminent domain. 6 Pa.B. 780. One such case involved a consolidated proceeding involving 26 eminent domain applications filed by Philadelphia Electric Company to acquire property to construct a 500kV transmission line. Re Philadelphia Electric Company, 52 Pa. PUC 198 (1978).

In Re Philadelphia Electric, the Commission, besides looking at need for the facilities and engineering and routing alternatives, examined individual property use of the condemnees and the impact on that land use of the proposed line's presence on the property. In so doing, the Commission considered property use impacts that included the relocation of a stable away from the proposed right-of-way (Application

No. 98253), 52 Pa. PUC at 205; the bisection of property by the proposed line (Application No. 98253 and Application No. 98257), 52 Pa. PUC at pp. 205, 207; the removal of shade trees which were useful in a condemnee's dairy operation (Application No. 98305), 52 Pa. PUC at p. 209; and the future use of a portion of two individual properties -- one for the expansion of an existing business and placement of an on-site sewage disposal system (Application No. 98255), 52 Pa. PUC at p. 206, and one for a planned 6-unit residential development (Application No. 98259), 52 Pa. PUC at p. 207. The Commission determined that the proposed line's physical impacts on these individual land uses did not alter the reasonableness of the utility's selected route over the individual properties. However, more germane to this discussion of property values, the Commission recognized that the assessment of the damage resulting from the line's impact on individual land use, present or future, was properly adjudicated in another forum.^{8/} 52 Pa. PUC at pp. 205, 206, 207 and 209.

Other cases in which the Commission determined that it could consider the impact of physically locating a transmission line on individual properties, but deferred

^{8/} Under the eminent domain law for electric utility condemnations, the proper forum for the determination of the value of damages to property was and continues to be the local courts of Common Pleas. See 15 Pa. C.S. §1511(g); 26 P.S. §§1-501, et seq.

determination of the damages caused by the impact to another forum included: Re West Penn Power Company, 68 Pa. PUC 262, 268 (1988); and Re Pennsylvania Power & Light Company, 70 Pa. PUC 164, 181 (1989).

Considering that the Commission must defer to the Courts of Common Pleas the issue of damages sustained by a particular property in a condemnation, it follows that any determination of monetary damage done to the market value of property located adjacent to a transmission line is likewise not within the jurisdiction or expertise of the Commission.

3. Legislative History of the
siting regulations.

An examination of the legislative history of the Commission's siting regulations,^{9/} specifically, 52 Pa. Code §57.72(c)(7) and §57.75(e)(3), does not support any argument that the Commission intended to include property values in evaluating siting applications. In fact, the legislative history establishes that these specific sections, which allow for the consideration of "land use" and "landscape"

^{9/} The siting regulations themselves were specifically promulgated pursuant to the Commission's authority under Sections 401 and 412 of the Public Utility Law, May 28, 1937, P.L. 1053, No. 286. Re: Proposed Rulemaking on Siting and Construction of Electric Transmission Lines, 6 Pa. B. 780. In the present version of the Public Utility Code, these sections are 66 Pa. Code §1501 and §1504, respectively, neither of which give the Commission authority to consider property values.

in siting applications, were meant to allow the Commission to assess the level of environmental impact which would result from the proposed line in order to fulfill its Constitutional obligations under Article I, Section 27. See Argument I.B., (1) at pp. 9 to 15, below.

52 Pa. Code §57.72(c)(7) reads as follows (emphasis added):

(c) An application shall contain:

* * *

(7) A description of studies which had been made as to the projected environmental impact of the HV line as proposed and of the efforts which have been and which will be made to minimize the impact of the HV line upon the environment and upon scenic and historic areas, including but not limited to impacts, where applicable on land use, soil and sedimentation, plant and wildlife habitats, terrain, hydrology and landscape.

52 Pa. Code §57.75(e)(3) reads as follows (emphasis added):

(e)(3) At hearings held under this section, the Commission will accept evidence upon, and its determinations of the application it will consider, inter alia, the following matters:

- (i) Land use.
- (ii) Soil and sedimentation.
- (iii) Plant and wildlife habitats.
- (iv) Terrain.
- (v) Hydrology.
- (vi) Landscape.

- (vii) Archeologic areas.
- (viii) Geologic areas.
- (ix) Historic areas.
- (x) Scenic areas.
- (xi) Wilderness areas.
- (xii) Scenic rivers.

In considering the legislative history of 52 Pa. Code §57.72(c)(7), it is also necessary to also look at 52 Pa. Code §57.72(c)(8), a section whose ontogeny is closely related to that of 52 Pa. Code §57.72(c)(7) and 52 Pa. Code §57.75(e)(3). 52 Pa. Code §57.72(c)(8) reads as follows:

(c) An application shall contain:

(7) A description of the efforts of the applicant to locate and identify an archeological, geologic, historic, scenic or wilderness areas of significance within 2 miles of the proposed right-of-way and the location and identity of the areas discovered by the applicant. . .

In the first incarnation of the siting application regulations, 52 Pa. Code §§57.72(c)(7) and (c)(8) appeared in Re Proposed Electric Regulation, 49 Pa. PUC 710, 713 (1976) and were published at 6 Pa.B. 781 as 52 Pa. Code §§57.73(7) and (8). These sections read as follows:

52 Pa. Code §57.73

An application shall contain:

(7) a summary of any studies which had been made as to the projected environmental impact of the HV line as

proposed, and of the efforts which have been and which will be made to minimize the impact of the HV line upon the environment and upon scenic and historic areas;

(8) the location and identification of any known archaeologic, geologic, historic, scenic or wilderness areas of significance within two miles of the proposed right-of-way;

6 Pa.B. 781.

The Commission regulation related to hearings, 52 Pa. Code §57.75(e)(3), was originally numbered as 52 Pa.

Code §57.75(d)(3) and read as follows:

(d) At the hearings held pursuant to this section, the Commission will accept evidence upon, and its determination of the application it will consider, inter alia, the following matters:

* * *

(3) The impact of the proposed HV line on the environment and on historic or scenic areas.

A reading of the above sections of the previous siting regulations reveals not only the correlation between Sections 57.72(c)(7) and (c)(8) and Section 57.75(d)(3) but also their underlying purpose to wit: to insure that the Commission is provided with the necessary information about environmental impact of a proposed electric transmission line. Inclusion of such information is necessary to meet the Commission's constitutional obligation under Article I,

Section 27 of Pennsylvania's Constitution to ensure the protection of the environment whenever the issue of damage to the environment is raised. Payne v. Kassab, 11 Pa. Commonwealth Ct. 14, 312 A.2d 86 (1973)^{10/}; Re Proposed Electric Regulations, 49 Pa. PUC 710, 712 (1976).

Subsequent comments by environmental groups to the proposed regulations caused the Commission to expand the language in 52 Pa. Code §§57.73(7) and (8), (citations omitted)^{11/}:

Environmental Impact Statements.

Several groups with a concern for the environment have suggested that part (7) of Section 57.73 should be changed so as to require the filing of an equivalent of the environmental impact statement mandated by Federal law. We decline to do so. The requirement of filing an environmental impact statement, by itself, may generate data needlessly. The real thrust of the Federal and State environmental policy laws is to require those who would adversely affect the environment to consider the environment

^{10/} 52 Pa. Code §57.76 actually represents, in part, the tripartite balancing test outlined in Payne, as constrained by the recognized limits of the Commission's statutory authority.

^{11/} The Commission made it clear, however, that the modifications to the siting regulations were made in response to the comments received and did not enlarge the original purpose of the regulations proposed. 8 Pa.B. 1403.

in their planning. In our order of March 2, 1976, adopting the siting regulations as proposed regulations we stated:

"The Commission takes notice of the fact that overhead electric transmission lines cannot be constructed without some adverse effect upon the environment."

This means that under Pennsylvania law every applicant for a siting certificate has an intensified burden to show on the record that the environment has been considered in its planning and that every reasonable effort has been made to reduce the environmental incursion to a minimum. Payne v. Kassab. . . . A particular application may require far more environmental documentation than a standard impact statement; another may require much less. However, in every siting proceeding the environmental impact of the proposed line will be an issue which the applicant must address affirmatively and completely in order to be granted a siting certificate. To aid the development of environmental issues, we have added language to §57.75(7) which sets forth the general types of impact that will be considered.

Archaeologic, Geologic, Historic, Scenic or Wilderness Areas of Significance.

Considerable concern has been expressed with respect to part (8) of Section 57.73 regarding the difficulty of defining "archaeologic, geologic, historic, scenic or wilderness areas of significance." We understand this concern and recognize the inherent difficulty in defining such terms. However, the problem is simply that the emphasis is misplaced. Our principal concern is that utilities undertake reasonable, conscientious studies, surveys, and searches to determine whether the proposed line will destroy

or adversely affect any such areas, whether or not the areas were previously known. A significant function of regulations such as these is to bring about, through the administrative process, a definition or valuation of features of our environment which may be diminished by the development of overhead electric transmission systems. Therefore, part (8) of Section 57.73 has been modified to emphasize that applicants must show that a reasonable effort has been made to determine whether such areas exist in proximity to the proposed line and at the same time to identify any areas which have been discovered as a result of that effort.

8 Pa.B. 1405.

As a result of the above discussion, 52 Pa. Code §§57.73(7) and (8) were changed to read as follows (emphasis added):

(7) a description of any studies which had been made as to the projected environmental impact of the HV line as proposed and of the efforts which have been and which will be made to minimize the impact of the HV line upon the environment and upon scenic and historic areas, including but not limited to impacts, where applicable, upon land use, soil and sedimentation, plant and wildlife habitats, terrain, hydrology, and landscape;

(8) a description of the efforts of the applicant to locate and identify any archaeological, geologic, historic, scenic, or wilderness areas of significance within two miles of the proposed right-of-way and the location and identity of such areas discovered by the applicant;

8 Pa.B. 1407.

No change was made at that time to 52 Pa.
Code §57.75(d) (related to hearings). 8 Pa.B. 1408.

Further modification to the Commission's siting regulations included a renumbering of Sections 57.73(7) and (8) as Sections 57.72(c)(7) and (c)(8), respectively, and an expansion of Section 57.75(d)(3) which the Commission

rearranged, and added to, . . . so that it includes all of the possible environmental impacts included in what shall become §57.72(c)(7) and (c)(8) (old §57.73(7) and (8)).

12 Pa.B. 1772 (emphasis added).

Section 57.75(d)(3) of the siting regulations, renumbered as Section 57.75(e)(3) now read:

(d) At hearings held under this section, the Commission will accept evidence upon, and in its determination of the application it will consider, inter alia, the following matters:

* * *

(3) The impact and the efforts which have been and will be made to minimize the impact, if any, of the proposed HV line upon the following:

- (i) Land use.
- (ii) Soil and sedimentation.
- (iii) Plant and wildlife habitats.
- (iv) Terrain.
- (v) Hydrology.
- (vi) Landscape.
- (vii) Archeologic areas.
- (viii) Geologic areas.
- (ix) Historic areas.
- (x) Scenic areas.
- (xi) Wilderness areas.

12 Pa.B. 1781-1782 (legislative notation omitted).

One final modification to 52 Pa. Code §57.75(e)(3) concerning topics for hearing was made at the request of the Department of Environmental Resources which requested that the item "scenic rivers" be added to the list. To enhance DER's implementation of the Scenic Rivers Act, the Commission approved the requested addition. 13 Pa.B. 133.

Considering that the original purpose of Sections 57.72(c)(7) and 57.75(e)(3) was to assure that the Commission be provided with information which would allow it to carry out its constitutional obligation to protect the natural resources of Pennsylvania, a public interest issue, it stretches credibility to contend that the inclusion of the terms "land use" and "landscape" in the siting regulations allows the Commission to consider a purely private financial concerns like the market value of an individual property. While the Commission may examine the environmental impact of the proposed line on an individual property which will be physically burdened with the line's presence, and on adjacent properties as to aesthetics and safety,^{12/} Prosecutory Staff does not believe that the intent behind the above-cited regulations permits the Commission to assess damages (decrease in market value) as a result of that environmental impact on

^{12/} See, Pennsylvania Environmental Services, Inc. v. Pa. Department of Environmental Resources, 94 Pa. Commonwealth Ct. 182, 189, note 9, 503 A.2d 477, 480, note 9 (1986).

property which will be physically burdened with the line or a fortiori, on property adjacent to the line.

- C. The reconstruction of Conrail's 138kV line as the Woodbourne-Heaton 230kV line will not adversely affect property values in the area adjacent to the transmission corridor.

The Protestants, although advised by the Commission in its remand order of March 8, 1991 that it had no authority to consider the impact of the reconstruction of the Woodbourne-Heaton 230kV line on their property values, nevertheless submitted such evidence into the record by their testimony and that of one of their expert witnesses, a land use planner, Ronald C. Turner. Similarly, PECO presented evidence on the line's potential for affecting property values through the testimony of one of their experts, land use planner James M. Silva.

Assuming, arguendo, that the Commission has the authority to consider off-site impact of a transmission line on the market value of adjacent properties, a review of the record evidence establishes that the Woodbourne-Heaton 230kV line will have minimal, if any, impact on property values adjacent to the line.

Although Mr. Turner testified that property values could be expected to decrease by up to 25 percent after the Woodbourne-Heaton 230kV line is energized (N.T. 571), on cross,

it was revealed that he reached this conclusion based on general articles which he admitted he did not fully read (N.T. 569, 570); and upon articles which actually contradicted his position (N.T. 572-573, 575-582).

Moreover, Witness Turner's conclusion that fear of alleged EMF adverse health effects would drive down market values in the area bordering the Conrail/PECO corridor is suspect. He testified that his opinion was based on his listening to the testimony of PAUSE members in this proceeding (N.T. 563) and "public" interviews conducted with members of PAUSE (N.T. 564-565). It is clear from the record in this proceeding that the PAUSE organization is highly biased in its position linking EMF and adverse health effects as seen through the organization's failure to provide its members with any articles which state that EMF present no risk or minimal risk of health problems (N.T. 495). For this reason, the basis for Turner's opinion about the fear of EMF having an adverse effect on property values is questionable.

In contrast, PECO's representative presented testimony directly related to the realities of land use in the transmission line corridor (PECO Rebuttal Statement No. 5). PECO Witness Silva explained that the towers, which Turner described as "a threatening element in transmission lines" (Protestants No. 1, p. 5) had been on this corridor since 1938, which is well before the Protestants purchased their homes (See Proposed Finding of Fact No. 3, p. 37) and well before PECO

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began rebuilding the Conrail 138kV line as the Woodbourne-Heaton 230kV line (PECO Direct No. 1, p. 4). In fact, 208 of the original 238 tower structures were used by PECO in constructing the line (PECO Direct No. 1, p. 4). It is expected that the original purchase price of the Protestants' property reflected not only the presence of the towers of Conrail's 138kV electric line, but of the railroad itself (PECO Rebuttal Statement No. 5, p. 13).

Moreover, the long term continuing presence of a high speed freight railroad in this corridor is a highly intrusive public use which could continue to affect property values in the area (PECO Rebuttal Statement No. 5, p. 14). Therefore, it is reasonable to assume that property values reflected by the real estate market in the area will not be adversely affected by the energization of the Woodbourne-Heaton line -- any diminution in value having already been reflected in the price initially paid by Protestants for their properties (PECO Rebuttal Statement No. 5, p. 14).

- II. The Public Utility Commission should adopt the concept of prudent avoidance as a policy for dealing with public concern over the alleged adverse health effects associated with exposure to electromagnetic fields from electric transmission lines.

"Prudent avoidance" is a concept which initially appeared in a report produced by researchers at Carnegie-Mellon University for the U.S. Office of Technology Assessment in 1989

(PECO Rebuttal Statement No. 5, pp. 8, 15). Prudent avoidance was also described in a brochure distributed by Carnegie-Mellon University (PECO Rebuttal Statement No. 5, p. 15.^{13/}

Prudent avoidance is, in the context of managing electromagnetic fields from transmission lines, the strategy of making minimal cost modifications in the design and siting of transmission lines that will help reduce EMF exposure to the public (PECO Rebuttal Statement No. 6, p. 18). The decision to exercise prudent avoidance is based on the recognition that adverse health effects have not been demonstrated and that changes in electric and magnetic field levels achieved through its exercise may have little or no effect on health (PECO Rebuttal Statement No. 6, pp. 15-16).

According to Carnegie-Mellon's brochure, "Electric and Magnetic Fields from 60 Hertz Electric Power: What do we know about possible health risk?", prudent avoidance is properly exercised when there is some basis for concern, but no definite establishment of a risk (Electric and Magnetic Fields, p. 24; emphasis added):

What can be done? What should be done?

First, continue and expand research,
focusing especially on issues of human

^{13/} This brochure was also listed as a reference in the written testimony of Protestants' witness Ronald C. Turner (Protestants Statement No. 1, p. 3, note 2).

health so we can have some clear answers. Almost everyone who has thought carefully about the issues of 60HZ fields agrees that this is needed.

* * *

Second . . . well, here things get difficult. It would be nice if we could spell out clear conclusions about actions. We can't. The reason is that science is not complete enough today to support such conclusions. Anything more we can say will go beyond science and involve judgments and values.

Basically there are three approaches available:

1. Conclude there is not yet enough evidence to warrant any action.

* * *

2. Conclude that there is some basis for concern. Adopt a position of "prudent avoidance," which means limiting exposures which can be avoided with small investments of money and effort. Don't do anything drastic or expensive until research provides a clearer picture of whether there is any risk and, if there is, how big it is.

3. Conclude we have a real problem and spend some time and money on an aggressive program of limiting field exposures now, while recognizing that we may eventually learn that some or all of this effort and money has been wasted either because it wasn't needed or we spent it the wrong way because we didn't understand the science well enough to spend it effectively.

From the above passage, it should be clear that the application of prudent avoidance is not the recommended approach in the face of a "real problem", i.e., an established risk. However, as a policy, the adoption of the strategy of prudent avoidance allows transmission lines to go forward in the face of obvious scientific uncertainty. Prudent avoidance does not counsel that electric lines not be built or not be energized (PECO Rebuttal Statement No. 6, pp. 18-19). As such, adoption of prudent avoidance as a policy by the Commission would allow electric utilities to continue building, upgrading and reconstructing electric facilities consistent with an electric utility's obligation to fulfill its statutory duty to furnish and maintain adequate, efficient, safe and reasonable service and facilities for the accommodation, convenience and safety of its employees and the public. 66 Pa. C.S. §1501.

As an approach to prudent avoidance, Prosecutory Staff favors its application on a case-by-case basis whereby an electric utility must use its expertise in system planning, line route and line design to propose a new, upgraded or replacement line which will allow for reduced levels of electromagnetic field exposure through modest cost efforts. We believe this approach is consistent with Pennsylvania case law which allows the selection of a transmission line route and design of the facilities to be left to the electric utility with review of the reasonableness of the decision left to the

Public Utility Commission. Stone v. Pa. PUC, 192 Pa. Superior Ct. 573, 162 A.2d 18 (1960); Re Proposed Electric Regulation, 49 Pa. PUC 709, 710-711 (1976).

In this proceeding, a "similarity based" approach to prudent avoidance was discussed in which the strength of electric and magnetic fields from specific transmission lines, new lines or those being rebuilt or upgraded, must be kept similar to other transmission lines in the same category (PECO Rebuttal Statement No. 6, p. 18). This approach was adopted by regulation in Florida and New York in their establishment of electric field exposure limits at the edge of the right-of-way (PECO Rebuttal Statement No. 6, p. 18). The Prosecutory Staff does not support adopting this approach because of the potential for utilities to do only what is required to meet the upper exposure limit for any given line.^{14/} However, we do see the value in comparing EMF field strengths from specific lines with those from typical lines so that individual efforts at exercising prudent avoidance can be evaluated in the context of the typical line.

^{14/} Prosecutory Staff notes that a "similarity based" approach to prudent avoidance was taken by the ALJ Robert P. Meehan in Application of West Penn Power Company for authorization to locate and construct the Penn Loop 138kV transmission line located in Westmoreland County, Initial Decision issued September 9, 1991 at Docket No. A-111250F037.

Prosecutory Staff also rejects the concept of charging utilities an exposure fee based on the number of people who will be living and working in proximity to the line.^{15/} The rationale for the fee is that the utility will be forced through fear of financial penalty to select a route which will potentially expose the fewest number of people to the line (N.T. 1361). In our opinion, the charging of an exposure fee does not reduce the amount of EMF field exposure to people living near the electric facility and results in increased costs translatable into increased rates for electrical service for all ratepayers. Moreover, the fee does not compensate for or mitigate the necessity for the application of the prudent avoidance methodology discussed heretofore.

III. The location and design of the Woodbourne-Heaton 230kV line is consistent with the concept of prudent avoidance.

Despite the fact that the Commission has not formally adopted the strategy of prudent avoidance as a policy in electric transmission line siting applications, the location and design selected for PECO's Woodbourne-Heaton 230kV line is

^{15/} The idea of an exposure fee was discussed during cross-examination of PECO's witness, James M. Silva (N.T. 1352-1363). These fees would be used for 60HZ health effects research (N.T. 1362).

fully consistent with the concept, which is to take modest efforts to reduce EMF exposure to the public.

As a strategy, prudent avoidance suggests that the number of people exposed to a transmission line be reduced. The record below establishes that the PECO/Conrail transmission line railroad corridor is nearly linear, thereby reducing the number of people who will be potentially exposed to electromagnetic fields from this line (PECO Rebuttal Statement No. 6, p. 17). Moreover, the land use surrounding the line corridor is per se compatible with the adjacent electric utility use; in fact, 78 percent of the area is not used for residential use, but for industrial, transportation, commercial, utility, institutional, open space or vacant land purposes, which again reduces the number of people in the region's population who will be exposed to EMF (PECO Rebuttal Statement No. 5, p. 13). Most importantly, re-use of an existing utility corridor, around which coordinated land use growth has already occurred, also eliminates the need to create a new utility corridor which would be disruptive to existing land uses such as high density residential areas, and which could potentially expose a greater number of people to electromagnetic fields from the transmission line (PECO Rebuttal Statement No. 5, pp. 12, 13 and 16; PECO Rebuttal Statement No. 6, p. 17).

Prudent avoidance also suggests that the EMF levels to which people are exposed be reduced. The design selected for the wiring configuration of the Woodbourne-Heaton 230kV Line -- the compact delta configuration -- will reduce the EMF from the line as will the "phase rolls" which have been incorporated into the line to reduce electrical interference with the railroad's communications system (PECO Rebuttal Statement No. 6, p. 17). Calculations done to estimate the levels of EMF expected from the line^{16/} suggest levels similar to those from other 230kV lines, and such levels are, in fact, within the range that people routinely encounter in their daily activities (PECO Rebuttal Statement No. 6, pp. 18, 19).

As cost is a significant consideration in prudent avoidance, the use of the compact delta configuration resulted in the most significant EMF reduction at the least cost (N.T. 11). Moreover, as a result of using the existing structures on Conrail's right-of-way, which were appropriate for the use of the compact delta configuration, PECO ratepayers saved \$2.5 million on construction of the project (PECO Direct No. 1, p. 6).

^{16/} In determining whether the principles of prudent avoidance were followed in designing and siting PECO's Woodbourne-Heaton 230kV line, no importance should be placed on the fact that the calculations on the levels of EMF expected from EMF were not done until the discovery stage of this hearing. This is so because the calculations only verified what PECO's engineer already knew -- that EMF levels from the compact delta configuration would be lower than those from other designs (N.T. 11).

Considering the totality of the circumstances, PECO's Woodbourne-Heaton 230kV Line is consistent with the principles of prudent avoidance.

Parenthetically, Prosecutory Staff wishes to note that PECO or any utility voluntarily applying principles of prudent avoidance in designing its lines, or referencing the concept in materials distributed as part of a public relations campaign does not translate into an admission on the part of the utility that EMF is an established safety risk. See Argument II, pp. 30-31. However, even if it can be argued that the act of PECO's applying prudent avoidance in designing the Woodbourne-Heaton line evinces an acknowledgment that there is some concern about the EMF issue, the existence of a concern is not enough to deny PECO's letter of notification. Under 52 Pa. Code §57.76(a)(2), the line must pose an unreasonable risk of danger to the health and safety of the public before the line can be disapproved. Because the record does not contain any evidence to support the Protestants' allegation that EMF is at present an established public health and safety risk, it cannot be properly concluded as a matter of law that the Woodbourne-Heaton line would pose an unreasonable risk of danger.

PROPOSED FINDINGS OF FACTS

Protestants

1. The Protestants do not own property in the right-of-way of PECO's Woodbourne-Heaton 230kV Line (N.T. 98, 130-131, 143, 151, 156, 160, 164, 165, 180, 188, 194, 196, 199, 219, 229, 238, 251, 258, 268, 438, 462, 466, 475, 482 and 488; PECO Direct No. 1, p. 5).

2. Protestants' property lines vary from a distance of 37 feet to in excess of 200 feet distance from the line, the closest measurement being at one corner of Protestant Matirko's property (N.T. 98, 130-131, 143, 151, 180, 196, 199, 219, 229, 238, 251, 270, 438, 488).

3. The majority of the Protestants, who testified about the length of time they owned their properties, have owned their properties for more than four years. Protestant Glathorn owned her property for the longest period of time -- 19 years. (N.T. 139-140, 164, 165, 186, 209, 222, 237, 263, 438).

4. The majority of Protestants have garnered their information about EMF and adverse health effects from television news reports, newspapers, magazine articles and literature distributed by P.A.U.S.E. (N.T. 111-112, 125, 139, 147, 162, 166, 173, 222, 260, 441, 483, 490, 494).

5. PAUSE has not distributed any literature to Protestants which does not state that there is not a health risk, or a slight health risk associated with EMF (N.T. 495).

6. Protestants expressed concern about EMF from the line causing adverse health effects in themselves and their families (N.T. 126, 139, 155, 167, 184-185, 201-203, 234, 253, 260, 265, 274, 440, 447, 471, 484, 490).

7. Protestants indicate that because of their concerns about EMF and health effects, they practice prudent avoidance in their homes by changing the location of alarm clocks and television sets and the manner in which they use appliances to reduce EMF exposure (N.T. 139-141, 148, 162, 197, 204, 217, 234, 244, 278, 446, 471, 476, 489).

8. Protestants indicate that if the Woodbourne-Heaton 230kV line is energized, they would practice prudent avoidance by selling their homes (if they could) and moving away (N.T. 129, 133, 206, 234, 235, 242, 244, 255-256, 261, 278-279, 439, 452, 476, 483, 491).

9. The named Protestant Robert Small's property is adjacent to the Conrail right-of-way and the transmission line is 45 to 50 feet from his property line (N.T. 270).

10. The named Protestant Robert Small does not own any property in the right-of-way of PECO's Woodbourne-Heaton 230kV line (N.T. 270).

11. Trees on Robert Small's property were mistakenly removed by crews clearing the right-of-way for the PECO line (N.T. 271, 282-283).

12. By way of compensation for the lost trees, PECO came to an agreement with Robert Small's wife, Jill, whereby PECO's work crew took down two or three dead trees in the Small's backyard and cut the wood into fireplace-size pieces (N.T. 282-284, 286-289; PECO's Cross Examination Exhibit No. 1).

Woodbourne-Heaton Line

13. The former Conrail electric 138kV transmission line was de-energized in 1986 and the 6,600 volt signal power feeder was de-energized in January 1991 (PECO Direct No. 1, p. 4).

14. Conrail quit using electric trains on this rail line in 1981 and the catenary wires were removed in 1986 (PECO Direct No. 1, p. 4).

15. The new 230kV line will be constructed within a 60 foot easement purchase from Conrail which is located within Conrail's property lines (PECO Direct No. 1, p. 5).

16. The Conrail right-of-way is 60 feet wide with the transmission line located at its centerline with 30 feet to either side (N.T. 11).

17. The Woodbourne-Heaton line will use 208 of the original Conrail transmission line 238 structures and will be supported on single poles with 3-phase conductors in the compact triangular (delta) configuration (PECO Direct No. 1, p. 5).

18. The compact delta configuration was used because the existing structural spacing was appropriate for a compact delta configuration (PECO Direct No. 1, p. 6).

19. Using existing structures saved PECO customers approximately \$2.5 million as compared to total replacement of the structures (PECO Direct No. 1, p. 6).

20. "Phase rolls", an engineering technique to reduce the interference between transmission facilities and nearby communication facilities, were incorporated into the design of the line at various locations and will result in lower magnetic field exposure (PECO Direct No. 1, pp. 6-7; PECO Rebuttal Statement No. 6, p. 17).

21. The electric fields expected to be generated by the Woodbourne-Heaton 230kV line using the compact delta configuration would be 1.87kV/m in the middle of the right-of-way; 1.2kV/m at the edge of the right-of-way and continues to decrease further away from the line; at 300 feet from the right-of-way centerline, the electric field is 0.013kV/m (PECO Direct No. 1, p. 7).

22. Magnetic fields from the Woodbourne-Heaton 230kV line will be dependent on loading on the line:

a) at emergency minimum loading when the line is de-energized for an emergency or maintenance reasons and expected current flow is 0 amperes, there is no magnetic field because there is no current on the line;

b) at "light" loading where the expected current flow is 180 amperes, maximum magnetic field at the middle of the right-of-way would be 21 milligauss, and at the edge of the right-of-way would be 13 milligauss;

c) at "normal" loading when the expected current flow is 360 amperes, maximum magnetic fields expected at the middle of the right-of-way is approximately 42 milligauss and at the edge of the right-of-way would be 25 milligauss;

d) at "heavy" loading when the expected current is 600 amperes, the magnetic field at the middle of the right-of-way is expected to be 70 milligauss and at the edge of the right-of-way approximately 42 milligauss; and,

e) at the "emergency maximum" loading, conditions (where another transmission line in the PECO system would be de-energized because of emergency situation and the expected current flow would be 1000 amperes), the maximum magnetic field at the middle of the right-of-way is expected to be 117 milligauss and at the edge of the right-of-way approximately 70 milligauss (PECO Direct No. 2, pp. 8-9).

23. "Light" and "normal" loading of the line would represent 90% of the expected loading on the line according to PECO's system planners (N.T. 71).

24. "Emergency maximum" loading on the line was not expected to exceed four hours per year (PECO Direct No. 2, p. 8).

25. The Woodbourne-Heaton 230kV line has been designed and constructed and will be maintained in accordance with the National Electrical Safety Code (PECO Direct No. 1, p. 8).

EMF in General

26. All 60HZ electric devices, including power lines and household appliances produce electric fields and magnetic fields (PECO Rebuttal Statement No. 6, p. 8).

27. Hertz (HZ) is a unit of frequency which relates to the number of alterations or cycles of a wave during a period of time. For a static field, the frequency is 0HZ. (PECO Rebuttal Statement No. 6, p. 9).

28. The term 60HZ means 60 cycles per second and for alternating current (AC) electric power lines the voltage and electric current reverse polarity, or direction, at a rate of 60 cycles per second (PECO Rebuttal Statement No. 6, p. 9).

29. The earth has a static or DC electric field of about 0.15kV/m; static electric fields can also result from taking off a sweater or walking across a carpet. Induced body voltages as high as 4,000 volts (4kV) and 8,000 volts (8kV) have been measured from walking across a carpet (PECO Rebuttal Statement No. 6, p. 8).

30. The earth has a static magnetic field and in southeastern Pennsylvania, the earth's magnetic field is about 560 milligauss (PECO Rebuttal Statement No. 6, pp. 8-9).

31. Most environmental exposures to electric fields are less than 8 kilovolts per meter and to magnetic fields are less than 5,300 milligauss (OCA Statement No. 1, p. 3).

32. Electric fields are the fields associated with the voltage on the conductors of an electric power line or device. The fields decrease with distance from the source and are easily shielded by objects such as trees (PECO Rebuttal Statement No. 6, p. 9).

33. Magnetic fields are measured in units of milligauss and are associated with the flow of electric current on electric lines or devices. Magnetic fields decrease with distance away from the source and are not easily shielded by objects such as trees (PECO Rebuttal Statement No. 6, p. 10).

34. Electric and magnetic fields exist whenever electricity is present; power lines, appliances and internal home and business wiring all generate EMF (PECO Direct No. 2, pp. 4-5).

35. Fields associated with electric transmission lines are sinusoidal in nature (PECO Rebuttal Statement No. 4, pp. 6, 16; N.T. 769-770).

36. Electromagnetic fields from electric transmission and distribution lines are non-ionizing because they have energies which are too small to produce ionization, the process by which fields of higher energy remove electrons from the atoms and molecules of biological cells and tissues (OCA Statement No. 2, p. 6).

37. Although people are exposed to appliances for a relatively short period of time while they are in use, people move from one activity to the next and from one location to another, each having their own sources of electric and magnetic fields. Subsequently, people are exposed to a continuous or almost continuous range of exposures in a typical day (PECO Rebuttal Exhibit No. 6, p. 12).

38. At 1.2 inches, a microwave oven generates magnetic fields from 750 to 2,000 milligauss; at 12 inches, the magnetic field drops to 40 to 80 milligauss and at 39 inches, the magnetic field is 3 to 8 milligauss. The magnetic field from an electric range at 1.2 inches is 60 to 2,000 milligauss; at 12 inches, 4 to 40 milligauss; and at 39 inches 0.1 to 1 milligauss. For a hair dryer, the magnetic field at 1.2 inches is 60 to 20,000 milligauss; at 12 inches, 1 to 70 milligauss and at 39 inches, the field drops to 0.1 to 3 milligauss. For a television, the magnetic field at 1.2 inches is 25 to 500 milligauss; at 12 inches the field is 0.4 to 20 milligauss and at 39 inches is 0.1 to 2 milligauss (PECO Direct No. 1, p. 5).

EMF and Biological Effects

39. There is not enough information to know whether these very low frequency electromagnetic fields are dangerous to people and which of their characteristics might be dangerous (N.T. 360; PECO Rebuttal Statement No. 2, p. 28; PECO Rebuttal Statement No. 3, p. 23; PECO Rebuttal Statement No. 4, p. 21).

40. Although biological effects are observed to be associated with EMF exposure, no connection between EMF exposure and human cancer has been proven (N.T. 368; OCA Statement No. 1, p. 10).

41. Electric field strengths several times greater than the threshold for perception may cause an initial arousal response in animals. However, this response fades rapidly and the animals habituate to such fields. Chronic exposure to such fields causes no obvious abnormality in neurologic function or behavior. There is no evidence at this time that such fields elicit a stress response (PECO Rebuttal Statement No. 1, p. 26).

42. There is no evidence at this time that power frequency electric or magnetic fields alter intracellular calcium levels or that calcium acts as a transducer of EMF effects on nerve, endocrine or immune cells (PECO Rebuttal Statement No. 1, p. 26).

43. There is no scientific basis at this time to conclude that power frequency electric or magnetic fields have any significant effects on circadian rhythms involving body functions or critical pituitary hormones (PECO Rebuttal Statement No. 1, p. 26).

44. At the present time, immune cell viability and function is not significantly affected by exposure to EMF and no adverse effects have consistently been demonstrated in intact animals (PECO Rebuttal Statement No. 1, p. 27).

45. At the present time, there is no basis to conclude that power frequency electric and/or magnetic fields have adverse effects on the health and function of the endocrine or immune systems (PECO Rebuttal Statement No. 1, p. 27).

46. There is adequate experimental data to show that EMF do not adversely affect complex endocrine system function needed for successful reproduction, growth or development (PECO Rebuttal Statement No. 1, p. 27).

47. Taken together, the epidemiologic reports fail to demonstrate any strong or consistent pattern of association between EMF and cancer among human beings. Therefore, to date, no demonstrated relationship between EMF and cancer in human beings is established (PECO Rebuttal Statement No. 2, p. 28; OCA Direct Statement No. 2, pp. 3-4, line 11 to p. 5, line 11).

48. The extensive research on molecular and cellular biology and cancer provides no scientific basis at this time to conclude that power frequency electric and/or magnetic fields cause, promote, or contribute to the development of cancer or other adverse health effects (PECO Rebuttal Statement No. 3, p. 22).

49. Ionizing radiation is at the extremely high end of the electromagnetic spectrum and this type of field is capable of transmitting very large amounts of energy sufficient to break chemical bonds in the molecules of the cell. This type of radiation can kill or damage a cell (PECO Rebuttal Statement No. 4, p. 10).

50. The energy in power frequency fields (60HZ fields) is much less than one-trillionth of that found in ionizing radiation, which is not enough to break chemical bonds in the cells like ionizing radiation (PECO Rebuttal Statement No. 4, p. 10).

Ion Cyclotron Resonance Theory

51. In science, the initial step in establishing new scientific paradigms or concepts is the hypothesis, which can be tested by experimentation and experimental replication and critiqued against a background of the body of experimental work done and established scientific principles (N.T. 426, 762-768, 783).

52. The ion cyclotron resonance is a hypothesis which attempts to identify a mechanism to explain the biological effects which are seen in certain experiments involving EMF exposure of whole animal or cells or tissue (Protestants Statement No. 2, p. 5; N.T. 783).

53. The ion cyclotron resonance hypothesis theorizes that the certain specific combinations of DC (direct current) and AC (alternating current) magnetic fields can act to put ions such as calcium, potassium and magnesium into resonance states and thereby influence their transport in and out of the cell (Protestant's Statement No. 2, p. 5; N.T. 783).

54. In function, the ion cyclotron resonance hypothesis explains that the biological effects observed as a result of exposure to 60HZ fields is dependent on local DC magnetic field, the local geomagnetic field (Protestant's Statement No. 1, p. 5; N.T. 877, 880).

55. The body of experiments conducted, when taken as a whole, have not proven that the ion cyclotron resonance hypothesis is valid (PECO Rebuttal Statement No. 4, p. 20; N.T. 425-427).

56. The ion cyclotron resonance theory is inconsistent with the way ions actually act in the human body (PECO Rebuttal Statement No. 4, pp. 18-20).

57. The ion cyclotron resonance theory has no implications for human health (PECO Rebuttal Statement No. 4, p. 20).

Property Values and Land Use

58. From a land use prospective, the Woodbourne-Heaton 230kV line is compatible with the existing land uses along the Conrail corridor in that 78% of the area is currently used for industrial, transportation, commercial, utility, institutional, open space or vacant land purposes (PECO Rebuttal Statement No. 5, p. 13).

59. The remaining 22% of the land use inventory along the Woodbourne-Heaton 230kV line is presently used for low density residences. The residential uses were developed in the immediate context of the existing rail utility corridor, on which transmission line poles and wires already existed. Therefore, past and current market valuations for property in the area already include market effects for proximity to a utility corridor for an active freight line (PECO Rebuttal Statement No. 5, pp. 13-14).

60. From a land use planning perspective, it would not be expected that re-energization of electric facilities on the corridor after a short hiatus would cause further market compensation (PECO Statement No. 5, p. 14).

61. Because of the high speed freight Conrail rail line, which is a highly intrusive land use, property values of property adjacent to the transmission line/Conrail corridor should not undergo further reduction in market value (PECO Rebuttal Statement No. 5, p. 14).

62. Present or further adverse land use impacts from energization of the transmission line is minimal and most likely to be inconsequential (PECO Rebuttal Statement No. 5, pp. 15, 16).

Prudent Avoidance

63. Prudent avoidance is a concept which was described by researchers at Carnegie-Mellon University in a 1989 report sponsored by the Congressional Office of Technology Assessment (OTA) and a brochure distributed by Carnegie-Mellon University (PECO Rebuttal Statement No. 6, p. 14).

64. The concept of prudent avoidance suggests modest efforts to reduce field exposure, and should be understood to be oriented toward that result rather than toward any required method of achieving that result. Prudent avoidance is a

concept that recognizes that a scientific determination cannot be made that changes in EMF levels will have any effect on health, and thus prudent avoidance advocates only a modest effort in making such changes (PECO Rebuttal Statement No. 6, pp. 15-16, 18).

65. Mitigative measures that should be considered in practicing prudent avoidance may include: a) avoiding heavily populated areas; b) avoiding parks, schools and other public facilities; c) widening rights-of-way; d) limiting public use of rights-of-way; e) using higher ground clearances and f) designing the power lines to reduce fields (OCA Statement No. 2, p. 7).

66. One approach to prudent avoidance is known as the "similarity-based" approach where levels of EMF from specific transmission lines are kept similar to levels of EMF from other transmission lines in the same voltage category. This approach was used in New York and Florida (PECO Rebuttal Statement No. 6, p. 18).

67. The "similarity-based" approach recognizes the assumption that the aspect of EMF exposure which may be important in regard to health is not known (PECO Rebuttal Statement No. 6, p. 18).

68. Typical high voltage transmission lines have a maximum electric field strength on the right-of-way from approximately 1 to 12km per meter and fields at the edge of the right-of-way from 0.3 to 3 kilovolts per meter (OCA Statement No. 1, p. 3).

69. Typical high voltage transmission lines have magnetic fields in the range of 20 to 140 milligauss, and maximum values which do not exceed 350 milligauss (OCA Statement No. 1, p. 3).

70. The electric and magnetic fields that will be associated with the Woodbourne-Heaton line are in the same levels as other typical 230kV transmission lines, and therefore consistent with the similarity-based approach to prudent avoidance (PECO Rebuttal Statement No. 6, p. 19).

71. The design of the Woodbourne-Heaton 230kV line comports with the concept of prudent avoidance in that through modest cost design changes, lower EMF is achieved. The line design is a compact delta (or triangular) configuration which produces lower fields than other typical configurations. Phase rolls used to mitigate induction effects on railroad tracks and Conrail communication systems will also result in lower magnetic fields (PECO Rebuttal Statement No. 6, p. 17).

72. The routing of the Woodbourne-Heaton 230kV line comports with the concept of prudent avoidance. The use of an existing utility corridor previously used for an electrified railroad and currently used by a diesel railroad avoids creation of a new utility corridor reducing exposure to the public. As to cost, the near linear route and the re-use of existing Conrail electric structures which are conducive to the compact delta configuration for line design with phase rolls, are also consistent with principles of prudent avoidance (PECO Rebuttal Statement No. 6, pp. 16-17).

PROPOSED CONCLUSIONS OF LAW

1. The Commission has jurisdiction over the parties and the subject matter of this proceeding.

2. The Protestants will not be adversely affected by the reconstruction of the former Conrail Line as the Woodbourne-Heaton 230kV Line.

3. The Letter of Notification filed by Philadelphia Electric Company comports with precepts of the concept of prudent avoidance.

4. The Letter of Notification filed by Philadelphia Electric Company substantially complies with the Commission's siting regulations at 52 Pa. Code §57.71, et seq.

PROPOSED ORDERING PARAGRAPHS

In consideration of the foregoing, IT IS ORDERED:

1. The Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval is hereby denied.

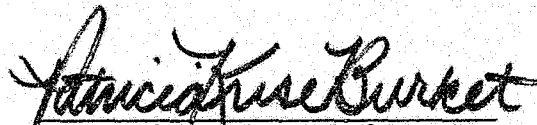
2. The transmission line must be operated and maintained in accordance with the National Electrical Safety Code.

3. The transmission line must be operated and maintained in compliance with all applicable statutes and regulations for the protection of the public and the natural resources of the Commonwealth.

CONCLUSION

WHEREFORE, as the Protestants have not shown that they will be adversely affected in any way by the reconstruction of the former Conrail 138kV transmission line as PECO's Woodbourne-Heaton 230kV line, Prosecutory Staff respectfully requests that the Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval, filed September 14, 1990 be denied, that no further hearings be held in this proceeding and that the Commission reaffirm its February 3, 1990 order approving Philadelphia Electric Company's Letter of Notification in the above-captioned proceeding.

Respectfully submitted,



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Dated: April 20, 1992

CERTIFICATE OF SERVICE

I hereby certify that a copy of the Main Brief of the Prosecutory Staff and Supplement A have been served on this date on the following persons in the manner indicated below:

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A handwritten signature in cursive script, reading "Patricia Krise Burket". The signature is written in dark ink and is positioned above a horizontal line.

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Pennsylvania Public Utility Commission
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DATE: April 20, 1992

MPK

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION OF :
PHILADELPHIA ELECTRIC COMPANY :
RELATIVE TO RECONSTRUCTING AND : Docket No.
REBUILDING OF THE EXISTING : A-110550, F.055
138KV LINE TO OPERATE AS A :
WOODBOURNE-HEATON 230KV LINE :

DOCUMENT
FOLDER

DOCKETED
DOCKETED
APR 22 1992

APPENDIX TO
MAIN BRIEF OF
THE COMMISSION
LAW BUREAU PROSECUTORY STAFF

SUMMARY OF RECORD EVIDENCE

RECEIVED

APR 20 1992

SECRETARY'S BUREAU
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SUMMARY OF TESTIMONY

RONALD J. OEDEMANN - Direct Testimony

Ronald J. Oedemann, a senior engineer with PECO, sponsored PECO Direct No. 1 which was a statement of his testimony on cross examination (N.T. 5-8).

Oedemann explained that he was Lead Project Engineer for the line and was responsible for coordinating all aspects of the transmission line including acquisition of the necessary right-of-way, coordination and approval of construction specifications and drawings, assuring all applicable codes are met, specifying material, acquiring necessary permits, coordinating the project with Conrail, coordinating project schedule and costs and monitoring construction (PECO Direct No. 1, p. 3).

Oedemann then described the Woodbourne-Heaton 230kV line as connecting two substations, the Woodbourne substation in Middletown Township, PA and the Heaton substation in Upper Moreland Township, PA, and as being built on an existing Conrail right-of-way and existing PECO property (Id., p. 4).

Oedemann then described the former Conrail line which was being rebuilt by PECO (Id., p. 4). He stated that the electrification system, including the 138kV transmission line, a major substation, 11kV catenary (overhead supply to the locomotive) wires, and a 6,600 volt signal power system, was placed in service in 1938 (Id., p. 4). Conrail quit using

electric locomotives on this line in 1981 and the catenary wires were removed in 1986 (Id., p. 4). He then explained that the 138kV transmission line was de-energized in 1986 and the 6,600 volt signal power feeder was de-energized in January, 1991 (Id., p. 4).

Oedemann then explained of the existing 238 structures, 208 of them were being used by PECO for the Woodbourne-Heaton transmission (Id., p. 4). He explained that 30 new structures were required to replace existing railroad structures which could not be utilized for PECO's line and that 5 new additional structures were required to be erected on an adjacent PECO property for the Line (Id., p. 4). Oedemann explained that the 230kV line was located within the existing railroad right-of-way, utilizing the "common corridor" approach, and required no condemnation of property (Id., p. 5). Oedemann stated that the line itself would be constructed within a 60 foot easement purchased from Conrail which is located within Conrail's property lines (Id., p. 5).

Oedemann said the line would be supported on single steel poles with 3 phase conductors in a compact triangular (delta) configuration and a ground wire (designed for lightning protection) attached to the top of the structure (Id., p. 5). Oedemann explained that the compact delta configuration was used because the existing structures were 300 feet apart and the distance was appropriate for a compact delta configuration (Id., p. 6).

Oedemann also explained that some of the former Conrail structures which were reused for the PECO line needed modification to insure safety and integrity of the line (Id., p. 6). Using existing structures saved PECO customers approximately \$2.5 million as compared to total replacement of the structures (Id., p. 6).

Oedemann also testified that special features were incorporated into the design of the line, specifically, at selected locations "phase rolls" were used on the line (Id., p. 6). Oedemann explained that a phase roll is an engineering technique^{1/} to minimize the interference between transmission facilities and nearby Conrail signal communication facilities (Id., pp. 6-7).

Oedemann also testified that construction on the Woodbourne-Heaton 230kV line began in the Spring of 1990 and is expected to be completed by the Spring of 1992 (Id., p. 7).

As to safety of the instant line, Oedemann explained that the line has been designed and constructed, and will be maintained in accordance with National Electrical Safety Code requirements (Id., p. 8). Oedemann then testified that the Woodbourne-Heaton line meets all requirements of the latest edition (1980) (Id., p. 9).

^{1/} According to Oedemann, a phase roll changes the relative location of all three phases or energized conductors from one supporting structure to another (Id., p. 6).

Oedemann then testified that additional modifications had to be made to the line to accommodate Buehl Field, an airport near the line to eliminate an aviation hazard (Id., p. 10). He explained that nineteen 6,600 volt open wire switches, transformers containing PCB's and access ladders to ground elevation, which were maintained by Conrail as part of its operations, had to be removed (Id., p. 11).

Oedemann then discussed the alternate designs which were considered by PECO in designing the line (Id., p. 11). He explained that the three available alternative designs are (1) "horizontal" (flat), (2) "vertical", or (3) "longer span delta", all of which assume a span length of 600 feet (Id., p. 11). Oedemann explained that none of these three alternative designs could use the existing Conrail structures (Id., p. 12). Moreover, he explained that the "horizontal" and "longer span delta" configurations would necessitate acquisition of additional right-of-way and that none of these designs could be used in the vicinity of Buehl Field because the higher poles which would be required would exceed safe heights for use near an airport (Id., p. 12).

Oedemann then compared the costs of constructing the line using alternative designs with the selected design (Id., pp. 12-13). He estimated that the cost of the project using the "vertical" design to be \$23.9 million, using the "longer span delta" design to be \$22.3 million and using the horizontal configuration to be \$22.1 million in comparison with the cost

of \$19.8 million for the design selected for the project - the "compact delta" configuration (Id., pp. 12-13). He also indicated that he did not believe the alternative designs would provide any safety advantages (Id., p. 13).

Cross-Examination

On cross, Oedemann clarified his testimony regarding the 60 foot easement (N.T. 11). He explained that along the entire 12.8 miles of the right-of-way, the line was centered on the right-of-way, 30 feet on either side (N.T. 11).

When questioned about whether the three alternate line designs discussed in his direct testimony were considered at the time the Woodbourne-Heaton Line was designed, Oedemann answered that they were considered, and in his engineering judgment, the design that was chosen for the line resulted in the lowest cost and resulted in the lowest EMF (N.T. 11).

On being shown OCA Cross Examination Exhibit No. 1, PECO's response to OCA Interrogatory, Set I, No. 8 which stated that no cost information or field calculations were prepared for alternative designs, Oedemann admitted that these were not done at the time, and that the calculations that appeared in his direct testimony were made between the time the interrogatory was answered and when he prepared his direct testimony sometime in July of 1991 (N.T. 12-13).

When questioned about whether any calculations were made about expected EMF from the preferred compact delta design for the line at the time the design was selected, Oedemann

admitted he did not make formal calculations, but he knew from experience that the compact delta design would result in a lower EMF field and took that into account before he selected the design of the line at a time prior to November 1989 (N.T. 20). Oedemann also testified he did not discuss with anyone else the best design for the line to minimize EMF, but based his decision on his professional experience and judgment (N.T. 20-21).

Oedemann also explained the concept of prudent avoidance as it relates to his designing transmission lines as his endeavoring "to build a transmission line that will result in lower fields at a modest increase in cost" (N.T. 23). Oedemann testified that the delta configuration was used on the Woodbourne-Heaton 230 Line because the right-of-way had structures in place and the close spacing of the span lengths between structures required the use of a tight delta formation (N.T. 26). Oedemann also testified that the desirability of minimizing EMF is also considered in selecting a location for a facility (N.T. 30), and is practiced by keeping a line as far as practicable from the edge of an unconstrained right-of-way (N.T. 31).

Oedemann also testified in response to questions on the National Electric Safety Code that he had listed only specific examples of the requirements of the Code in his direct testimony and that the Code did not have any requirements related to considerations of EMF (N.T. 35). He also explained

that he did not consider EMF to be a safety problem, but explained that PECO practices prudent avoidance to minimize EMF exposure because it was concerned about the public in light of the fact that studies made on EMF shows that the evidence is inconclusive that there may be some health risk or health effect due to EMF (N.T. 36).

CHARLES BOEGGEMAN - Direct Testimony

Charles J. Boeggeman, an electrical engineer in PECO's Consulting Services Branch of the Engineering and Design Division of the Transmission and Distribution Services Department, sponsored PECO Direct No. 2 as his direct testimony which concerned electric and magnetic fields expected to be produced by the Woodbourne-Heaton Transmission 230kV Line (N.T. 44). In his testimony, Boeggeman testified that he had been employed as a project engineer and as such designed aerial and underground electric distribution lines (PECO Direct No. 2, p. 1). He also testified that for the next 3 1/2 years he was an equipment and standards engineer, responsible for monitoring and responding to EMF related issues and for the last 2 years, EMF issues were his only responsibility (Id., pp. 1-2). Currently, he explained he provides technical EMF evaluations on existing and proposed electric transmission, distribution and substation facilities; coordinates research efforts at PECO in areas of epidemiology, exposure assessment and EMF management; conducts EMF education programs for PECO employees,

customers and the public; and monitors EMF research and literature (Id., p. 2).

Boeggeman testified that a field is a space or region where an influence can be said to exist and as an example, explained that a campfire has a temperature field around it that decreases as you move away from the fire (Id., p. 4). Boeggeman further explained that electric and magnetic fields exist whenever electricity is present and that power lines, appliances and internal home and business wiring all generate EMF (Id., pp. 4-5).

Boeggeman stated that an electric field is created by voltage and that the higher the voltage, the higher the strength of the electric field (Id., p. 5). He stated that the unit of measure of a magnetic field is the milligauss (MG) (Id., p., 5). He explained that a milligauss is 1/1,000th of a Gauss and gave examples of magnetic fields generated by various appliances at varying distances (Id., p. 5). Boeggeman confirmed that electric and magnetic field strengths decrease as you move away from the source of the fields (Id., p. 6).

Boeggeman also explained that electric and magnetic field strengths from transmission lines can be calculated using computer programs that have been developed for this purpose (Id., p. 6). One program, ENVIRO, was developed by EPRI and was verified for accuracy at EPRI's High Voltage Transmission Research Center in Lenox, Massachusetts (Id., p. 6). Boeggeman testified that ENVIRO is used by utilities worldwide and he used it for calculations used in his testimony (Id., p. 6).

Boeggeman testified about the electric fields expected from the Woodbourne-Heaton 230kV line using the compact delta configuration (Id., p. 7). He testified that the highest electric field level in the middle of the right-of-way will be 1.87 kV/m; at the edge of the right-of-way, the electric field is approximately 1.2kV/m, and the electric field continues to decrease further away from the line (Id., p. 7). According to Boeggeman's calculations, the electric fields at 300 feet on either side of the right-of-way center line is 0.013kV/m (Id., p. 7).

As to the magnetic fields, Boeggman testified that magnetic fields are created by "current" or "amperage" and that magnetic fields from the Woodbourne-Heaton 230kV line will vary depending on a number of factors (Id., p. 7). Boeggeman explained that he made calculations for five different loading conditions of the line: 1) emergency minimum loading when the line is de-energized for an emergency or maintenance reasons and expected current flow is 0 amperes; 2) "light" loading where the expected current flow is 180 amperes; 3) "normal" loading when the expected current is 360 amperes; 4) "heavy" loading when the expected current is 600 amperes and 5) "emergency maximum" situation in which another transmission line in the PECO system is de-energized because of emergency situation and the expected current is 1,000 amperes because the Woodbourne-Heaton line would have to carry the additional load (Id., p. 8). Boeggeman explained he did not expect that the

"emergency maximum" situation would exceed four hours per year (Id., p. 8).

Boeggeman explained that the "emergency minimum" situation results in no magnetic fields because there is no current on the line; and that "light" loading situation results in a maximum magnetic field of approximately 21 milligauss in the middle of the right-of-way and approximately 13 milligauss at the edge of the right-of-way (Id., p. 9). Boeggeman then stated that at "normal" loading, the maximum magnetic field expected at the middle of the right-of-way is approximately 42 milligauss and approximately 25 milligauss at the edge of the right-of-way, and at "heavy" loading, the magnetic field at the middle of the right-of-way is expected to be approximately 70 milligauss and at the edge of the right-of-way approximately 42 milligauss (Id., p. 9). At the "emergency maximum" loading condition, Boeggeman testified that the maximum magnetic field at the middle of the right-of-way is approximately 117 milligauss and approximately 70 milligauss at the edge of the right-of-way (Id., p. 9). Boeggeman then testified that magnetic field levels for all loading scenarios continued to decrease with the distance from the line (Id., p. 9).^{2/}

Boeggeman also testified that using the computer program, he determined electric and magnetic field level

^{2/} These calculations also appear in Table II which was attached to PECO Direct No. 2.

calculations for the three alternative line designs described by Oedemann in PECO Direct No. 1 and presented these figures in Table III of his direct testimony (Id., p. 10). The three designs Boeggeman calculated field level values for were the longer-span delta (triangular), the flat (horizontal) configuration and a vertical configuration (Id., p. 10).

Cross Examination

On cross examination, Boeggeman stated that the fields listed in his testimony from various appliances were produced when the appliance was in use, but one would expect a residual field to be produced by a clock in a microwave oven when the appliance was not in use (N.T. 47). He also stated that under normal loading conditions, that there will be a load of some magnitude on the Woodbourne-Heaton line throughout the day unless the line is out of service (N.T. 48).

Boeggeman also stated that the effects of the magnetic fields from the actual Conrail rails were taken into account in designing the Woodbourne-Heaton Line (N.T. 48). He explained that the phase rolls, which were used to reduce currents on the rails would also reduce any effects on pipelines, which were coincident with the rails (N.T. 49).

In calculating the field levels expected from the Woodbourne-Heaton 230kV Line, Boeggeman stated he used 12 foot phase spacing because he wanted to be more accurate in his testimony (N.T. 50-51). In a prior answer to an OCA interrogatory, he had used 14 foot spacing because the previous

witness Oedemann had used 12 to 15 or 16 foot phase spacing and he wanted to use a middle of the road value (N.T. 51). He also stated that about 90% of the length of the transmission line is represented by 12 foot spacing (N.T. 51).

Boeggeman also clarified his testimony by stating that the comparison of the magnetic fields of the compact delta design and the other three alternatives were taken at mid-span and calculated at maximum sag (N.T. 52). He also explained that maximum sag would not be achieved because it is at maximum conductor temperature (N.T. 52).

In regard to a question about the relative loading of the line, Boeggeman responded that the zero ampere loading on the line would be when the line was out of service for repairs or another reason for a period in any given year from days or weeks depending on the situation (N.T. 70-71). The second two loading scenarios, 180 amperes and 360 amperes represents 90% of the expected loading on the line according to PECO's system planning people, Boeggeman testified (N.T. 71).

In regard to the Woodbourne-Heaton Line, Boeggeman testified that the line design selected comported with concept of prudent avoidance and that it was not necessary to do anything extra to reduce the fields (N.T. 75-76).

EDWARD F. KOERPER, JR. - Direct Testimony^{3/}

Edward F. Koerper, Jr. of 300 Casey Circle, Huntingdon Valley, Upper Southampton Township, Bucks County, Pennsylvania, testified that the proposed Woodbourne-Heaton 230kV Line is 143 feet from his residence and his residence is 63 feet from the edge of the right-of-way (N.T. 97-98). He also stated that his property line adjoins that of Conrail's right-of-way and that PECO's right-of-way is 50 feet beyond his property (N.T. 98). In other words, he stated that the centerline of the transmission line is 80 feet from his property line (N.T. 98-99). Koerper explained that his rear yard abuts the Conrail right-of-way for the entire 200 feet of the rear yard (N.T. 99). Koerper also explained he had two daughters, ages 3 and 4, who play in the backyard (N.T. 100). Koerper further explained that a patio is also present in the backyard which is used for family meals in the summertime (N.T. 100).

Mr. Koerper testified that from his research and reading of information supplied to him by the utility, he believed it was impossible for him to practice prudent avoidance because his "property is going to be constantly encompassed by these fields that [he] cannot shield [his] family from" (N.T. 103). Koerper also stated his concern about

^{3/} It was stipulated that the residents who would testify were not experts on EMF (N.T. 95, 113).

the financial and moral consequences of selling his house to avoid EMF exposure to his family (N.T. 104-109).

Koerper also explained the ontogeny of his concern about EMF: from his first meeting with PECO representatives in August 1990 at the time the project was first begun to his reading of the report on the \$2 million EMF study undertaken by California's Public Utility Commission (N.T. 110-111). He confided that he was not reassured by the study because the study indicated that biological effects were caused by EMFs (N.T. 111-112).

Cross Examination

- In response to question, Koerper expressed his understanding of what prudent avoidance is: to reduce the EMF that we come into contact with in our daily lives because of the "implied implications that they may cause" (N.T. 126). When asked whether prudent avoidance had any economic cost constraints, he sidestepped the question (N.T. 126). Koerper also suggested that the line, if it was to be built in this corridor, be buried, but admitted that if the line was buried it was not his understanding that there will be no EMF (N.T. 126). After being asked about his contention that the right-of-way for the proposed line was not sufficient, Koerper also admitted he was not an electrical engineer and had not designed an electric transmission line (N.T. 126-127).

Redirect

Koerper testified that his house was worth between \$175,000 and \$200,000 (N.T. 129).

MARGARET E. LAWLER - Direct Testimony

Margaret E. Lawler of 1533 Grace Circle in Feasterville, in Lower Southampton Township, Bucks County, testified regarding the relationship of her property to that of previous witness Koerper as being "a mile and a half further north along the line" (N.T. 130). She further testified that her property is adjacent to the line and that the side of her house is along the railroad tracks (N.T. 130). She explained that the edge of her property is 70 feet and her house is 90 feet from the transmission line (N.T. 130-131). She further explained that her children play out back, that there is a porch out back where they eat meals in the summer and the dog is outside all the time (N.T. 131). Lawler explained that she has 3 children: a son, 21 years old and two daughters, 17 and 13 years of age (N.T. 131). She also stated that the family has a basketball net out front in the cul de sac where her children and half the neighborhood children play basketball, soft ball and other street games and ride bikes (N.T. 131-132). She explained that the transmission line is 90 feet to the side of the cul de sac (N.T. 132).

Lawler explained if the power line is energized, she and her family have chosen to move and her house is presently up for sale (N.T. 133). She testified that they had no buyers and the property had been listed three and a half months (N.T. 133). She also testified that she did not reduce the asking price for her property (N.T. 137). As to how her family will practice prudent avoidance up to the time she will be able

to sell her house, Lawler testified that she and her family will spend less time outdoors or even in the area because she stated that fields still go through walls (N.T. 138). Lawler also testified that from information she received through PAUSE and that she read in women's magazines, she believes that it is essential that she "prudently avoid" EMF (N.T. 139). Lawler explained she is used to seeing health conditions, both real and imagined, because she is a registered nurse, who works in a recovery room and intensive care (N.T. 139).

Cross Examination

On cross examination, Lawler testified she bought her house nine years ago and that she and her family still use electricity and electrical appliances in their house (N.T. 139-140). She also agreed that it takes transmission lines like the proposed line to bring electricity to her house and it had to be located somewhere (N.T. 140). In terms of prudent avoidance Lawler practiced in her home, she explained that she quit using her electric blanket two years ago when she became aware of EMF, and she makes sure that she stands away from appliances which are in use (N.T. 1412).

GEORGE L. HENRY - Direct Testimony

George L. Henry of 508 Militia Hill Road of Southampton Township testified that his property was 2 miles east of Koerper's property (N.T. 143). He further testified that the line at issue is located behind his house and that his

property line is approximately 105 feet from the transmission line (N.T. 143). From his house to the transmission line is an additional 60 feet (N.T. 143-144). He testified that he has a 5 year old daughter (N.T. 144). He further testified that his back yard has a swimming pool, and a swingset and he is currently building a combination workshop/garage in his backyard (N.T. 144). He also testified his daughter also plays in her friend Ashley's back yard which is exactly 36 feet, 6 inches from the transmission line (N.T. 145).

When asked how he would change his activities if the line were energized, Henry replied that he would not let his daughter play in her friend's back yard and that he would have his back yard tested, although he admitted that he is not that close to the line (N.T. 145). If there was found to be "an effect" in his back yard, Henry testified that he didn't know what he'd do because all his money was tied up in his house (N.T. 145-146).

Cross Examination

Henry testified that he had seen "all the television specials on EMFs" and stated that he didn't know if it was prudent or not, but it scared him (N.T. 147). He stated he purchased his house three years ago (N.T. 147).

Henry acknowledged that there were measurable EMFs in his house already -- from the television and microwave -- and that there was a fluorescent light in the bathroom he intended to replace (N.T. 148). He also stated he planned to stay away

from the microwave and television set when it was on (N.T. 148). He also testified if the line were energized, he would have to do additional readings to see how dangerous the amount of EMF would be, but admitted he had no idea what levels of EMF were safe (N.T. 148-149).

KAREN DALRYMPLE - Direct Testimony

Karen Dalrymple of 583 Valley View Road in Langhorne, Middletown Township, Bucks County, testified that her property was located toward the eastern end of the transmission line (N.T. 149-150). She also testified that the distance from the back of her house to the transmission line is 250 to 300 feet (N.T. 150-151). She further testified that it was about 150 feet from the line to her nearest property line and that her property abutted the line at the rear (N.T. 151). Dalrymple testified that the houses in the neighborhood are built on a hill and her swimming pool is down the hill at the bottom of the yard close to the property line (N.T. 151-152). There is also a clubhouse which they constructed for their son right at the property line (N.T. 152).

Dalrymple testified that her family consists of herself, her husband, her 15 year old son and the dog (N.T. 153). Other uses of her back yard testified to by Dalrymple included: laying in a hammock supported by trees, and playing volleyball or croquet (N.T. 153). Basketball is played on the court which is in front of the house (N.T. 153).

Dalrymple also testified that five years ago they put an enclosed porch in back and they spend a lot of time there (N.T. 153).

She testified that she had not taken any action in respect to her property since she learned about the transmission line proposal (N.T. 154).

As to her knowledge on EMF, Dalrymple stated that she read all the literature on EMF and she can't help but be afraid (N.T. 155). She further stated that she is a nurse, who takes care of cancer patients daily, and that her greatest fear is dying of cancer (N.T. 155).

Cross Examination

Dalrymple also admitted that trains run along the tracks; that there were two sets of tracks on the Conrail property; and that the tracks are separated by woods (N.T. 156).

PATRICIA KELLY HALL - Direct Testimony

Patricia Kelly Hall of 641 Valley Road in Langhorne, testified that she lived several miles from Mr. Koerper and Mrs. Lawler toward the eastern end of the line (N.T. 159). She further testified that she had a husband and three children -- two girls, ages 16 and 13 and a son, age 12 (N.T. 160). Hall also testified that her side yard is closest to the line (N.T. 160). She explained that she is on a hill and much of the time her children spend playing ball or whatever is on the

flat area in front of Mrs. Dalrymple's house (N.T. 160-161). She also explained that she and her family spend a lot of time in Mrs. Dalrymple's pool (N.T. 161-162). She stated she did not know exactly how far the Dalrymple's property was from the line (N.T. 162).

When questioned about her understanding of EMF and prudent avoidance, Hall responded she understood it, that she had read a lot about it and watched the Diane Allen special on the news, and that she practices prudent avoidance by leaving the room when the microwave is in use and not allowing her children to be in the room (N.T. 162). She also stated that she doesn't stand near the oven which she uses alot in preparing dinner meals; that she does not use an electric blanket and that she moved all of the electric alarm clocks away from the heads of everyone's bed (N.T. 162).

If the line is energized, Hall testified she will no longer allow her children to play down near Mrs. Dalrymple's house and she, herself, will not swim or visit Mrs. Dalrymple's house (N.T. 162-163). With respect to her own house, she testified she would have the fields measured there after the line is energized (N.T. 163).

Cross Examination

On cross examination, Hall testified that she was a member of PAUSE, but did not know if she was a named protestant (N.T. 163). She also testified that she lived in her house five years and that her husband designed and built the house

himself (N.T. 164). She further testified that her house is located approximately 66 feet from the line (N.T. 164).

BARBARA GLATHORN

Barbara Glathorn of 467 Mitilia Road, Upper Southampton Township, testified that she lives approximately 2 miles east of Protestant Koerper's house, and that she resided in her house for 19 years (N.T. 165). She further testified that the line is approximately 400 feet from her house and that her house faces the line, but that there is a row of houses between her house and the line (N.T. 165). If the line was energized, she testified her family would spend a lot less time outside (N.T. 166). She stated that they bought the house in the suburbs because of the great amount of land and the beautiful woods and they spend a lot of time outdoors -- her daughter sunbathing and the family barbecuing and playing volleyball, croquet and badminton (N.T. 166).

Glathorn testified that because of what she read about the damage EMF can have on human beings, she wanted to sell her house (N.T. 166). She disclosed that she obtained her information about EMF from Microwave News, Currents of Death, The New York Times, the Inquirer, a CBS series on EMF and Diane Allen's series (N.T. 166). Glathorn revealed that because of her husband's condition -- he had polio when he was five -- and the history of cancer in her family, she is concerned for all of them (N.T. 167).

Cross Examination

On cross-examination, Glathorn admitted that she had not measured the actual distance between her house and PECO line; she had just judged it to be 400 feet (N.T. 172). She stated that there was a row of houses, a street and the Conrail right-of-way between her house and the line (N.T. 172-173). She also stated she planned to take EMF measurements at her home after the line is energized to determine what steps she might take (N.T. 173). Glathorn confirmed that her knowledge about the effects of EMF was from a variety of articles and television reports (N.T. 173). She also confirmed that the line couldn't be seen from her house and that trees also separated her house from the line (N.T. 173). She also clarified her previous testimony by stating that there was only one home across the street from hers that separated it from the Conrail right-of-way (N.T. 174).

ROBERT MATIRKO - Direct Testimony

Robert H. Matirko of 1390 Clover Lane, Feasterville, testified that he lives approximately two and a half miles to the east of Ed Koerper and in the same vicinity of Mrs. Glathorn in Lower Southampton Township (N.T. 179). He also testified that the line is approximately 37 feet from his property line and runs completely across the back of his yard (N.T. 180). He further stated that the line crosses over from the far side of the track to the near side directly behind his

house (N.T. 180). In answer to questions seeking clarification of his statement, he explained that he meant the poles are located on the far side of the track to the west of his property, and in the back of the property and to the east of the property, the poles are located between the rail line and his property (N.T. 180). Matirko also testified that his back yard is 195 feet wide, and the 37 feet distance to the line from his property line does not apply across his whole back yard, and that only one corner of the property is 37 1/2 feet from the line (N.T. 180-181). Matirko then described his use of his back yard (N.T. 181). He explained that he has a large patio which is used for outdoor eating in the summer and for family functions (N.T. 181). He also explained that he has a hammock and a swing that they use which is close to the line (N.T. 181). Three photographs, which were marked as Protestants Exhibit Nos. 4, 5 and 6, were sponsored by the witness (N.T. 182-184).

In answer to a question about his understanding of the health risks if the line is energized, Matirko stated that although he is concerned with his health, his main concern is with his wife, who has a very low immune system, and every week she has to get allergy shots and she is susceptible to many things (N.T. 184-185). He testified if the line is energized they will curtail the use of their back yard in which they have invested a lot of time and money (N.T. 185). He implied that he would also curtail social functions held in the back yard

because he didn't want to have people come over knowing that there was a potential health risk (N.T. 185).

Cross Examination

On cross examination, Matirko admitted he was not a named protestant in this matter (N.T. 186). He testified that the line is 166 feet from the corner of his house (N.T. 186). He also testified that he owned his house for eleven years and that the poles about which he testified were located then where they are today (N.T. 186). He also testified that freight trains travel on the tracks behind their house (N.T. 186). Matirko admitted that he and his family use electricity and electrical appliances in their house (N.T. 186).

DANTE BONTEMPO - Direct Testimony

Dante Bontempo of 1381 Clover Lane, Feasterville in Lower Southampton Township, testified that he lives three miles east from Ed Koerper, along the line (N.T. 188). He also testified that he lives in the same neighborhood as Protestant Matirko, directly across the street from him (N.T. 188). Bontempo testified his house faces the power line and is approximately 300 feet from the line (N.T. 188). He stated that he cannot use any of his property because his house is on the hill, but he explained that he makes use of a playground, land donated by the development at the end of the cul de sac approximately 50 feet away from the power line (N.T. 188-189). He explained he has six grandchildren and the playground is

where they go for all their weekend activities: soccer, horseshoes and stickball (N.T. 189). He further explained that they used to play basketball there until the courts were vandalized (N.T. 189). Bontempo stated that if the power line were energized, he doesn't feel he'd have the opportunity to play there with his grandchildren anymore (N.T. 189).

As to the effect on his property by the proposed transmission line, Bontempo stated that he took early retirement in June and he had intended to sell his house in a year and a half and move to a lesser value home in a retirement community (N.T. 189). He indicated he needed the extra income from the sale of his house to supplement his income and he believed that the energization of the power line will cause his house to depreciate (N.T. 189).

Cross Examination

On cross examination, Bontempo admitted that he did not know if he was a named Protestant in this matter (N.T. 194). He also admitted that the transmission line does not abut his property, that it is across the street from his property and that there is an intervening house across the street (N.T. 194). Bontempo also pinpointed the location of the cul de sac playground: at the end of his street next to the railroad track (N.T. 194). He also disclosed that there is no fence between the playground and the railroad (N.T. 195). He stated that he had owned his home for eighteen years (N.T. 195).

Redirect

On redirect, Bontempo stated that in practicing prudent avoidance, after 35 years he threw out his electric clock, which was on the nightstand by the bed, and got a battery operated clock (N.T. 197). He also stated that they had thrown out their microwave oven (N.T. 197).

LYNN COHEN - Direct Testimony

Lynn Cohen of 1509 Grace Circle in Feasterville, testified she lived right next door to Peg Lawler, who testified earlier (N.T. 199). She further stated that her house is approximately 177 feet from the power line and that there is one house between the line and her house (N.T. 199). From her property line, the line is 147 feet away (N.T. 199). She explained the line is closest to her side yard and because it runs adjacent to her house, it is also close to her back yard (N.T. 199).

Cohen testified she had two children: a nine year old daughter and a four year old son, who is a diabetic (N.T. 200). She explained that her son spends most of the day at home and spends most of his spare time playing in the cul de sac or in the back yard (N.T. 200). She further explained that the end of the cul de sac is approximately 55 feet to the pole (N.T. 200). She stated that all the neighborhood children spend most of their time there (N.T. 200).

When questioned what she knew about EMF, Cohen explained that she has read every publication she could get her hands on and they all link EMF and health effects (N.T. 201). She also explained that because her son is a diabetic, she has had the occasion to visit Children's Hospital and has seen children undergoing chemotherapy (N.T. 201). She stated that health is a primary issue in her family and she wants to make sure her son grows up healthy and does not sustain any adverse effects because of his diabetes (N.T. 202). Her conclusion from reading a study by Jolley (phoentic) about the effect of EMF on insulin producing Beta cells is that she didn't think it would be a safe environment to have a child playing "there" when and if this line is energized (N.T. 201-203).

When questioned as to what she has done since learning about the plan to energize this line, Cohen stated that she had done many things -- that she had adjusted the television in her bedroom because it faced the head of her son's bed; that she got rid of her microwave; and that her children do not sit too close to the television (N.T. 203-204). She also testified that she does not use an electric canopener and is doing whatever she can to eliminate any magnetic fields in the home (N.T. 204).

Cohen also testified that it was a long, hard decision, but they decided to put their home on the market (N.T. 204). She testified that she has not lowered the price on her property although they've been asked to do so

(N.T. 205). She stated that she has not had any formal offers on the house, but people have come through the house (N.T. 205). She also stated that the proximity of the proposed power line to the house has not affected any of the people coming through the house because they have not gotten to that point formally (N.T. 205). She did state that it was written on their highlight sheet that power lines were being installed (N.T. 205). She also volunteered that she could never sell her home in good conscience and tell another family that there was no problem moving into the house (N.T. 206).

Cohen also testified that they decided to rent a house and live away from the line if it is energized whether or not they are able to sell the home (N.T. 206). She testified that in preparing or researching this case, her husband sustained ulcers and needed to be hospitalized (N.T. 206). She also testified that she had less time to spend with her family because of the research she was doing (N.T. 206). She also testified that the kids are worried that they were discussing how they could halt the line because they didn't want to be split up (N.T. 207).

Cohen then testified that her children's bedrooms are on the opposite side of the house from the power line (N.T. 207). She also testified that her family is predisposed to cancer on both sides (N.T. 208). She explained that her grandmothers had breast cancer (N.T. 208).

Cross Examination

On cross examination, Cohen stated that her house was on the market for two and a half months (N.T. 208). In response to questioning, Cohen identified the Jolley study she had earlier referred to as a 1982 study by Jolley, Henshaw and Knierin-Henshaw which was published in Bioelectromagnetics (N.T. 208-209). She also confirmed that her son plays with electric cars but that she believed her husband tested them for milligauss levels (N.T. 209). She also testified that she had lived in the house for a little over eight years (N.T. 209).

Redirect

Cohen testified that she would not expose her children to magnetic fields when asked what she would do if EMF were to have an effect on insulin production (N.T. 210).

WILLIAM COHEN - Direct Testimony

William Cohen of 1509 Grace Circle, Feasterville, testified that Mrs. Lynn Cohen was his wife and that he agreed with her as to the facts and their intentions if the line was energized (N.T. 211). He also testified that he met with PECO officials twice (N.T. 21). He stated that PECO witness Ron Oedemann came to his house and measured the distance from the line to the corner of the house and gave him an estimate as to what he felt the projected magnetic fields would be (N.T. 212). He stated the Oedemann's projections varied from Boeggeman's about loading on the line and the magnetic fields expected from the line (N.T. 212-213). He stated that they

projected at his house, 3 milligauss at 600 amps, 5 milligauss at 1200 amps and 8 milligauss at 1800 amps (N.T. 213). Cohen testified that these projected levels of EMF would occur inside his house (N.T. 213-214). He stated that he was not given any projections that would be outside his house (N.T. 214).

As to literature he's reviewed, Cohen stated he tries to stay away from the dramatic ones like Currents of Death, but he called and spoke to various researchers -- John Peters, Charles Gram, Bill Wisecup, David Carpenter, Weldon Jolley and Ross Addey and that they sent him various studies (N.T. 215). He admitted that some of them were too technical to understand (N.T. 215). Based on his conversations with these researchers, he testified that on the day that the line was energized, his wife would be leaving and he could go with her (N.T. 216). He stated he had already contacted a rental home agency and was told he could be put in a house within a week (N.T. 216). Cohen also stated he had gotten a meter so that he could make his own measurements (N.T. 216). He stated that there is no field around them right now and the only electric appliance they own is a toaster (N.T. 216). Cohen also confirmed that he was hospitalized for ulcers two months ago (N.T. 217).

Cross Examination

On cross examination, Cohen restated that the only electrical appliance they had was a toaster, but admitted that there were electric lights in the home, a refrigerator, central air conditioning and a vacuum cleaner (N.T. 217-218). He

stated that they had thrown away a microwave oven and had a gas range (N.T. 217).

CAROL DEMPSEY - Direct Testimony

Carol Dempsey of 705 Buck Road in Feasterville, Lower Southampton Township, PA testified that her property is two and a quarter miles east of the property of Ed Koerper (N.T. 219). She also testified that she had three girls: ages 21, 19 and 14 (N.T. 219). She explained that her property line is 105 feet from the transmission line and her house is 150 feet from the line (N.T. 219). She also explained that her house doesn't abut the line right-of-way but that she lives on the other side of Buck Road from the line (N.T. 219). She stated that there was no residential property across Buck Road between her house and the line (N.T. 219-220). She also stated that she didn't know the distance from the road to the railroad tracks, and that the line's poles were on her side of the railroad tracks (N.T. 220). Dempsey explained that her children sleep in two upstairs bedrooms that are in the front of her house facing the line (N.T. 220). She also explained that her house is on a hill and when she looks out, she is even with the train tracks and that you can see the poles, being about 70 feet high, out the bedroom window (N.T. 221). She further explained that the train tracks at the poles are elevated about the street level (N.T. 221).

When questioned about her concern on EMF, Dempsey explained that she had read studies and all the newspaper articles including the New York Times and the township Courier and was concerned (N.T. 222). She indicated that she is not in a position to sell her house right now because she has two children in college and very little equity in the house (N.T. 222). Therefore, she stated, they would have to spend as much time away from the house as possible (N.T. 222).

Dempsey stated that her children have many school and neighborhood friends and that they have lived in the house for 13 years (N.T. 222). She explained that one daughter just graduated from college and is at home while the other is living at LaSalle University, but returns home on weekends because she works at Hechinger's to make spare money (N.T. 223). Dempsey testified that her 14 year old daughter just started high school and that it would be difficult for her to have friends over to play games in the front or back yard if the line was energized. (N.T. 223). She surmised that her daughter would have to spend more time away from home (N.T. 223).

Dempsey testified that the only contact she had with PECO was through Charles Martin, a public relations person, regarding the condition of the property where it was putting up the line (N.T. 224). She stated that they had left it in such a mess that it was very undesirable looking at it from her house (N.T. 224). She complained that they had cut down all the trees and defoliated the ground (N.T. 224-225). She stated

that people also started leaving tires and trash on the property, but admitted that PECO had cleaned that up (N.T. 225).

Cross Examination

On cross examination, Dempsey stated that she was not 100 percent sure but that she believed she was named defendant in this matter (N.T. 225). She explained that a two lane road, Buck Road, which is a state highway, goes in front of her house (N.T. 225). She stated that the trees which had been cut down were on the right-of-way PECO purchased from Conrail (N.T. 226).

When questioned whether she had had measurements taken, Dempsey replied that she hadn't and she wouldn't because there is no proof that a low measurement isn't harmful (N.T. 226). She stated that she thought if there were any detectable level she would stay away from her house because the exposure wouldn't be off and on like an appliance, but would be full-time (N.T. 227).

FRANK ENGLISH - Direct Testimony

Frank English of 239 West Bristol Road, Feasterville, PA, 19053, testified that he lives approximately a mile and a quarter east from Cohen's residence in Lower Southampton Township (N.T. 228-229). He also testified that the corner of his house is approximately 101 feet from the pole and his property line is about 90 feet from the line (N.T. 229). He

further testified that the rear or northwest corner of his house is closest to the line as the line runs at an angle on the west side of the house and his house sits at an angle to the line (N.T. 229).

English then testified that his house sits back from Bristol Road and is very secluded and that he has a lot of trees (N.T. 230). He stated that he has an 80 foot deck along the back of the house which is 45 feet wide on the west side and 55 feet wide on the east side (N.T. 230). The distance to the line from the corner of the house is measured not from the deck, but from the northwest corner of the house which is also his bedroom (N.T. 230). He also testified that his property is 10 feet off of Conrail's right-of-way (N.T. 231).

When asked about from what sources he acquired his information about EMF, English identified Currents of Death and other articles, notably the New Yorker magazine (N.T. 233). He testified that the more he read, the more he felt he didn't want to be associated with it and it made him upset and angry (N.T. 233). When asked what he learned about EMF that made him upset and angry, he stated that the field is invisible but you can't control it (N.T. 233). He stated that the lines could be buried or you could run lines side by side but that wouldn't completely stop the fields (N.T. 233). He stated that the fields have a tendency to be everywhere (N.T. 234).

When asked about possible health implications, he stated that they liked their home and have spent a considerable

amount of money on it, but if there was a possibility that either he or his wife would be exposed to some form of cancer or biological cell change, he didn't want to be there (N.T. 234). He stated if the line was energized he would practice prudent avoidance by abandoning his property (N.T. 234).

As to other steps they have taken to practice prudent avoidance, English stated that they changed the way they used appliances, rearranged radios and televisions and beds and eliminated a lot of unnecessary electrical items (N.T. 234). He also explained that they don't use the toaster anymore, they stay away from the microwave when it is in use on an occasional basis; and they disposed of their black and white television (N.T. 235). He explained that they have a color television but seldom have time to use it (N.T. 235).

When asked about the possibility of selling his house, English replied that he had put the house on the market prior to the transmission line being constructed as a test market (N.T. 235). English stated that Joe Kelly, of Kelly Real Estate, showed the house numerous times and that they had lost a sale because the people brought their appraiser with them (N.T. 235). After the people looked at the house, they went outside and saw the new pole that had been installed and asked about it (N.T. 235). English said he disclosed the fact that PECO was building a 230kV line on the Conrail right-of-way (N.T. 235). Nothing more was said, English testified, but two

days later Kelly received a letter from this couple stating that they were no longer interested in the house because of the proposed powerline (N.T. 235). He stated that he had not had any other offers since that time (N.T. 235).

Cross Examination

On cross examination, English testified that the trees that he testified that were destroyed were on Conrail property (N.T. 236). He testified that there was a transmission line on the train line when they purchased the house in 1979, but he understood from the neighbors that the line had not been energized for ten years (N.T. 237). He stated that he did not confirm this information with Amtrak or Conrail (N.T. 237).

English also clarified his testimony about the relationship of his property to the PECO line (N.T. 237-238). He explained that the house sits at an angle to the line and across the front of their property it adjoins the Conrail line (N.T. 237). He further explained that the back of his house, his property line is 10 feet from his house and about 91 feet from the PECO poles on the Conrail line (N.T. 238).

On cross examination, English explained that three months prior to finding out about the line, his house was listed with a friend in the real estate business for a test market (N.T. 238). When he found out about the line, English stated he told Kelly to put it on the market and to get rid of it (NT. 238). English also testified that three people lived in his house: he, his wife and his mother-in-law (N.T. 239).

DOROTHY ENGLISH - Direct Testimony

Dorothy English of 239 West Bristol Road in Feasterville, Lower Bucks County, testified that she is the wife of the previous witness Frank English (N.T. 240). She also testified that she agreed with his testimony (N.T. 240). She then testified how she acquired her knowledge about EMF (N.T. 241). She explained that she called a lot of universities and asked about any medical evidence or research that was underway (N.T. 241). She testified that she also called the Bioelectromagnetic Society and PECO and a lot of other places (N.T. 241). She also explained that she was just trying to understand what EMF were and what the state of medical research was (N.T. 241). She admitted that she couldn't necessarily interpret everything she read but she felt two things were apparent: there was a lot of information available but some of it was old (N.T. 241-242). She stated that some of the research was 20 years old (N.T. 242).

English continued that if it is the case that EMF can biologically effect cells, she doesn't want to be near it (N.T. 242). She claimed that from almost everything she picked up from the research indicates a window of somewhere below two and a half to five milligauss would be safe (N.T. 242). She stated that there was zero milligauss outside now (N.T. 242).

English also explained that she was drawing a distinction between biological change and disease (N.T. 242).

Her understanding of the distinction she explained is that EMF accelerates the rate of cell division and in some cases alteration to the structure of the cell itself (N.T. 243). She recognized that she didn't understand all of the medical literature but expressed her concern that after 20 years of exposure to EMF whether she could produce the same quality of blood or tissue cells that she does now (N.T. 243). Because of the conflicting information that she has read, she believes that there are enough questions so that it is reasonable that people not be subjected to EMF like human guinea pigs (N.T. 243).

On practicing prudent avoidance in her daily life, English explained that they went throughout the house and measured their appliances and rearranged them in the last year and a half (N.T. 243-244). She further explained that they reoriented television sets so their backs are against outside walls and reduced their use of electric lights and appliances (N.T. 244). She testified that if the line is energized, she will practice prudent avoidance by abandoning their house because it is her understanding that EMF readings will be relatively high at her house (N.T. 244). Financially, she explained their home is their lifetime investment (N.T. 244). English did confirm that she had known her husband had placed the house on the market on a test basis before learning about the line, and stated that it had been their intention to relocate somewhere else (N.T. 245). She stated that they

subsequently listed the house only to find it could not be sold (N.T. 245). When questioned about whether the house had been listed at a different price than it was listed at in the test marketing, English answered that so far they've reduced the price \$60,000 to \$70,000 in an attempt to sell, but people coming through the house are saying that the line is too close, that they don't want to be near it and they're afraid for their children (N.T. 245).

English testified that she was one of the co-founders of PAUSE and her organization of the group resulted from interactions she had with PECO, who assured her there was no problem with EMF (N.T. 246).

Cross Examination

On cross examination, English stated that EMF levels were tested outside their house and the levels were zero (N.T. 248). She also testified that at certain times of day when she is using appliances, or electric lights, the fields in her house are not at zero (N.T. 248).

Redirect

English stated that the only appliance that emits EMF on a twenty-four hour basis is the refrigerator and the well, and that they don't have central air or leave lights on all day (N.T. 249). In response to a question about the comparison magnetic fields emitted by the transmission line as stated by PECO, and the appliances in her house, English testified that something like a hair dryer surpassed those EMF levels but a

hair dryer is only in use for five minutes (N.T. 250). She stated that you couldn't shut off a powerline (N.T. 250).

WILLIAM J. HARLEY - Direct Testimony

William J. Harley of 1660 Bonne Brae Drive, Huntingdon Valley, Upper Southampton, Bucks County, testified that the line is to the rear of his house near the area his dining room and office (N.T. 251). He also testified that he spends about ten hours a day working in his office if he works at home (N.T. 251). The rear of the house, Harley testified, is 206 feet to the transmission line, and it is 60 feet to his property line (N.T. 251). Harley explained that the line runs parallel to the back of the house for the entire length of the back yard, approximately 270 feet (N.T. 251). He explained that his two adult children, who are out of school and working, reside with him and use the property (N.T. 251). He uses his office approximately eight to ten hours a day on Monday through Friday when he is not traveling on the road and sometimes on Saturday and Sunday (N.T. 252).

Harley explained that he didn't know all the technicalities about EMF but he had seen enough television reports and articles about EMF to be scared to expose his family to these fields (N.T. 253). He is concerned because he has cancer on his side of the family: his mother, grandmother and grandfather all died of cancer (N.T. 253). He also explained that his wife's father died from cancer, and it was

his understanding that EMF could trigger a dramatic cell change to activate cancer cells (N.T. 253).

Harley testified that they had only lived in the house for fifteen months and had only been there three months when PECO started cutting trees down (N.T. 253). He testified he could not sell his house (N.T. 253). He confirmed he had contacted a realtor but he explained that all the money he had from his other house plus all their savings went into buying his new house (N.T. 253).

Harley also testified that if he didn't have over \$100,000 or \$125,000 down on his house and a very small mortgage, he would turn the keys over to the bank and tell them they owned the house and leave (N.T. 255-256). He stated he could not afford to move and he was locked into the property (N.T. 256).

Cross Examination

On cross examination, Harley stated he believed that he was a named party in this matter (N.T. 256). He also affirmed that he uses a personal computer as part of his work (N.T. 256). Harley also admitted that he smokes cigarettes, but not in the house because he doesn't want to expose his family to cigarette smoke (N.T. 256).

VIRGINIA LYNN MONARCH - Direct Testimony

Virginia Lynn Monarch of 17 Wychwood Lane, Langhorne, PA, testified that the PECO line goes along the back of her

property and it is approximately 50 feet from her property line (N.T. 258). She commented that her lot is an unusual size and there is nothing between her house and the property line except trees (N.T. 258). She estimated that the line was about 170 feet from the wall of her house (N.T. 258).

Monarch testified there were four members in her family: herself, her husband, her six year old daughter and her eleven year old son (N.T. 259). She further testified that her son had the closest bedroom to the power line at the rear of the house where her bedroom is also located (N.T. 259).

Monarch then explained that the reason that they moved to the house was because it had woods for a back yard (N.T. 259). She indicated that her son had deficit dysfunction, a neurological disease and she expressed fear that her son would get worse because of it (N.T. 260). She indicated that she educated herself about EMF by reading a lot and watching television (N.T. 260).

When asked how she avoids the potential effects of the transmission line if it were energized, she stated that she would move (N.T. 261). She stated that moving would be devastating financially to them and would be disruptive to their children's education (N.T. 261). She explained that her house is not listed and that any discussions about the sale of her house were done on an informal basis (N.T. 261). She explained that her neighborhood was considered to be desirable and a real estate agent contacted her twice about selling the

home (N.T. 261). She wasn't interested in it at the time but 4 months later when the agent called again, she decided to see what it was worth (N.T. 261). She testified that the couple loved the house but the man who was a science teacher at a local school decided they didn't want to buy the house when it started coming out that the line was going up (N.T. 262).

Cross Examination

On cross examination, Monarch stated that she believes that her property abuts Conrail's property line although she admitted that she didn't know where Conrail's property began, but she knew where her property ended (N.T. 262). She testified she lived in her house four years and when she bought the house, she knew that there was a freight line and a defunct electric line (N.T. 263).

ALIX SHIRLEY MAIER - Direct Testimony

Alix Shirley Maier of 1331 Clover Lane in Feasterville testified that Mr. Bontempo and Mr. Matirko also lived on Clover Lane (N.T. 263). She also explained that she is on the same side of the street as Mr. Bontempo, therefore, across the street from the line facing it (N.T. 264).

Maier indicated that she had a 12 year old daughter and a 10 year old son but she does not allow them to play in the playground cul de sac that Bontempo mentioned in his testimony (N.T. 264). She stated that they do take walks and they play in the fenced-in back yard (N.T. 265).

When asked about her familiarity with EMF, Maier testified that when she was eight she moved to a neighborhood in Levittown and she was four houses away from what she called high tension lines (N.T. 265). She explained that of nine closest houses, they had 4 cases of cancer and she was one of them (N.T. 265). Of the four cases, she stated, two women had died (N.T. 265). She indicated that the cancers included uterine, brain and uterine/breast cancer (N.T. 265). She explained that she had uterine cancer and it took her many years of surgeries, doctors and medication to produce two children (N.T. 265). She realized after hearing some of the testimony that her bedroom was the closest room in the house to the wires when she lived in Levittown and she lived there until 1962 when she went off to college (N.T. 266). She expressed concern for her children because she educates her children at home and they are home more than other neighborhood children and have a better chance of more exposure (N.T. 266). She stated that they also play across the street in back yards and swim in friends' pools in yards which are close to the tracks and the lines (N.T. 266). She explained if the line was energized she didn't want to stay there but she did not believe that she could afford to move, but she would find somewhere to go (N.T. 267). She testified that if there was a risk, even a slight risk, she would not expose her children to it (N.T. 267).

Cross Examination

On cross examination, Maier testified that she was not good at judging distance but stated that she was about as far away from the line as Bontempo's house (N.T. 268). She also testified that they moved in in June 1978 and lived there for 13 years (N.T. 268).

ROBERT SMALL - Direct Testimony

Robert Small of 15 Wychwood Lane, Langhorne, Middletown Township, PA, testified he lived two doors away from the previous witness Virginia Lynn Monarch (N.T. 269). He also testified that he lives northwest of the line, which runs for two hundred feet parallel to the back of his property (N.T. 269-270). He further testified that his rear property line runs adjacent to the railroad right-of-way and the transmission line is 45 to 50 feet to his property line (N.T. 270). He further testified that PECO cut down trees in constructing the line which were on the Conrail right-of-way, but also on his property (N.T. 271). Small indicated that he had never come to an agreement on compensation in dollars or any other form for the loss of his trees although PECO agreed that they had torn down some of his trees (N.T. 272). He clarified this statement by saying he didn't know whether he was dealing with a PECO employee or a subcontractor, but that a supervisor in charge of the clearing process acknowledged to him that PECO had cut down some of his trees (N.T. 272). He couldn't identify the supervisor as being from the PECO crew or

from the subcontractor (N.T. 273). Small also volunteered that he was willing to forego the loss of his very mature trees, which he valued at \$10,000 or \$20,000 for the sake of the health of his children (N.T. 274).

Small further testified that his house is between 110 and 130 feet from the transmission line and 75 to 90 feet to his property line (N.T. 275). Small indicated that his family consisted of his wife, age 35, his son, age 5 and his daughter, age 2 (N.T. 275). He testified that his daughter is in the back bedroom, on the interior side of the back of the house which faces the line (N.T. 276). Small indicated that he encourages his children to play in the back yard away from cars and that they spend most of their time there (N.T. 276). When asked how he intended to practice prudent avoidance, he indicated that he did not know how to explain to a two or five year old that they could play in the back yard for only an hour and a half (N.T. 276).

Small explained he had not received much useful information about how to practice prudent avoidance from PECO except to unplug his toaster (N.T. 278). He has moved his alarm clock to the other side of the room from its spot two feet away from his bed to minimize the potential problem (N.T. 278). He stated that he did not know how he can exercise prudent avoidance in regard to the transmission line which will be emitting EMF in a constant, fixed fashion (N.T. 278). He also stated that he wanted a PECO employee to buy his house and

he would be gone (N.T. 279). He stated that if the line is energized he would move his two and five year old out of what he believes is a risk environment because of PECO's own admission that it is prudent avoidance (N.T. 279). When asked about the financial loss he would suffer if he moved, he stated he would lose out of pocket somewhere between \$30 and \$50,000 (N.T. 280). This figure, he insisted did not include the \$25,000 to \$40,000 in improvements, wallpaper, paint and draperies his wife sunk into the house (N.T. 280). Small admitted that he had not listed his property, but had market evaluations done (N.T. 281). He admitted that he "side-stepped" the issue of the power line with realtors because he knew that other realtors, who had been told by residents the reasons for their moving, have, because of the liability, disclosed the construction of the transmission line (N.T. 282). He further volunteered that he intended to mislead the realtor the same way PECO misled him, and that he wanted PECO to indemnify him from anyone that he potentially sold his house to (N.T. 282).

Cross Examination

On cross examination, Small denied that PECO had removed other trees from his property at his or his wife's request (N.T. 282). He also denied that PECO removed a tree in front of his home, on the other side of his home from the line (N.T. 283). He then clarified the sequence of events: PECO cutting down 10 or 12 trees without his being aware of what was

going on; a supervisor proposing to him that that work crew take down two or three dead trees in his back yard instead of fighting about monetary compensation which could go through the court system; and he told the supervisor he'd think about it (N.T. 283). He testified that the next thing he knew, they came in and took down the trees (N.T. 283). He stated he never agreed that cutting down the trees would be compensation for his trees (N.T. 284). He further stated that the wood was not cut into fireplace sized pieces (N.T. 284).

On being shown a document which read that "the following work is promised with the approval of Robert and Jill Small, 15 Wychwood Lane, Langhorne, PA", Small admitted that it was his wife's signature on the document, but he claimed never to have seen it before (N.T. 284). He further stated that he could verify his wife's signature, but he didn't know what went on the paper first (N.T. 286).

Redirect

On redirect, Small testified that he was never approached by a PECO real estate acquisition agent (N.T. 287). He also confirmed that he had never authorized his wife to act as his agent in respect to the agreement with PECO (N.T. 287).

DAVID ROSENBAUM - Direct Testimony

David Mark Rosenbaum, President of Risk Analysis Corporation, Suite 202, 6723 Whittier Avenue, McLean, Virginia, 22101, sponsored OCA Statement No. 2 as his prefilled written

testimony (N.T. 298-299). He had one minor correction to his statement: the word "constant" should have been in the sentence "These men were exposed to strong magnetic fields" (N.T. 299).

In his written statement, he stated that he had over 20 years experience in analyzing the effects and risks of exposure to ionizing and non-ionizing radiation and other risks (OCA Statement No. 2, p. 1). Briefly, he was in charge of writing the United States General Accounting Office report Somatic Health Effects of Low Level Ionizing Radiation; he was a Deputy Assistant Administrator of the U.S. Environmental Protection Agency and Director of Radiations Programs there (Id., p. 1). At EPA, his responsibilities included non-ionizing radiation, Rosenbaum testified (Id., p. 1).

Rosenbaum then presented a summary of his knowledge about the present epidemiological evidence on the effects 60HZ fields on people (Id., p. 3). Rosenbaum stated that several studies by well qualified epidemiologists have reported associations between what may be surrogates for long-term average field strength and various types of diseases; in other studies there was no apparent correlation when actual measured (short-term) field strength is used instead of the surrogate (Id., pp. 3,4). Other studies, he stated, have reported either no significant correlation or no relationship between fields or field surrogates and cancer while another study has observed negative correlations between exposure to high magnetic fields and cancer (Id., pp. 3,4). Rosenbaum stated that another study

reports increased cancer, but lower total death rates because of less cardiovascular disease for those exposed to high fields (Id., p. 3). Yet another study Rosenbaum cited, shows higher cancer incidence for people farther from a power line than for people living closer to a power line (Id., p. 3).

Rosenbaum then commented that it was important to distinguish between ionizing and nonionizing interactions (Id., p. 6). He explained that ultraviolet and higher frequency fields have enough energy to remove electrons from the atoms and molecules of biological cells and tissues (Id., p. 6). He explained further that this process was called ionization, and the events accompanying ionization can lead to death, mutation and initiation of cancer (Id., p. 6). Power transmission and distribution fields are nonionizing because they have energies that are too small to produce ionization and the mechanisms by which ionizing radiation produces damage in living cells do not apply to power frequency electric and magnetic fields (Id., p. 6).

Rosenbaum then testified what he believed to be prudent policy in the face of such uncertainty (Id., p. 6). He testified that research into the effects of electric and magnetic fields should be continued; and that the government and the industry should be aggressive in periodically informing the public about the latest information, stressing its uncertainty and changeability (Id., pp. 6-7). He also stressed that the utilities should disclose this information in an impartial manner and before it is required (Id., p. 7).

Rosenbaum also stated that it was important that the public be involved in the decision-making process before critical decisions are made, and that at least all companies considering power line projects should consider the cost and effects of possible mitigative measures before any construction is decided on (Id., p. 7). He stated that this was not done in the case of PECO's 230kV line, but that all calculations on alternatives were done after the line was virtually finished and then only after a request from OCA for such calculations (Id., p. 7). He stated that mitigative measures that should be considered before construction begins may include but are not limited to: 1) avoiding heavily populated areas; 2) avoiding parks, schools and other public facilities; 3) widening rights-of-way; 4) limiting public uses of right-of-way; 5) using higher ground clearances; and 6) designing the power lines to reduce the fields (Id., p. 7).

Rosenbaum also testified that substantial reductions in average magnetic field can usually be obtained at a reasonable cost (Id., p. 8). He offered that designing a power line using current codes may not minimize fields because current codes were drawn up by consensus committees which did not even consider magnetic fields (Id., p. 8).

Cross Examination

On cross examination, Rosenbaum confirmed that he had a Ph.D. in the field of theoretical physics, and a masters and bachelors degree in physics (N.T. 301). He also confirmed that

he did not have any graduate course work in biological sciences or medicine or epidemiology, nor did he ever design a 60HZ transmission line (N.T. 301). He explained that he did a thesis in biology in radiation biology even though he was in physics (N.T. 313).

Rosenbaum reaffirmed that in his direct testimony he stated that reductions in average magnetic fields of 50 to 75 percent over current practice should be possible at reasonable cost on new lines and he explained he got that statement from Pennsylvania Power & Light's statement as to their future plans (N.T. 313-314). Rosenbaum then explained that the statement doesn't refer to this particular line but to a newly constructed line (N.T. 314-315).

Rosenbaum then presented testimony on odds ratios, and confidence levels and their statistical significance (N.T. 324-328). Rosenbaum confirmed that the results of case control studies are usually reported as risk ratios which indicate whether "things" are more or less good for the set you're commenting on (N.T. 324). He explained an odds-ratio of "one" usually means you break even (N.T. 324). He also confirmed that these studies also provide a calculation of statistical significance for the odds ratio (N.T. 324). Rosenbaum explained that it is easy to calculate risk ratios but is really difficult to know the significance of them (N.T. 324).

Rosenbaum then explained levels of confidence and stated a range is used of either 5 or 95 percent depending on how you looked at it (N.T. 324-325). Rosenbaum explained that a confidence level of 5 or 95 means there are five chances in 100 or one change in 20 that something will happen by accident (N.T. 325). He commented he believed it was just an arbitrary line drawn and that results reported to be lower than the 95 percent confidence level should not be chucked and that results greater than 95 percent confidence level should not be accepted as if they were absolutely proven in stone (N.T. 325-326).

Rosenbaum then reiterated that if an odds ratio drops below one it tends to mean the thing is good for you; if the odds ratio is above one, it tends to mean the thing is bad for you, but it doesn't mean anything unless you know what weight to give to the number through calculation of the confidence level (N.T. 326).

Turning to the specific studies mentioned in his direct testimony, Rosenbaum confirmed that in the 1979 Wertheimer/Leeper study used wiring codes and not EMF measurements in reporting their results (N.T. 329-330). He explained that he was referring to wiring codes when he stated in his direct testimony that Wertheimer and Leeper reported an increased cancer rate among people living near primary and secondary distribution lines (N.T. 330). Rosenbaum explained that the wiring code used by Wertheimer and Leeper took into

account thickness, number of wires and service drops as proximity to the wires (N.T. 330-331). Rosenbaum also confirmed that in the 1982 Wertheimer and Leeper study, they reported their results in terms of wiring code, but not EMF measurements (N.T. 331).

Referring to an occupational study by Barregard in his testimony, Rosenbaum confirmed that workers were exposed to static magnetic fields of 100,000 milligauss, which in other words, was zero hertz, meaning that the field did not vary with time (N.T. 331). He reported that these static magnetic fields did not seem to do any harm to the workers and that the odds ratios was less than one (N.T. 332). He volunteered that this was a definitive type of study because since the workers were moving through static magnetic fields they actually generated currents in their bodies (N.T. 332). He stated that researchers found an actual decrease in mortality and cancer incidence among these workers (N.T. 332).

When questioned about the Savitz study, Rosenbaum explained that Savitz used both measured short term field strength and a form of the surrogate for EMF measurement -- the wiring code (N.T. 338-339). He testified, that the wiring code used by Savitz was not the same as the wiring code used by Wertheimer and Leeper (N.T. 339). In fact he volunteered that the two studies done by Wertheimer and Leeper used different wiring codes (N.T. 339).

In answer to a question of whether the costs of prudent avoidance should include the potential for the utility to buy the properties of the public along the right-of-way to lower the public exposure to magnetic fields, Rosenbaum stated that he did not believe it was for him to list an agenda of items that needed to be considered (N.T. 355). He agreed that two ways to lower exposure to heavily populated areas would be to avoid those areas or to remove the population, but stated that to what extent that that needs to be done depends on the particular circumstances and what the cost is (N.T. 356).

Recross Examination

When asked to characterized what the biological studies indicated to him, Rosenbaum stated that the evidence is quite strong that EMF at the frequencies under consideration can interact with human cells and cells in general (N.T. 367). He felt it was surprising that such interactions occur considering the general feeling 20 years ago was that the wavelength of 60 cycle fields which is more than 3,000 miles in length had no chance of interacting with human cells (N.T. 367). He believed that evidence of this interaction requires that the issue be taken more seriously (N.T. 367).

DAVID E. JANES - Direct Testimony

David Earl Janes of Risk Analysis Corporation, Suite 202, 6723 Whittier Avenue, McLean, Virginia, 22101, sponsored OCA Statement No. 1 as his direct testimony

(N.T. 368, OCA Statement No. 1, p. 1). He indicated that the prepared statement, OCA Statement No. 1, represented his direct testimony with one correction -- the superscripted reference on page 7 at line 17 should be "two" instead of "four" (N.T. 369).

In his direct testimony, Janes stated that he is Vice President of Risk Analysis Corporation and was appearing at OCA's request (OCA Statement No. 1, p. 1). He stated that he had over 30 years in analyzing the effects and risks of exposure to ionizing and nonionizing radiation (Id., p. 1).

Janes explained that electric and magnetic fields produced demonstrable, measurable effects in humans, animals and experimental cellular systems and gave an example of the phenomena: hair movement on the back of the hand when the arm is raised above the head in an electric field and strong magnetic fields can be sensed through flickering light flashes (magnetophosphenes) they produce in the visual system (Id., p. 2). He further explained that the fields that produce these two effects are not commonly found in environmental exposures, but that exposure to weaker electric and magnetic fields also affects biological systems (Id., p. 2). Janes defined a weak field as one which induces in tissue a current density too small to affect the function of critical tissues such as the heart and the central nervous system (Id., p. 2). Janes explained that electric and magnetic fields induce currents or the flow of electric charge in objects placed in the field (Id., p. 2).

Janes then testified that typical high voltage transmission lines have a maximum field strength on the right-of-way from approximately 1 to 12 kilovolts per meter and fields at the edge of the right-of-way from 0.3 to about 3 kilovolts per meter (Id., p. 3). For its 230kV single circuit line, Janes reported that PECO calculated the maximum right-of-way fields to be 1.9 to 2.3kV/m and the fields at the edge of the right-of-way to be 1.2 to 1.3kV/m (Id., p. 3).

Janes then testified that magnetic fields under high voltage lines are variable being dependent on the line current that varies with the transmitted power (Id., p. 3). He stated that typical values fall in the range of 20 to 140 milligauss and maximum values probably do not exceed 350 milligauss (Id., p. 3). Janes then reported that PECO calculated the maximum right-of-way field to be 42 milligauss and the maximum edge of the right-of-way field to be 25 milligauss for its 230kV single circuit line carrying 360 amperes (Id., p. 3). Under heavy loading (600 amperes) and emergency maximum loading (1000 amperes) the magnetic fields would be higher (Id., p. 3).

Janes then testified that the interaction of power frequency fields with humans and animals results in intensified electric fields at the outer surface of the body and electric fields and currents inside the body (Id., p. 3). He explained that if an electric field exists at some location, for example on a transmission line right-of-way, and there are no objects in the field between the conductors and the ground, the field is an unperturbed electric field (Id., p. 5).

Janes also explained that the electric fields induced inside the body are very much weaker than the external unperturbed and surface electric fields (Id., p. 5). These induced internal fields and their associated current densities depend on body shape and orientation with respect to the field direction (Id., p. 5). This means, Janes explained, that larger unperturbed fields must be used in laboratory studies of small animals to obtain current densities equivalent to those induced in humans (Id., p. 6).

Janes then testified as to the manner in which power frequency magnetic fields interact with people and animals (Id., p. 6). He explained that this interaction cause currents inside the body, but unlike electric fields, magnetic fields are not intensified at the surface of the body (Id., p. 6). He also explained that the magnitude of the induced currents are proportional to body size, meaning that larger magnetic fields must be used in the laboratory to obtain current densities equivalent to those induced in humans (Id., p. 6).

Janes then testified that the literature on the effects of weak electric or magnetic field exposure on biological systems is large and has been extensively reviewed and analyzed by experts (Id., p. 6). He reported that both positive and negative effects have been reported, but in general, many things are unaffected by exposure to weak electric and magnetic fields: growth and development, morbidity, blood cell populations, serum chemistry, and

cardiovascular function (Id., p. 6). He also reported that there was solid experimental evidence that some effects occur in exposed animal and cellular systems (Id., p. 6).

Janes then proceeded to give examples of studies in which the effects of exposure to weak fields have been reported (Id., pp. 6-9).

Janes testified that one biological effect reported on exposure to weak electric fields is perception (Id., p. 7). He commented that humans and animals can sense the presence of electric fields (Id., p. 7). He explained that the median threshold unperturbed electric field in which humans feel hair movement is about 7 kilovolts per meter, but is as low as 2 kilovolts per meter for some people (Id., p. 7). He further explained that the intensified surface electric field responsible for hair movement in humans lies within the range of 30 to 65 kilovolts per meter and detection sensitivity is influenced by humidity with higher humidities giving lower detection thresholds (Id., p. 7). Rats, Janes testified, perceive unperturbed electric fields in the 3 to 15 kilovolts per meter range, although the mechanism of detection is not clearly understood (Id., p. 7).

Janes also testified that humans and animals do not perceive magnetic fields in environmental exposures but humans can sense magnetic fields above 100,000 to 200,000 milligauss through flickering light flashes (magnetophosphenes) they produce in the visual system (Id., p. 7). He noted that fields

this large are only found in experimental, industrial or medical applications (Id., p. 7).

Janes also testified that one consistently observed effect of weak electric and magnetic fields on animals studied in the laboratory is the disruption of circadian rhythm (Id., p. 7). Janes explained that circadian rhythms are biological rhythms that repeat at approximately 24-hour intervals (Id., p. 7). As example, he cited an example that normal body temperature has a regular daily cycle of about one degree Fahrenheit (Id., p. 7). He further explained that the times of maximum and minimum temperature depend upon lifestyle and for most people, the maximum occurs late in the afternoon and the minimum is early in the morning (Id., pp. 7-8).

Janes then gave examples of the effects of weak fields on circadian rhythm involving melatonin, a hormone that among other things, regulates sexual function and development (Id., p. 8). He explained that the concentration of melatonin has a daily rhythm, high at night and low during the day (Id., p. 8). He stated that exposure to 60HZ electric fields in the range of 1.7 to 39 kilovolts per meter suppresses nighttime concentrations of melatonin in the rat pineal gland (Id., p. 8). He also stated that Kavaliers and co-workers reported that their observation of the effect of a static magnetic field (rotating at about 1HZ) on the nocturnal response of mice to morphine is consistent with a reduction of nocturnal pineal gland activity and levels of melatonin (Id., p. 8). He further

stated that the suppression of nocturnal rise in melatonin in rats is apparently reversible and that elevated melatonin levels returned to pre-exposure levels within three days after exposure was stopped (Id., p. 8).

Janes also cited the effect of weak fields on neurotransmitters, whose circadian rhythms are altered in the brains of rats exposed to 39kV per meter, 60HZ fields (Id., p. 8). He commented that neurotransmitters act as chemical bridges between nerve cells in the transmission of sensations such as light, heat and pain (Id., p. 8).

Janes then gave examples of effects of weak electric and magnetic fields observed in studies of cellular systems (Id., p. 8). One area where effects have been seen with consistency, he stated, was in the synthesis and activity of biologically important macromolecules such as ribonucleic acid (RNA) and proteins (Id., pp. 8-9). Janes explained that among other things, RNA copies information from DNA so that proteins can be produced (Id., p. 8).

Janes also reported that one study that combined extremely low frequency magnetic fields (16, 75 or 100HZ) with static magnetic fields reported small decreases (5 to 8 percent) in the proliferation of rabbit ligament fibroblasts (Id., p. 9). In a parallel study in which the frequency of the magnetic field was held constant at 100HZ and its amplitude varied, cell proliferation first decreased and then increased as the amplitude of the magnetic field was increased (Id. p. 9).

Janes then commented that the mechanism for these observed weak field effects are not known (Id., p. 9). He listed several models which have been speculated to be the mechanisms by which these effects are observed: (1) one involves changes in the cell membrane that affect cell function; (2) another is a resonance model which involves the magnitude and the direction of the earth's static magnetic field, the direction and the frequency of the applied time varying magnetic field and the ratio of the charge to mass of several biologically important molecules (Id., p. 9). Janes indicated that these models had not been experimentally established (Id., p. 9).

Cross Examination

On cross examination, Janes testified that he considered himself to be an expert in physics and biophysics, but did not claim to be a medical doctor or an expert in immunology, endocrinology or oncology although he had done work in those systems (N.T. 371). He allowed that he would defer to a qualified specialist in immunology, endocrinology and oncology for medical conclusions (N.T. 372). He also testified that he does not have an advanced degree but completed all the requirements except for completion and defense of a thesis for a Ph.D. in biophysics at the Medical College of Virginia (N.T. 372).

Janes testified that the 60 Hertz fields from a power line and a 60 Hertz field from an electric clock are basically

the same except for intensity (N.T. 375). He also testified that appliances and household wiring are sources of power frequency fields (N.T. 375). Janes confirmed that power frequency fields in the United States are 60 Hertz and in Europe, they are 50 hertz (N.T. 375). He also testified that power frequency fields would be expected if one is running something electrical from a 60 Hertz line as a power source (N.T. 375). Janes added that with current flowing, you will find magnetic fields and that you could have electric fields without current flow (N.T. 376). He confirmed that fact that there was power frequency fields present in the room in which he was testifying (N.T. 376). He stated that he did not have detailed information to make a judgment in terms of intensity distribution to say that people get more exposure from electric and magnetic fields from power lines or from non-power line sources (N.T. 376).

When asked for an alternate definition of circadian rhythm which did not include the word rhythm, Janes provided an example using body temperature (N.T. 410-411). He explained that normal body temperature goes through a cycle that repeats every 24 hours, and that for people who do not do shift work or work at night, the maximum temperature is usually late in the afternoon, usually after some activity or food ingestion (N.T. 411). He then stated if you follow the cycle, the temperature will decrease and it will be at a minimum when people are asleep prior to when they wake up (N.T. 411-412).

He stated the variations in temperature are small and they repeat essentially every 24 hours in a cycle which is called circadian rhythm (N.T. 412).

Janes affirmed that in his direct testimony at page eight, he had mentioned weak field effects on melatonin, a hormone that among other things regulates sexual function and development (N.T. 415). He explained that a hormone is an organic molecule that is manufactured in an endocrine gland and has its physiological impact by entering the circulation and acting at sites remote from where it is synthesized (N.T. 415). Janes then stated that the general hypothesis is that melatonin acts as an inhibitor of other hormones that have to do with the synthesis of molecules and cells that enter the reproductive process (N.T. 415). He stated that he was not an expert in this field and referred to the description by both Reiter and Wilson, both recognized experts in the area of melatonin (N.T. 416). Janes could not give an answer to the question of whether melatonin alters gonadotropin levels in humans (N.T. 416). He agreed that most of the studies on melatonin function were done on rats and that when it comes to sexual function and developments rats and humans are substantially different from one another (N.T. 416).

Janes then confirmed that neurotransmitters have circadian rhythms in unexposed animals as seen in that study (N.T. 422). He did not know whether neurotransmitters in human brains had circadian rhythms (N.T. 422).

JOSEPH BIANCHIMANO - Direct Testimony

Joseph Bianchimano of 91 Bridgestone Drive, Langhorne, PA, 19053, testified that he had lived at that address for 28 months and that he is married and has two young children -- a six year old and a one year old (N.T. 437-438). He also testified that it is 50 feet from the tower to his property line and 75 feet from the tower to his house (N.T. 438). He stated that he is a realtor with Remax Realtors and that he is the broker/owner of that company (N.T. 438). Remax Realtors sell predominantly residential real estate in the tri-county area and that he is actively trying to sell his home (N.T. 438). He testified that he had not been successful in his efforts (N.T. 439).

Bianchimano explained the reason he is trying to sell his home is that he is concerned about his children from reading the EPA's current statement that these high voltage lines may pose a possible carcinogenic risk (N.T. 440). He continued that in his mind there is a preponderous of the evidence that there is a risk (N.T. 440). When asked upon what he based his opinion about the risk from the power line if it were energized, Bianchimano replied from the studies he had been reading, predominantly the Swedish studies, the EPA Reports, the current radio announcements on National Public Radio, and current seminars held in Washington, D.C. (N.T. 441).

Bianchimano testified that when he sells property and he has a client interested in purchasing a lot near a proposed power line, he tries to steer them away from it (N.T. 441). He explained that he had a moral problem if the family had children in light of the potential risk (N.T. 442).

When asked whether he would communicate his concerns about the potential of energizing the line to a purchaser of his home, he replied that he would and would give them whatever information he had and would let them draw their own conclusion (N.T. 443). Invariably, he testified, their conclusions always led them to shop elsewhere (N.T. 443).

He then verified that prospective purchasers have come to his house but indicated that he did not have a "for sale" sign on his house (N.T. 443). He also confirmed that he advertised his home but only in his office, and that he made full disclosure to prospective buyers about the power line (N.T. 443).

Bianchimano testified that prospective buyers want to know why he is selling the house and why two other homes are for sale on his block (N.T. 443). He explained that there are only 11 homes in his community and they have been built in the last two years, and three of those homes are on the market (N.T. 443). He also testified that he is president of the homeowners association (N.T. 443). In answer to a question about what he had done to advertise his house he contradicted his previous testimony and answered the standard marketing

procedures: advertising, signs, Multiple Listing Services (N.T. 444).

When asked have you taken any steps in your house to prepare for the potential energizing of the power line, Bianchimano responded that he could not move his house so there was nothing he could do (N.T. 445). He stated he had a rental property, but that would mean leaving his house vacant and he has a mortgage (N.T. 445). He also stated that he couldn't rent his house because there is no market to rent a 4,000 square foot house (N.T. 446).

When asked how the potential energization of the power line affects how he or his family lives, he replied that they have changed a lot of things in their daily lives (N.T. 446). He testified that his family stands away from the microwave when it is on, he asks the children to stand back from the television, he moved his son from a room below an attic that had a heating unit in it to another room (N.T. 446). However, he stated, that room faces the power line and he has no other place to put him (N.T. 446). He also stated that they practice prudent avoidance by not using electric blankets and moving his clock over to the far bureau (N.T. 446). He stated that the power line is a situation over which he had no control (N.T. 447).

Bianchimano testified that his wife just had a cancer operation in May of 1991 (N.T. 447). He then testified that she has a family history and he is concerned in the event she is susceptible (N.T. 447).

Bianchimano also testified that there is an open area next to the power line and that the homeowners association had a common interest in the parcel and was going to put a playground there (N.T. 448). He testified that it is just not a smart thing to do at this point (N.T. 448).

Bianchimano stated that he spent a lot of money on it (N.T. 456). He testified that he had spent \$300,000 for the purchase of the home and had a \$153,000 mortgage on it (N.T. 456, 458). He also testified that he had made \$35,000 in improvements after he bought it and he had future plans to finish the basement, and put a pool and concrete work in the back (N.T. 456, 457). He stated that his property is approximately 2.2 acres, but the house itself is at the front of the lot near the power line because the balance of his property is in a floodplain which prohibits him from building additions in the rear area of the home (N.T. 458). Bianchimano also volunteered that he would gladly sell his property for the price he paid for it (N.T. 458).

Bianchimano testified that if the power line was energized, it would disrupt his life because the family would like to move (N.T. 459). He testified his child is in a special education program in Council Rock School District but he can't stay in Northampton because all of his equity is tied up in the house (N.T. 459). He stated that he would have to move to a cheaper area or rent an apartment (N.T. 459). He speculated he would probably go back to Philadelphia, but

stated that he wasn't crazy about their school system, but he felt it was safer than living near a power line (N.T. 459). He liked to sell the property but didn't feel right about selling to another family with children (N.T. 460).

Cross examination

On cross examination, Bianchimano verified that a freight line travels in front of his house, but testified that the train schedule is erratic that sometimes you will get one or two or five trains a week (N.T. 462). He then testified that his property is across the street from the railroad tracks and clarified that his house sits back 75 feet from the edge of the property which faces the power line (N.T. 462). He confirmed that his house does not abut the Conrail right-of-way and that there is a parcel of land, a strip and then the power line (N.T. 462). He also confirmed the fact that his house is an all electric home with a heat pump (N.T. 462). When asked whether he was a named protestant in this matter, he instead stated that he had been with PAUSE since the beginning, had acted as a liaison between PAUSE and Northampton Township and participated in PAUSE fundraising activities (N.T. 463-464).

Bianchimano again attempted to clarify his statement about the power line's distance from his house by stating that he would say that it was a total of 125 feet from his door to the power line (N.T. 464). He admitted that he measured the distance from his property line to the power line, but had not measured the width of the street or the intervening parcel of land (N.T. 464).

JOHN FOX - Direct Testimony

John Fox of 17 Wychwood Lane, Langhorne, PA, testified that his property covers eight-tenths of an acre and the corner of his property by his estimates is 60 or 70 feet from the power line (N.T. 466). He estimated that his house was somewhere between 170 to 190 feet from the power line (N.T. 467). He testified that he is married and he has two children -- a ten year old boy and a six year old girl (N.T. 467). He also testified that when they bought the house, they considered whether they should buy a house close to the railroad, but determined that they could probably control their children to reduce the risk of an accident on the tracks (N.T. 467).

Fox testified that his children's bedrooms are at the point closest to the power line, but he could do nothing short of relocating to a different house to relocate their bedrooms (N.T. 468). He also testified that his house is not presently for sale, but he stated that it would be if the power line is energized (N.T. 468). He volunteered that several months ago a real estate agent contacted him about selling his house, but the prospective buyer, a science teacher from Neshaminy School District decided not to buy it because he didn't want to be near a power line (N.T. 469).

Fox testified that it wasn't the physical appearance of the power line that affected him, but his learning about the

health risks associated with power lines (N.T. 470). He stated that it's mostly the education he received after hearing various reports about health risks from the line that affected the way he approached electricity use in his home (N.T. 471). When asked what changes he made in his lifestyle since becoming aware of the intention to energize the line, Fox stated that they moved clocks, reduced the use of the microwave, stand back away from the microwave, exercising what he termed to be prudent avoidance, and they joined an organization (N.T. 471).

Fox testified that he has learned that there are studies that prove that there are cluster groups of increased leukemia in children and brain cancer and other health risks other than cancer (N.T. 471). He also testified that he learned that there is an absolute connection between electromagnetic fields and the human cell which is especially risky when young children's cells are developing rapidly (N.T. 471). He claimed that from what he learned in high school general science, for the next 10 years his kids would be replacing their bodies every seven years and he was concerned that the effects would be harmful to the growth process (N.T. 472).

When questioned, Fox testified that he had spent \$210,000 on the purchase of the home and has a mortgage of approximately \$90,000 (N.T. 472). He also testified that he spent \$20,000 to \$30,000 since he purchased the home (N.T. 472).

JOSEPH KELLY - Direct Testimony

Joseph Kelly, 3904 Warfield Drive, Huntingdon Valley, PA, testified that his business address is 206 Holland Road, Holland, PA (N.T. 475). He testified that his business address is approximately 500 feet from the power line and that he does not own this property, but leases it (N.T. 475). He testified he had six full-time people working for him in his real estate sales and management business -- three men and three women (N.T. 475). He testified that his business has been there for seven years now (N.T. 475). He testified that he had learned about the power line about a year and a half ago through his association with other people (N.T. 476).

He testified that in using the computer terminal, he tries to stay three or four feet away from it when he uses it (N.T. 476). If the power line is energized, he would strongly consider relocating his business which would not be to his advantage because his business is in a prime location (N.T. 476). The reason that he would consider relocation is that he did not want to be located in close proximity to a power line (N.T. 476).

In answer to a question of whether he had been involved in any of the offers to sell his home along the power line, Kelly testified that he had a house for sale that abuts the power line for approximately a year and a half (N.T. 477). When asked what advice he gives to prospective purchasers about

power lines, he explained that he spoke to other people in his field and the conclusion was if the power line is open and visible, disclosure about the power line is not necessary (N.T. 478). If the power line was proposed, he stated that he would be under an obligation to tell prospective buyers about it (N.T. 478).

Kelly then testified that he is aware that there are other houses on the market that are adjacent to or abut the proposed power line and that they have been on the market for a considerable period of time (N.T. 479). One, he stated was on the market for a year and a half and others have been on the market for approximately six to nine months (N.T. 479).

Cross examination

On cross examination, Kelly confirmed that there were houses which were not near the proposed power line which have been on the market for six to nine months (N.T. 480). He then testified that there weren't a lot of houses that have been on the market for a year and a half (N.T. 480).

Kelly also testified that he spends approximately 10 to 12 hours a day in the office and that his employees are not in the office that often (N.T. 481). He clarified that half of his employees are real estate agents and they spend half of the time he spends there (N.T. 481).

MICHAEL LAWLER - Direct Testimony

Michael Lawler of 1513 Grace Circle, Feasterville, PA, testified that he is married and has three children: ages 21, 17 and 13 (N.T. 481-482). He testified that he owns a half acre of property and that the perimeter of the property is 70 feet from the proposed line (N.T. 482). He also testified that the line is 90 feet away from the edge of his home (N.T. 482). He also testified that the house cost him \$80,000 and he put another \$4,000 in it (N.T. 483). He testified that he has a \$78,000 mortgage on the house and that it is presently for sale (N.T. 483). It has been for sale for three months (N.T. 483). No one has made an offer to buy the house (N.T. 484).

When questioned about the reason that he put the house up for sale, Lawler replied that they were very scared about EMF because of watching television coverage, and reading newspapers and magazine reports (N.T. 483). They were concerned for their children (N.T. 484).

In regard to changes made in their lifestyle since learning that the line would be energized, Lawler testified that they started reading material on electric blankets and stopped using them (N.T. 484). He stated he doesn't allow his children to use the microwave and that when his wife and he use it, they walk away from it when it's running (N.T. 484). He also testified when his wife uses the electric stove, she stays away (N.T. 484).

When asked if he would permit his children to play there if the line was energized, Lawler said no, if he can't sell his house he'd take them elsewhere to play (N.T. 485). He confirmed that he had a 21 year old son who is away at college, but stated that when he comes home, he and his friends play basketball in front of his house (N.T. 485).

When questioned about how his lifestyle would change if the line were energized, he stated that it would scare him to death and he'd have to try to move (N.T. 485). He stated that financially [moving] would hurt him because his son and his wife are both in college and his daughter will be going soon (N.T. 486).

When asked whether his wife was concerned about the intention to energize this power line, Lawler stated that she had testified previously; that she was a nurse and she was aware of children with leukemia (N.T. 486). She is also very upset about having to move because she loves the house and the neighborhood (N.T. 486).

ELAINE KUPCINSKI - Direct Testimony

Elaine Kupcinski of 1508 Grace Circle, Feasterville, PA, 19053, testified that she is married and has three daughters: twins that are 12 years old and a 14 year old (N.T. 488). She then testified that she owned one-half acre, and that the property line was 70 feet from the power line (N.T. 488). Her residence is approximately 90 feet from the line (N.T. 488).

In answer to a question about whether she would allow her children to play in the cul de sac across the street if the line was energized, Kupcinski answered no, that they would have to play elsewhere (N.T. 489).

Kupcinski also testified that since learning about the power line, she has changed her and her children's lifestyles to practice prudent avoidance; i.e., moving electrical clocks away from the bed, and leaving the room when you are using a microwave or an electric dishwasher (N.T. 489). She explained she has gas and electric in her home so she doesn't have a lot of electrical appliances (N.T. 489).

If the power line was energized Kupcinski stated that she would move (N.T. 490). She is concerned for the children's health because both her family and her husband's family have a history of cancer (N.T. 490). She stated that after reading all the literature that was made available by PAUSE she couldn't in good conscience stay in the house (N.T. 490).

When asked about the amount of money that she spent in purchasing her property, she replied she purchased the house for \$80,000 and put in approximately \$10,000 in improvements (N.T. 491). She offered that her husband had done a lot of the work himself and she really couldn't document the amount (N.T. 491). She also testified that they have a \$60,000 mortgage on the house (N.T. 491).

When asked whether she would sell her house if the line was energized, Kupcinski replied that she would, but that

it wasn't presently for sale (N.T. 491). She explained that she talked it over with her husband and felt if several people in the same area or on the same street are putting their houses up for sale at the same time, people aren't even going to want to come and look at the house because they wonder why everyone's moving at once (N.T. 491). She testified that they decided to wait to see the outcome of the hearings and then decide whether to move or not (N.T. 491-492). Right now they weren't financially in a position where they could do that (N.T. 492).

When Kupcinski was asked about where she obtained information relating to the potential harm caused by the energized power line, she replied that she is part of the organization and reads all the literature that comes in, and that she had seen information on television, in the newspapers and in magazines (N.T. 494). She testified that she had never seen any studies distributed by PAUSE that there was no risks or a slight risk from EMF (N.T. 495).

When asked what she would be able to do to protect herself if PECO energizes the line, Kupcinski stated she didn't believe that she could do anything (N.T. 496). She stated that she didn't see any other option, but moving (N.T. 496).

RONALD A. TURNER - Direct Testimony

Ronald A. Turner, a principal in the firm of Ronald A. Turner & Associates, Architect and Planners, sponsored Protestants Statement No. 1 as his direct testimony (N.T. 517).

Turner first testified on land use in the area of the Woodbourne-Heaton transmission line (Id., p. 1). He stated that the township through which the line passes, has undergone enormous changes in the last 40 years (Id., p. 1). For example, the region contained 31,285 persons in 1950, and by 1990 it contained 161,310 people, a growth rate of over 400% (Id., p. 1). Turner summarized this testimony by stating that land use patterns around the line have intensified at an extraordinary rate over the past four decades and are expected to continue. Consequently, the constant urbanization of the area is a significant factor in deciding whether or not the Woodbourne-Heaton line should be energized (Id., p. 1).

Turner then testified as to scientific evidence and public perception regarding the impact of EMF fields (Id., p. 2). He stated that the public awareness of the linking of EMF fields to health was precipitated by articles appearing in the press and magazines (Id., p. 2). While some researchers conclude there is a definite link between EMFs and health, others assert that there is no relationship (Id., p. 2). These differences of opinion present citizens and public agencies with dilemmas in regards to action (Id., p. 2).

Turner stated that his own research and interviews led him to the conclusion that there is a deep fear among knowledgeable citizens regarding the danger of exposure to all sources of EMFs and that this fear has led to a problem in the selling of residential structures in areas adjacent to

transmission line rights-of-way (Id., p. 3). He claimed initial evidence suggests value reductions in the areas of 15-25% (Id., p. 3, note 3). He anticipates that environmental audits presently used by financial institutions in evaluating properties will soon include relationships to EMF generators like transmission lines (Id., p. 3).

Turner then discussed ways of handling off-site EMF impacts (Id., p. 3). He advocated that this issue should be controlled by township zoning and planning ordinances (Id., pp. 3-4). However, he recognizes that PUC-regulated functions are generally exempt from zoning provisions of local municipalities (Id., p. 4).

Turning to the impacts of the proposed line on surrounding areas, Turner stated that in his experience and through interviews, it has become clear [to him] that the "towers" are viewed as a threatening element in the lives of community residents and that this has become a cause for declining values and disinvestment within that same community (Id., p. 5). He summarized this line of testimony by stating that until the uncertainty and differences of opinion are settled, one way or another, there is a high probability that [property] values will decline, disinvestment will occur and changes in land use, which are contrary to local policy and zoning, will result in the areas immediately adjacent to transmission lines (Id., p. 6).

As the final part of his testimony, Turner addressed the "Concept of Prudent Avoidance and Public Policy Recommendations" (Id., p. 6). He identifies Prudent Avoidance as a term introduced in an extensive study sponsored by the U.S. Congress' Office of Technology Assessment and defines it as "looking systematically for strategies which can keep people out of 60HZ fields arising from all sources, but only adopt those which look to be prudent investments given their cost and our current level of scientific understanding about possible risks" (Id., p. 7). Turner concluded his testimony by stating that the prudent avoidance approach would delay energizing of the line due to its proximity to residential and public areas, and that doing so would avoid any potentially adverse health impacts for current and future inhabitants along the line route (Id., p. 8).

Cross Examination

Turner testified that he was an architect and planner and had a bachelor's degree in architecture, but not a masters or doctorate degree (N.T. 519).

Turner testified that the population of Northampton Township increased over 1,475% over the last 40 years and was one of the areas he referred to as had continual urbanization (N.T. 536, 537). Turner testified that it is between four to five miles from the upper part of Northampton Township to the power line (N.T. 546). Turner testified that he did not include data about the growth and urbanization of Northampton

Township just in the area of the power line, but that all of Northampton Township was included (N.T. 547).

When asked if he testified that he believed the impact from the line would be concern about the EMF issue, Turner replied that he focused only on that concern. He discounted other concerns which might have dealt with aesthetics and parking and other noise because there had been a line there before (N.T. 547, 548).

Turner then testified that his population increase study included Hatboro Borough which had grown population over 50% in the last 40 years (N.T. 550). Turner testified that Hatboro Borough is one of the areas undergoing what he called "continual urbanization", which he indicated should be a significant factor in deciding whether to energize this line (N.T. 551). He further testified that Hatboro Borough is fairly well developed at this point and will not have much additional population unless there are significant divestitures of public facilities; it has been urbanized over the period from 1950 to 1990 (N.T. 550). Turner testified that the line does not enter Hatboro Borough directly, but that it is immediately south of the borough (N.T. 550). Turner testified that Hatboro Borough is within a half mile of the line, but that he was not sure (N.T. 551).

Turner testified that in his study he attributes an increased population over the last 40 years of over 400% for Lower Moreland Township (N.T. 553). When asked if [Lower

Moreland Township] is another area he identified as having continual urbanization that should be a significant factor in deciding whether to energize the line, Turner answered yes (N.T. 553-554). Turner testified he did not know how large Lower Moreland Township was in square miles (N.T. 554). He then testified that Lower Moreland Township extends approximately two miles away from the power line (N.T. 554).

When asked, Turner testified that for all the townships identified and worked on his exhibit, the included data on population growth was for the entire township rather than the portion of the townships in the vicinity of the power line itself (N.T. 555).

When asked if it would be fair to say that one of the reasons [he] recommended delaying energizing this line is because of claimed effect on property values, Turner responded yes (N.T. 556). When asked if he was a licensed real estate agent or broker, Turner testified no (N.T. 560). When asked if he was an appraiser or conducted any land appraisals, Turner testified no (N.T. 560). When asked if he had conducted any formal appraisal of the property values for the line, Turner testified that he did not (N.T. 560).

When asked if it was his position that energizing the line will affect property values and cause disinvestments, Turner testified yes (N.T. 561). Turner then testified that when he talks about decreased property values he was talking about a change in market values of the property (N.T. 561).

Turner then testified that the basis for his property value opinion was his own research and interviews and listening to the testimony of the applicant and the Protestants (N.T. 563). He further stated that the interviews and listening to the Protestants confirmed [to him] that there was a real fear of the EMF issue (N.T. 564). When asked if the interviews he referred to in previous testimony were with members of PAUSE, the same organization involved in this proceeding, Turner answered yes (N.T. 565). Turner then testified that the PAUSE members expressed concerns about the impact on property values as well as on health values (N.T. 566).

Turner also testified that he relied upon some research for his conclusions regarding an impact on property values (N.T. 568). He stated that in interrogatories 15(a), (c), (d) and 22, he was asked to provide his research on this issue and indicated he gave [PECO] an annotated bibliography which was prepared under his direction (N.T. 568-569). Turner testified that he had read in full each of the documents in his annotated bibliography (N.T. 569). Turner then contradicted himself by testifying that his reading of the documents was a combination of reading entire studies or summaries only where summaries existed (N.T. 570).

Turner then testified that his property value research provided initial evidence of 15 to 25% reduction in property values (N.T. 571). When asked if it would be accurate

to say that in one reference, the author Kinnard found that there was no negative effect on the value of property, Turner responded that in a previous study Kinnard found no evidence of negative impacts (Reference 16 of interrogatory 15(d)) (N.T. 571-572). Turner admitted that to the best of his recollection that the article by Kinnard he cited also stated that there was no decrease in property values (N.T. 572).

Turner testified that Reference 17, an article from Fortune Magazine was the source of the statement in his testimony that property values could decrease 25% after the power line was energized (N.T. 572). Turner admitted that the Fortune article "suggested" that property values could decrease, and that the Fortune article was 5 pages long and had one paragraph on property values (N.T. 572-573). Then Turner stated that the paragraph basically refers to a statement by a David Lewis of Houston, Texas, estimating that houses near transmission lines would drop 25% in value (N.T. 573). Turner testified that he did not know if Lewis was talking about a situation where a power line was going to be placed in an existing corridor such as a railroad, and did not investigate whether it was comparable to the existing circumstances (N.T. 573). Turner then testified that he did not know whether Lewis did an appraisal to come up with his 25% number (N.T. 573).

Turner admitted that many of the articles he relied on for his opinion about decreases in property values caused by

EMF and transmission lines made no reference to appraisal or property value data and actually found no effect on property values by transmission lines (N.T. 575-582).

When asked about whether or not property values will decline, Turner testified that if people think they will decline and they are motivated by fear, they will tend to sell (N.T. 592). He further testified that he thinks it is clear that if buyers also become aware of electromagnetic field impacts and the possibility of health impacts, that they will be looking at these properties in the same way and values will decrease (N.T. 592).

Turner then confirmed in his testimony that the Franciscan Health System was a project identified in his interrogatories (N.T. 617). He further confirmed that he did not recommend the project not be built or be delayed because of EMF from an adjacent transmission line (N.T. 617-618).

Redirect -

Turner testified that his conclusion was that the energizing of the line, given public perception of its health effects of the line, would cause a diminution of the values of the real estate and diminution of the quality of life of persons living adjacent to the line (N.T. 677).

ABRAHAM R. LIBOFF - Direct Testimony

Abraham R. Liboff of 345 Berwyn Road, Birmingham, Michigan, sponsored a document entitled Testimony Submitted to

the Pennsylvania Public Utility Commission (N.T. 740). The statement was marked for identification as Protestant's Statement No. 2 (N.T. 740). When asked if there were any additions or corrections to the testimony, Liboff indicated that page seven on research funding was missing from his statement, but with this exception, his statement was his direct testimony (N.T. 741, 744, 751).

In his direct testimony, Liboff listed his credentials as an expert in the field of physics and medical physics: he is professor of physics and director of the medical physics doctoral program at Oakland University in Michigan; for eleven years he was Chairman of Oakland University's physics department; and he was awarded his Ph.D. in physics at New York University in 1964 for research in low-energy cosmic rays (Protestants' Statement No. 2, p. 1).

Liboff stated that in the sixties, it was already known that weak electrical currents, of the order of microamperes, can somehow influence repair mechanisms in hard and soft tissues (Id., p. 1). Over the years, electromagnetic procedures which were developed became recognized clinical techniques for treating certain types of bone problems although there still is a lack of reasonable explanation as to the efficacy of such procedures considering that the power input of these signals is too small to invoke any conceivable physical mechanism (Id., p. 2). The fact that this phenomenon can not be explained using simple physical law may mean that biological

systems contain receptors or sensors designed to recognize small signals (Id., p. 2). He stated that the specialized mechanism that the cell employs to detect these undetectable signals has not been found, but then hypothesized when the mechanism is found, it will be fully consistent with physical laws (Id., p. 2).

Liboff then stated that eleven years ago, he spent sometime at the Naval Medical Research Institute (NMRI) in Bethesda, Maryland to study possible biological effects of ELF (Extremely Low Frequency) signal, a submarine communications signal (Id., p., 2). As a result of his research at NMRI, he concluded that human cells exposed to very weak ELF magnetic fields exhibit a consistent increase in DNA synthesis over cells not exposed (Id., p. 2). He stated that his work was published in Science (Id., p. 2).

Liboff continued that as with his earlier work on bone repair, which was also published in Science, the observed cellular effects seen in his NMRI studies have also proven extremely difficult to model (Id., p. 2). He also stated that the ELF intensities that were shown to be biologically sensitive at NMRI were so small as to be lower than any conceivable threshold level (Id., p. 2).

Liboff stated that he was not alone in seeing the above mentioned effects and in particular, Marron et al. showed that such fields can affect cell cycle, Goodman et al. showed that protein synthesis is affected and Bawin et al. found that

calcium efflux from brain tissue is enhanced (Id., p. 2). He stated that these studies were published respectively in Nature, Science and Proceedings of the National Academy of Sciences (Id., p. 2).

Liboff also explained that small fields are spoken of as being nonthermal or "weak", an adjective from physics (Id., p. 3). He continued that a weak electric or magnetic field is so small that there is no good physical reason to presuppose any sort of physical interaction with living systems (Id., p. 3). He further explained that the magnetic fields associated with electric power lines fit into this "weak" category (Id., p. 3).

Liboff then stated that the unlikelihood that these phenomena occurring was the reason that early epidemiological work by Nancy Wertheimer suggesting a connection between leukemia deaths and power lines was attacked (Id., p. 3). He also implied that there was also criticism of Savitz's follow-up work and every positive study for the same reason -- the unlikelihood of the interaction (Id., p. 3). Liboff then criticized the critics of these studies as being engaged in a sort of hysterical nonscientific evaluation of the epidemiological data with a lot of energy spent searching out minute disparities between Study A and Study B; giving uncritical emphasis to a very few earlier negative studies; arguing about "cause and effect" (which he terms a non sequitur in that epidemiology never establishes causal relationships);

and searching for confounding factors or hidden variables to explain away unpleasant correlations (Id., p. 3). He believed that the epidemiological findings that find a correlation have not been accepted because they are politically sensitive and that there is money at stake (Id., p. 3).

Liboff then identified three lines of independent evidence on ELF-induced biologic change which he believes must be considered together: (a) bone repair studies, (b) altered cell responses and (c) epidemiological cancer studies (Id., p. 3). Liboff stated that if one accepts the strength of the experimental research in the first two categories, one should be willing to accept evidence in the third category (Id., p. 4). Based on his experience in science, Liboff believes that if one looks at the entire picture, there is a variety of physiological processes which are exquisitely sensitive to ELF magnetic fields, and that one of these pathways apparently leads to cancer in humans (Id., p. 4).

Liboff then stated that although the media has featured a number of epidemiological studies involving cancer, two areas of studies have been ignored (Id., p. 4). The first involve human reproduction (Id., p. 4). Liboff explained that in a study involving pregnancy and the use of electric blankets originally published in 1979, Dr. Nancy Wertheimer concluded that the use of electric blankets in the first trimester can lead to problems (Id., p. 4). Liboff added that some parallel evidence has been published indicating that embryonic changes

occur in both chick eggs and fish eggs following exposure to weak ELF magnetic fields (Id., p. 4).

Liboff then mentioned a study of endocrine changes connected to the pineal gland in animal and human following electromagnetic exposure, which was conducted by Dr. Barry Wilson (Id., p. 4). He stated that there was a possibility that one of the pathways affected may result in breast cancer (Id., p. 4). He also saw in Wilson's work, a potential explanation for the anecdotal reports mainly in Eastern bloc nations over the past few decades, classified as neurasthenic episodes for individuals exposed to power lines and other electric sources (Id., p. 5). Liboff also cited the work of Graham and Cohen, who reported evidence in changes in human heart beat in a group of men exposed to 60HZ magnetic fields for short periods of time, and that of Dr. Russell Reiter of the University of Texas who asserted that some sleep disorders should be regarded as being caused by the electromagnetic environment (Id., p. 5).

Liboff also stated that over the last two or three years, he has come to believe that there are more than mere biological effects that may result from such exposures, but that there also are hazards to humans (Id., p. 5). He stated his opinion is based on his gradual acceptance of epidemiological evidence (Id., p. 5).

Liboff then explained his ion cyclotron resonance concept, which he hypothesized as a mechanism to explain the

physical part of the ELF interaction (Id., p. 5). He stated that the effects which are observed as a result of exposure to 60HZ magnetic fields are functionally dependent on the local DC (direct current) magnetic field, i.e. the local geomagnetic field (Id., p. 5). He explained that certain specific combinations of AC and DC magnetic fields can act to put different biological ions such as calcium, potassium and magnesium into resonance states and thereby influence their transport into and out of the cell (Id., p. 5).

Liboff explained that the ion cyclotron resonance theory was tested in 1984 at NMRI in a study sponsored by New York State Power Lines Project (Id., p. 5). He stated that in that first ICR experiment, he found the strongest possible indication favoring the hypothesis, and since that time has carried out dozens of other experiments designed around the ICR hypothesis using diatoms, human lymphocytes, embryonic chicks, rabbits, yeast and bacteria (Id., p. 5). He stated that most of the studies were successful, but admitted that some had negative results (Id., p. 5). He stated, that although there had been criticisms of his work, he and his colleagues have been sure of their results for some time (Id., p. 5).

Liboff then noted a second area of research with the ICR theory involves exposing human lymphocytes to calcium tuned fields which resulted in profound changes in calcium uptake (Id., p. 6). He explained that the experimental protocol was adopted and extended by Dr. Jan Walleczek at Laurence Berkeley

Laboratory (Id., p. 6). He stated that one of the things predicted by ICR analysis may be the specific values of the earth's magnetic field for which 60HZ exposures would be particularly hazardous (Id., p. 6).

Liboff then stated that less than a year ago, he had begun a series of experiments, as a more complete follow-up to earlier unpublished work he had done which involved examining the effects of weak ELF resonance exposures on human cancer cell lines, notably human lymphoma (Id., p. 6). In the previous experiments (conducted about 1983) Liboff found that mouse myeloma and lymphoma cells displayed extraordinarily high rates of proliferation if ELF magnetic fields were applied (Id., p. 6). The results of the study were never published because, Liboff testified, they seemed too high (Id., p. 6). He learned later, he stated, that two other researchers, Dr. Wendell Winters of the University of Texas and Dr. Abe Parola of Ben-Gurion University, working independently had seen the same effect (Id., p. 6).

Liboff explained that his most recent results on human lymphoma cells reaffirm these results, but also found that the degree of proliferation in 60HZ magnetic fields is closely dependent on the local geomagnetic intensity, rising and falling sharply in the vicinity of certain cyclotron resonance points (Id., p. 6). He then stated that he was now reasonably certain that human cancer cells, at least in vitro, can show significant progression following exposure to weak

60HZ fields at specific geomagnetic resonance values (Id., p. 6).

Cross Examination

Liboff confirmed that he had a master's degree and a Ph.D. in physics, and not in a subspecialty such as biophysics or atmospheric physics (N.T. 755). He also confirmed that he had not taken any courses beyond the undergraduate level in immunology, teratology, molecular genetics, cellular biology, pathology, epidemiology and oncology (N.T. 755-756). He testified he sat in on a course in biochemistry but did not formally take it, and that he took courses in biophysics which is a subject he also teaches (N.T. 755, 756). He also stated that Oakland University does not have a medical school and he is not a medical doctor (N.T. 756-757).

Liboff verified that he is familiar with the scientific concept of replication and explained the concept thusly: that the mere replication of an experiment from one laboratory to the next does not necessarily fulfill the demands of what scientific replication are about (N.T. 760). He further explained that scientific replication in a larger sense has to do with a large picture and not a specific experiment (N.T. 760). He explained that the problem with a specific experiment is that it is impossible for one laboratory to replicate another experiment in terms of all necessary experimental parameters in the protocol (N.T. 761). He then added that you would have to go down to the time of day and

temperature and the people walking down the street and a hundred and one parameters that no one knows when they do an experiment are important or not (N.T. 761).

Liboff agreed that to truly replicate something, you would need to have all the conditions the same (N.T. 762). On whether the use of the word "replicate" is applicable to experiments which only repeat an experiment as close as possible, but not all the conditions, Liboff stated that it was almost a matter of advocacy instead of truth (N.T. 763).

When questioned about if he knew of an example where one got the same results from follow-up experiments which did not duplicate the exact conditions of the original experiment, Liboff cited a calcium efflux experiment which had been initiated by a group of researchers in Dr. Adey's laboratory in California in 1973 or 1974 which involved the loss of calcium from sliced brain tissue (N.T. 764). In the experiment an efflux of calcium was observed as a result of applying a specific field (N.T. 764). When the experiment was done by another group of researchers, it resulted in an influx of calcium (N.T. 764). Liboff explained that researchers on different sides of the issue took the influx of calcium as opposed to the efflux of calcium to argue against the believability of the first experiment (N.T. 764). Liboff counted himself among those who believed that if both experiments were carefully done then one conclusion that could be drawn is that there are some changes in calcium which could

be manifested as either an influx or an efflux (N.T. 764-765). Liboff then agreed that when there is more than two or three experiments on a particular subject, then it is more likely that more is known about the subject and the association and added that that was the way science moves that you need a body of work to make decisions (N.T. 768).

Liboff then agreed that the transmission line will create 60HZ sinusoidal fields rather than pulsed fields when operated properly (N.T. 769). He also agreed that sinusoidal and pulsed fields have different characteristics and that one difference is that pulsed fields contain many frequencies or a spectrum of frequencies higher than 60HZ (N.T. 769-770).

Liboff agreed that there was a difference between showing a biological effect and a health hazard and stated that there are all sorts of biological effects that under simple conditions need not be hazardous (N.T. 778). He offered examples: (1) sugar placed on the tongue is not hazardous if you are young enough, not overweight or diabetic and (2) the measured physiological changes that result in the change in the physical background from going from an air conditioned room out into the sun (N.T. 778). He then expressed the opinion that the term "hazardous" reflects a situation where there is some measured level of illness, or in extreme case death that might result in a correlative way with a specific parameter (N.T. 779). He explained it would be hazardous for some people to place sugar on the tongue and for some people to undergo a severe change in temperature (N.T. 779).

On the subject of epidemiology, Liboff agreed that the field could be described as the study of the patterns of disease in population and added that it could be used for things other than disease (N.T. 779). He also agreed that he didn't know a mechanism by which EMF creates biological effects, but he set forth a hypothesis for that mechanism (N.T. 780).

When asked about whether it was accurate that no one has identified an established not hypothetical mechanism for the interaction, Liboff stated he had a mechanism and many people are basically in agreement with his mechanism or hypotheses (N.T. 782). He then agreed that his ion cyclotron resonance idea was a hypothesis as distinguished from a theory and that the basic path that is followed is from hypothesis to theory and beyond (N.T. 783).

Liboff agreed it would be fair to say that a hypothesis is an idea around which you design experiments to test whether that hypothesis is correct or not, but he stated that it need not be an experiment and that hypotheses are theoretical (N.T. 784). He stated that the hypothesis under scrutiny in this case has both experimental and theoretical ramifications that might not lend themselves to laboratory experimentation (N.T. 784).

Liboff also confirmed that he conducted a number of experiments on his ion cyclotron resonance (ICR) hypothesis including experiments on rats (N.T. 785). He testified that he

believed he had said in his deposition that the rat study was not a published experiment, but the report leaked out and someone attempted to replicate the experiment and failed (N.T. 786).

Liboff also testified that he was part of a larger group that was working with diatoms, a single celled microscopic organism found in fresh and seawater bodies of water (N.T. 787). He explained they are the equivalent of plankton, which whales eat by droves (N.T. 788).

Liboff also stated that the researchers at the University of Rochester were attempting to repeat his work on diatoms but he was not sure that they had completed or published the work (N.T. 788). He did hear that they were not able to repeat the same results (N.T. 788).

Liboff also verified that Dr. Parkinson at the University of Michigan attempted to repeat the diatom experiments but was not able to achieve the same basic results (N.T. 789). He explained that there are some questions as to whether or not the experiments were done under the same conditions specifically as to the source of the diatoms and how they were handled (N.T. 789).

Liboff then confirmed that he did work with human lymphocytes and that there had been attempts to replicate this work (N.T. 790). He acknowledged that one group in London, England attempted the experiments and did not get the same basic results (N.T. 790). He also confirmed that a group in

London, Ontario also attempted to replicate the lymphocyte work and could not (N.T. 790-791). Liboff also testified that giving them the benefit of the doubt about their ability to design proper exposure coils, a group at Berkeley managed to replicate his work on cyclotron resonance (N.T. 792).

Liboff confirmed that Dr. Walleczek was one of the group of researchers who replicated his work with human lymphocytes (N.T. 792). Liboff also confirmed that Walleczek's group added another variable to the original Liboff experiment -- the use of mitogenic stimulation of the lymphocytes (N.T. 792). He explained they added the mitogen ConA, and when they did that, they obtained very consistent results (N.T. 792-793). Liboff then testified that the two laboratories have resolved the difference in experimental design because of the likelihood that Liboff used a larger density of cells, such that the cells were self-stimulating by virtue of cell contact, which would have been equivalent to adding an external mitogen (N.T. 793).

Liboff also confirmed that he did research on embryonic chicks and he stated that he wasn't aware of any attempt to repeat those results under cyclotron resonance conditions (N.T. 796). When asked whether his research with rabbits had been replicated, Liboff said that those experiments had been done as part of an entrepreneurial situation where the patents for ion cyclotron resonance were licensed to a company who was working to develop a device for repairing bone

(N.T. 796). He explained that the research on rabbits was not published, but it was his understanding that the experiments had been done in a number of institutions (N.T. 796-797).

Liboff also confirmed that other researchers have not published any results of any studies dealing with an attempt to repeat his work in the ion cyclotron resonance area (N.T. 799).

Referring to work done by Reva Goodman he had mentioned in his direct testimony, Liboff confirmed that the research was done on protein synthesis and on RNA stimulation (N.T. 799). Liboff verified that he was not an expert in the type of work that Dr. Goodman did (N.T. 800). He then stated that to the best of his knowledge, her work had not been replicated in any other lab (N.T. 800). He also stated that although Goodman's work had not been replicated, she has seen consistent results over the years (N.T. 801).

The cross examination turned to the experiment involving calcium efflux done by Baywyn, Kazmarek and Adey, which was published in 1974 (N.T. 801). Liboff explained that in this experiment, a chick brain was perfused with calcium 45 so as to have calcium move into the brain tissue and then the brain was sliced and the slices divided into control and experimental groups (N.T. 802). Liboff explained that the slices in the experimental group were exposed to whatever field they were using, and the controls were not (N.T. 802). Comparisons were made as to how much radioactive calcium leaked into the environment (N.T. 802).

Liboff confirmed that Dr. Carl Blackman tried to reproduce the experiment and did it for nine or ten years (N.T. 802). He also confirmed the fact that the Rochester group tried this experiment too and admitted that at one point Dr. Morton Miller convinced him there was a technique in the way the brain was being sliced so that there was something different between the controls and experimentals (N.T. 803). He spoke to Blackman about this observation, but Blackman said that they randomized the way they took brain slices (N.T. 804). He stated that this led him to think that the Rochester group has less than a total grasp of what was going on (N.T. 804). He added that their lack of replication of this experiment as well as the studies with lymphocytes and diatoms (referred to earlier) reflects a way of doing science that is not the way he does it (N.T. 804). Liboff testified that he would not extrapolate the calcium efflux studies to humans (N.T. 805).

Liboff then confirmed he had referenced experimental research he had done on DNA synthesis in his report (N.T. 805). He stated that the results of his study had been replicated by Takahashi and was published in "Experientio" (phoenetic from transcript) (N.T. 805). Liboff stated that the fields he used in his experiment were very high -- the lowest being a few hundred milligauss and the highest being 16 Gauss (N.T. 806). He also explained that the frequencies he used were 15 Hertz to 4,000 hertz, and the fields were almost 90% sinusoidal (N.T. 806). He added that they did do some experiments

involving pulsed signals (N.T. 806). Liboff confirmed that the Takahashi paper used pulsed fields (N.T. 807).

Referring to the epidemiological study by Nancy Wertheimer on reproductive effects and electric blankets cited at page four of his direct testimony, Liboff confirmed that the study was important because it, along with her previous 1979 study dealing with leukemia, initiated two separate epidemiological areas that are now being investigated (N.T. 818). Liboff stated that Wertheimer has a Ph.D. in psychology (N.T. 818).

Liboff verified that he had, in his direct testimony, indicated that there was evidence indicating changes in chick eggs and fish eggs (N.T. 826). He identified the work on chick eggs as that being done by the Madrid group including Delgaito and Veda and Jocelyn Leal, and by a navy group called Project Hen House (N.T. 826). He testified that the Madrid group used mainly pulsed fields which produced some results (N.T. 826-827). Liboff then testified that Project Hen House represented an attempt to verify the work observed in Leal's laboratory (N.T. 827). He testified that they also used pulsed fields (N.T. 827).

Liboff testified that he had written a statement that "biological systems contain receptors or sensors designed to recognize these small signals", but explained that it's an implied statement that does not necessarily mean that anybody has ever observed sensors or receptors that are capable of

detecting a magnetic field (N.T. 843). He also explained that it's just an explanation as to how magnetic fields could interact with biological systems and that they have been identified (N.T. 843).

Liboff testified that more research needed to be conducted on EMF but that the primary source of funding for this research should not be the Department of Energy, which Liboff believes would succumb to easily to political pressure (N.T. 846). Liboff also stated that he didn't think that the Department of Defense should be in charge of research funding in this area because he didn't think the Office of Naval Research is a very liberal group when it comes to supporting research in a way that doesn't provide constraints (N.T. 850). He offered the opinion that work should be housed in the National Institutes of Health or the National Science Foundation (N.T. 850). He also did not think EPA should be in charge of funding because they do most of their research in-house so that none of their people or scientists can come to a hearing like this to testify (N.T. 851). Liboff also indicated that he had this feeling that the amount of information on the subject is being filtered by the process which prevents information from coming to groups (N.T. 851).

Liboff then testified that the NIH should be doing the bulk of the funding (N.T. 857). He stated that the NSF is a little more difficult to involve in a logical way because they wouldn't fund epidemiological research because it's too

clinical (N.T. 858). The NIH does epidemiological research (N.T. 859).

Liboff also testified that his opinion about hysterical and non-scientific evaluation does not refer to individuals in the epidemiological area who are making these reviews, but to individuals who are not epidemiologists making these reviews (N.T. 862). He further explained that he was referring to people like Professor Adair at Yale, holder of the prestigious Sterling Chair in Physics, who said that these studies were wrong because there is no explanation for them (N.T. 862-863). He called this evaluation non-scientific of an epidemiological report (N.T. 863, 864). He stated that a scientist must have an open mind (N.T. 867). Liboff affirmed that this same non-scientific approach can occur when somebody would look at epidemiological data and conclude that there must be something going on here and stated that it cuts both ways (N.T. 868).

Liboff confirmed that in his direct testimony he did say there may be specific values of the earth's magnetic field for which 60HZ exposure will be particularly hazardous (N.T. 877). He added that his opinion was based on two things: 1) his ion cyclotron resonance theory and 2) recent experiments that are in the abstract process (N.T. 878). He stated that when these 60HZ fields are in combination with local DC fields, "we" can predict that there will be biological effects for certain values of the earth's magnetic field (N.T. 879). He

then stated that "we" do not have a good handle on the role of the intensity of the 60HZ field, and that the role of intensity is not included in his ion cyclotron resonance predictions (N.T. 879). He also stated that the peak value of the AC intensity as measured in milligauss is another parameter that has to be taken into account in assessing a potential hazard (N.T. 879). He believed what was logical to suggest was to try to minimize the intensity of AC fields (N.T. 879). This, he said, was independent of the argument between frequency and the DC or geomagnetic field (N.T. 879).

Liboff clarified his testimony stating that he thought that there are biological effects that occur at certain combinations of frequency, in this case 60HZ, and the local geomagnetic field (N.T. 880). He also stated that whatever biological effect one will find which possibly could go to a hazardous condition would be found under these combinations of frequency and magnetic field (N.T. 880). He testified that he did not study whether those earth magnetic field values exist in the area along this line (N.T. 880). Liboff testified that he did not have the data for the magnetic fields for this line when he wrote his testimony (N.T. 880-881).

Redirect

Liboff reiterated his opinion that experimental results were not free standing to establish a health hazard (N.T. 884). He added that in the bioelectromagnetic community, various inputs are weighted (N.T. 884). He continued that if

enough biological studies and other studies in a totally different area is available, then conclusions are drawn which, although not proving, say potential hazard, certainly tend to provide a basis on which such discussions concerning hazards might be more detailed in terms of taking these as real possibilities (N.T. 884).

When asked whether there is a consensus in the area of physics that one must know the pathway in order to reach a conclusion on cause and effect, Liboff replied that the area of physics is a bad example of what you are trying to say (N.T. 901). He stated in physics, pathways are demanded and for that reason, more is asked of the scientist (N.T. 901). He continued that in the biophysics area, you want an efficacious result so pathways are of less interest to clinicians and of more interest to scientists (N.T. 902).

Liboff then confirmed that he testified that looking for confounders was a good thing (N.T. 919). Liboff then explained what confounders were using the example of childhood leukemia's association with wire codes (N.T. 919-920). He explained in epidemiology that there are two variables that you are trying to get a relation between and a confounder is something that basically fools the epidemiologist so a person who thinks he is studying wire code may actually be studying traffic density nearby or the level of income (N.T. 920). He ventured that some of these epidemiological studies may result in correlations in which leukemia deaths might be confounded,

not with the power line, but what the power line relates to: traffic density, income, etc. or formaldehyde or pitch connected with the poles (N.T. 921). He also ventured that the confounder might be something else to do with the magnetic field so that the confounder concept can be used both to tear down the problem of magnetic fields causing cancer, or it can be used ultimately to make the problem more possible (N.T. 922). He agreed that confounders were the same as hidden variables in lay terms (N.T. 922).

Recross Examination

On recross, Liboff was questioned about his statement that there was a possibility that the confounders seen in epidemiological studies might be something else magnetic (N.T. 931). He testified that that was the spirit of what he said and allowed that it might be some other magnetic source other than the power line (N.T. 932). He added that it could still be related to the power line -- perhaps it's geographical orientation (N.T. 932).

RICHARD BOCKMAN - Direct Testimony

Richard S. Bockman, 520 East 72nd Street, New York, NY, 10021, sponsored the Rebuttal Testimony of Dr. Richard Bockman (N.T. 967) as Philadelphia Electric Company Rebuttal Statement No. 1. The witness identified and corrected a number of typographical errors in his testimony but indicated that his testimony would be the same if he were asked the same questions today (N.T. 968).

In his direct testimony, Bockman identified himself as a medical doctor, a researcher and a teacher in the fields of endocrinology and immunology (PECO Rebuttal Statement No. 1, p. 1). The witness explained that endocrinology is a subspecialty of Internal Medicine and involves the study and treatment of hormonal and metabolic disorders, which are associated with abnormalities in body chemistry and with disordered physiological function (Id., p. 1). Bockman then explained that immunology is a medical subspecialty which involves the study and treatment of disorders to the body's defense system against infection and disease (Id., p. 1). Bockman stated that currently he spends the majority of his time engaged in clinical and laboratory studies to determine the mechanisms by which the endocrine system regulates calcium metabolism (Id., p. 2).

Asked to describe the endocrine system, Bockman explained that the endocrine system refers to tissues and organs in the body that produce or respond to hormones (Id., p. 5). He testified that when complex biologic processes like conception or fetal growth occur, they are regulated by an elaborate temporal sequence of hormone secretions under control of the endocrine system and that a biological disturbance to any component of the endocrine system would have deleterious consequences which would be measurable (Id., p. 5). He concluded that endocrine function is a very sensitive measure of the possible biological effects of an external stimulus such as electric or magnetic fields (Id., pp. 5-6).

Bockman then testified that an enormous amount of research on whether there are endocrine system effects from electric and magnetic field exposure which fall into four general categories: 1) research relevant to the neuroendocrine function; 2) research on endocrine gland functions; 3) research on biologic rhythms and, 4) research on reproduction and growth (Id., p. 6).

Bockman then testified that the neuroendocrine system is comprised of hormone-producing tissues of the brain and pituitary gland (Id., p. 6). Bockman further explained that the pituitary gland is the "master gland" because it produces a variety of hormones that regulate many different organs (Id., p. 6). The pituitary is also regulated by hormones from higher brain centers so it is the neuroendocrine system as a whole that affects control of peripheral endocrine tissues (Id., p. 6). Bockman stated that the hormones produced in peripheral tissues circulate in the body and in turn regulate functions of the neuroendocrinological system in a complex feedback loop, much the way as a thermostat regulates a furnace to keep household temperature at an acceptable level (Id., pp. 6-7). Bockman explained that the human body responds to any external stimulus such as sound, heat or light by activating thousands of nerve cells which, in turn can trigger neurochemical releases affecting the body's endocrine system (Id., p. 7). Bockman explained that this is a normal physiologic response and does not imply that injury to the responding neurons is

occurring or that other potentially adverse effects will result (Id., p. 7).

Bockman then identified four areas of research that have been conducted on EMF and neuroendocrine function:

(1) in vivo (whole animal) studies to assess electric and/or magnetic field stimulus perception by humans; (2) animal behavior studies to electric fields; (3) animal studies to determine whether exposure to electric and/or magnetic fields result in neurochemical changes that might be associated with adverse health effects; and (4) an area of related research with calcium metabolism (Id., p. 7).

Bockman testified that people and animals usually perceive EMF through external cues -- the mechanical switching as the experimental field is turned on, the slight movement and the tickling sensation that is associated with hair vibration (Id., p. 8). Bockman then testified that the force and frequency of hair vibration correlates directly with the strength and frequency of the AC electric field (Id., p. 8).

Bockman explained at the present time, there is no data to support the concept that people can perceive electric or magnetic fields from electric transmission lines when no external physical cue such as sound or hair movement is present (Id., p. 8). Bockman explained that there is no evidence to date to indicate that humans can perceive power frequencies magnetic fields at levels that far exceed the levels associated with transmission lines (Id., p. 8).

Bockman then testified that in most EMF studies with fields at levels significantly above the threshold for perception, there is an arousal response (Id., p. 9). Bockman explained that after this initial response, the test animals quickly grow used to the fields (habituate) and all endocrine parameters that were being measured rapidly return to their basal state even though the field is maintained (Id., p. 9). Bockman then offered examples of two studies in which animals rapidly habituate to field strengths that are significantly above their threshold for perception (Id., p. 9).

Bockman also testified that when field strength increases, test animals demonstrate a wide variety of responses (Id., p. 10). As an example, Bockman indicated that rats were reported to show an aversion to electric fields of 75kV/m, but closer study revealed that they avoided these higher fields during inactive sleep periods, but continued to freely explore the high field area when they were active (Id., p. 10). Bockman explained that at electric fields greater than 100kV/m, animals frequently experience microshocks, similar to carpet shocks, as they move around their cages, which are very strong stimuli (Id., p. 10). He explained that humans near transmission lines are not subjected to fields of this magnitude and do not experience microshocks as a consequence (Id., p. 10).

Bockman turned his attention to a discussion of research on neurochemicals (Id., p. 10). He testified that to

date that there is little to suggest field strengths above an animal's perception threshold could cause any abnormality in neurological function or behavior (Id., p. 10). He explained that subtle changes in blood or brain levels of neurotransmitter substances or of enzymes regulating neurotransmitter levels have been observed in some studies (Id., p. 10). He indicated that these changes in neurotransmitter levels probably reflect the fact that the animals perceive the field and are demonstrating a normal recognition response to a newly perceived external stimulus (Id., p. 10). He also indicated that in these studies no abnormal neurological or behavioral correlates were observed and the reported responses were within the normal range of experience for the test animals and cannot be considered a health risk (Id., p. 11). He also testified that the same conclusion was reached following a major independent review of EMF research conducted by the National Academy of Sciences (Id., p. 11). He testified that even with 50HZ magnetic field exposure as high as 50,000 MG, no changes in cerebral blood flow or brain wave activity (EEG) were observed in humans (Id., p. 11). In sum, he concluded, the studies of neurotransmitter levels have not demonstrated any deleterious affects of exposure to power frequency electric or magnetic fields (Id., p. 11).

Bockman then explained that calcium acts as a signal molecule between external stimuli and the inner functioning

(metabolism) of cells and plays an important role in the function of the endocrine system (Id., p. 11). Bockman explained that the EMF on calcium metabolism typically has involved naked cells and/or tissue in culture in petri dishes (Id., p. 12). He explained that the principle objective of this research has been to investigate whether EMF exposure induces significant changes in calcium metabolism in isolated cells and tissues (Id., p. 12). He also explained that to the extent that these changes occur in vitro, the next inquiry would be whether these changes are observed in whole animals and whether such changes affect endocrine system function or result in potentially adverse effects (Id., p. 12). He further explained that one of the categories of in vitro calcium research is known as "calcium efflux" research (Id., p. 12). He explained that many of the calcium efflux studies that have been conducted to date used amplitude-modulated radiofrequency fields (147,000,000 to 150,000,000HZ with the field modulated at 6 to 16HZ) which differ from 60HZ fields from power lines (Id., p. 12). Moreover, he explained that the results of these experiments are inconsistent in that they report conflicting changes in calcium efflux from study to study (Id., p. 12). Bockman then explained that with respect to 60HZ fields, the available data indicate that such fields do not affect calcium metabolism in living organisms (Id., p. 12).

On the significance of the calcium efflux research, Bockman stated that the important question is whether they have

identified any changes in biologically active calcium because calcium is found within cells, within cell membranes and attached to cell membranes and not all of this calcium is biologically active or significant (Id., p. 12). Bockman also testified that the calcium efflux studies examined calcium movement in non-functional dying tissue, which in and of itself, raises questions about the biological significance of the calcium movement seen in these experiments (Id., p. 13). Bockman also stated that there is no evidence in the calcium efflux studies that EMF exposure has an effect on any of the cell's calcium-dependent processes (Id., p. 13). In fact, he continued, that a study by Parkinson showed that when key calcium parameters are considered (cytoplasmic calcium levels), EMF had no measurable effect on biologically active calcium in cells (Id., p. 13). Bockman also testified that other investigators using techniques capable of measuring the movement of individual calcium ions across the cell membrane recently reported that they found no EMF-induced changes in calcium movement (Id., p. 13).

Bockman testified that EMF does not cause changes in biologically important calcium in whole animals and if biologically important calcium was being disturbed, one would expect to see functional changes in animals exposed to EMF (Id., p. 13). He explained that these findings by Parkinson and Hanks are consistent with the previous research results of several primary investigators in this area who have found no

functional changes in cells or in intact animals during exposure to EMF (Id., p. 13). His conclusion on research on EMF and calcium metabolism is that there is no indication that 60HZ electric and/or magnetic fields modulate cell function or endocrine system function by altering calcium metabolism (Id., p. 13).

Bockman then offered his testimony on EMF research on endocrine gland function (Id., p. 13). He began by explaining that many powerful hormones are produced by the endocrine glands including gluco-corticoids (such as corticosterone, a hormone produced by the adrenal glands and essential for life), epinephrine, norepinephrine, and growth hormone (Id., p. 14). Bockman explained that these hormones are released when an animal is stressed and can significantly alter body metabolism (Id., p. 14). He explained that examining the levels of these hormones provides a very strong indicator of whether there is any effect on endocrine gland function and provides a direct measurement of whether these important hormones were altered (Id., p. 14).

Bockman then testified that the results of these studies was that even with prolonged exposure to significant electric and magnetic fields, these hormones are not elevated in the blood and the data indicate that the animals are not stressed by these fields (Id., p. 15). He explained that in an early set of experiments, Marino et al. claimed that prolonged exposure of mice to EMF caused a decrease in corticosterone

levels, but subsequent experiments by Graves & Poznaniak, Free et al., Hackman & Graves, Porter, and Quinlan et al. failed to corroborate this finding (Id., p. 15).

Bockman then testified that the third major area of research involves circadian rhythms, which is a biological rhythm that has a cycle equal to one day (Id., p. 15). He also explained that researchers examine biologic rhythms because changes in those rhythms are a possible indicator of the body's responsiveness to external stimuli (Id., p. 16).

Bockman then testified that substantial research has been conducted regarding EMF and major biological rhythms, and hormones such as prolactin and growth hormone (Id., p. 16). None of these major biologic rhythms were altered by exposure to EMF (Id., p. 16).

Bockman testified that he was familiar with the research conducted by Vasquez et al. which reported an alteration after EMF exposure of the circadian rhythm of certain neurotransmitters as measured in the rat hippocampus (Id., p. 16). He then evaluated this research and commented that the role of neurotransmitters as chemical bridges for light, heat and pain do not occur in the hippocampus, and in the area of the brain where these functions occur, there are no known circadian rhythms in neurotransmitters (Id., p. 16). Bockman also testified that Vasquez's study must be evaluated in the context of the body of neurotransmitters which shows there is no adverse effect on neurotransmitters and in the

context of research that shows that biologically important rhythms are not disturbed by exposure to EMF (Id., p. 16). In this context, Bockman testified that the Vasquez results do not indicate a harmful effect on biological rhythms (Id., p. 16).

Bockman then testified that he was familiar with the research done by Wilson, Reiter and others on the circadian rhythm of the hormone "melatonin" (Id., p. 17). He explained that melatonin is a hormone that is produced in the pineal gland, which has no known function in the human (Id., p. 17). He also stated that melatonin is one of several neurological hormones that is known to have a distinct rhythm that is tied to daylight/darkness cycles, and commented that melatonin levels in rats are suppressed by light and increase with darkness (Id., p. 17).

Bockman then explained an experiment whereby lab rats that were kept under highly artificial conditions, deprived of any environmental cues, produced a small decrease and time delay in the expected nightly rise in pineal gland melatonin levels (Id., p. 17). He reported that at least 3 weeks of fixed artificial laboratory conditions were needed to elicit this response, but within three days of removing the rats from these artificial conditions, normal melatonin rhythms were re-established (Id., p. 17). Bockman reported that there was no deleterious effects on the health of the animals observed in the study, and no study has demonstrated any biological effects of magnetic field exposure (Id., p. 17). Bockman also stated

that in a more recent study, the investigators reported that they failed to find any differences in pineal melatonin or melatonin metabolic levels in animals exposed to field strengths of 10 to 65kV/m while another investigator recently reported that baboons exposed to 60HZ, 6kV/m and 500 MG fields showed no change in nocturnal melatonin levels (Id., pp. 17-18).

Bockman concluded his testimony on melatonin/EMF research by stating that there are no known or reported biologic consequences of the reported change in dark cycle melatonin levels, either in rats in humans, nor is there evidence of any effect of EMF on any other major biologic rhythm or any other hormone (Id., p. 18). Furthermore, he reiterated that the changes seen in melatonin rhythms are not associated with changes in other major biological rhythms such as sleep/wake cycles, body temperature, eating patterns or the circadian release of other hormones (Id., p. 18). He also testified that the reported changes in dark cycle melatonin levels are limited to rats exposed to electric, and not magnetic fields (Id., p. 18).

Bockman then testified regarding the research on EMF and reproduction and development (Id., p. 18). Bockman explained that the reproduction system in mammals is very susceptible to disturbance from extrinsic stimulus that causes internal imbalances in hormone function and disruption of any step will cause the process to fail, making such failure

detectable through decreased fertility or increased fetal death (Id., p. 18).

Bockman reported that early studies by Marino et al. reported effects on reproductive parameters, but stated that these studies were confounded by electric shocks the animal received from improperly grounded cages (Id., p. 19). He explained that subsequent studies controlled for these confounders found no effects of EMF on fertility, mating performance or fecundity (Id., p. 19). In a recent study by Rommermeim et al., Bockman explained, several hundred laboratory rats were exposed to fields of 10, 65 or 130kV/m for 19 hours a day, both before pregnancy and during gestation (Id., p. 19). He further explained that Rommermeim reported no differences between exposed and unexposed animals for impregnation, maternal mortality, fetal weight, sex ratio, fetal malformations and fetal growth (Id., p. 19).

On experiments with chick embryos, Bockman also explained that the research done by Delgado and in the Henhouse Project, pulsed fields were used, which are not created by transmission lines (Id., p. 19). He also identified a study which involved extensive research on chick embryos using power frequency fields where a variety of reproductive endpoints were used (Id., p. 20). They found that exposure to power frequency fields did not affect any of the reproduction and development endpoints studies (Id., p. 20).

Bockman then indicated he was familiar with Wertheimer's epidemiological work on reproductive effects -- one examining the question of whether the use of water beds is associated with fetal loss and the other examining the use of electric heat in the home (Id., p. 20). He stated that Wertheimer reported that both of these activities were found to be associated with adverse reproductive outcomes (Id., p. 20). He indicated that Wertheimer's work had been severely criticized in the Final Report of the Scientific Advisory Committee of the New York State Power Line Project on many grounds including that the researchers selected a bias sample, that they selected arbitrary, non-scientific comparison periods, that data collection methods were crude and that the fetal loss rates could not be determined (Id., p. 20). He also stated that Wertheimer's reports were not persuasive in light of other well-done animal research, discussed previously which reported no effect on reproduction and development (Id., p. 20).

Bockman then indicated that recent animal studies by Rommermeim et al., Mahmoud et al., Berman and Chacon et al. showed no effects on numerous reproductive endpoints (Id., p. 20). He also mentioned another study, which was conducted by the National Institute of Occupational Safety and Health (NIOSH) and the American Cancer Society, and examined whether women working with video display terminals (VDTs) during pregnancy had an increased risk of spontaneous abortion (Id.,

p. 20). The study included 800 pregnant women and the exposed group typically worked an eight hour day with VDTs (Id., p. 20). This study, Bockman reported, found no increase in the risk of spontaneous abortion associated with the occupational use of VDTs (Id., p. 21).

His conclusion regarding the research on EMF and reproduction and development was that despite extensive examination, there is no persuasive evidence that power frequency fields has any adverse effects on reproduction, development or related endocrine functions (Id., p. 21).

Bockman's testimony then turned to EMF and the immune system (Id., pp. 21-22). He explained that the immune system is a network of cells and tissues originating in bone marrow and fetal tissue that protect the body from disease (Id., p. 21). He further explained that the immune cells have a unique capacity to recognize substances that are foreign to the body such as bacteria, viruses and transplanted tissues and inactivate the foreign object (Id., pp. 21-22). If, however, the immune system fails to function properly, then an invading disease invariably overwhelms the body defenses (Id., p. 22). He then explained that because immune cells can be regulated by a variety of hormones, the immune system can be altered by endocrine function (Id., p. 22). He identified cortisone and corticosterone, products of the adrenal gland as prime examples of hormones that regulate immune cell function (Id., p. 22). He then explained that if cortisone is present in excessive

amounts, it can reduce the ability of immune cells to fight invading bacteria and viruses.

Bockman testified that several excellent studies have examined the levels of cortisone and corticosterone in animals exposed to EMF and in only one study could a transient and minimal rise in blood corticosterone levels be measured (Id., p. 22). He continued that the minimal rise in levels occurred only when the field was switched on the first time (Id., p. 22). Within fifteen minutes, blood hormone levels return to normal levels and show no further rise whether the field is maintained or switched on and off (Id., p. 22). He then testified that at the present time there is no evidence to suggest that the fields associated with AC power lines are a sufficient stimulus to cause an abnormal rise in corticosterone or cortisone levels, and no scientific basis to conclude that power frequency fields can affect the immune system through altered endocrine function (Id., p. 22).

Bockman then testified about other tests which could be used to assess the integrity of the immune system and that some tests are designed to examine the function of specific immune cells taken from the body (in vitro tests) while others examine the reactions of the whole organism to various challenges to the immune system (Id., p. 23). He characterized in vivo tests as being more accurate (Id., p. 23).

Bockman described specific in vitro research on EMF and the immune system (Id., p. 23). One study by Conti et al.

he described used human peripheral blood lymphocytes placed in short term culture (Id., p. 23). He explained that cell proliferation responses of these lymphocytes to mitogens were measured in the presence and absence of EMF (Id., p. 23). He reported that in vitro exposure over the frequency range of one to 200HZ inhibited mitogen-induced blastogenesis (Id., p. 23). He also reported that very low amplitude fields with suboptimal doses of mitogen had a small effect in increasing cell proliferation (Id., p. 23). He stated that the biologic relevance of these studies using mitogens, agents to which people are not typically exposed, remains unclear (Id., p. 23). He stated that standard toxicity protocols have been used to study the effects of EMF on animals exposed to various pathogenic micro-organisms and in an early study by Odinstov, no differences in mice which were injected with bacteria and acutely exposed to a 50HZ electromagnetic field (Id., p. 24). With chronic exposure to the fields, more of the exposed animals died when a semi-lethal dose of bacteria was injected as compared to the control group (Id., p. 24).

In separate experiments, Cerretelli et al. (1979) reported no differences in mortality rate among mice injected with *Staphylococcus pyogenes* were seen when mice were exposed to 25kV/m fields for up to 42 days (Id., p. 24). He explained that in an earlier study using the same protocol, after 212 days of exposure to a 75HZ, 100kV/m field, no difference in mortality was measured in exposed mice which were inoculated

intranasally with influenza virus and unexposed mice which were inoculated in the same manner (Id., p. 24). Bockman explained that the organisms used in the last two experiments were comparable but the earlier studies of Odinstov with the Listeria bacteria have not been replicated (Id., p. 25).

Bockman also stated that several groups of investigators have examined a variety of immune parameters in animals exposed to power frequency fields, but no significant changes in the parameters had been observed (Id., p. 25). Bockman then discussed the experiments of Morris et al. who assessed immunoglobulin synthesis, serum complement levels, and immune cell number and distribution in mice exposed to 60HZ fields 21 hours per day for 30 or 60 days (Id., p. 25). He reported no differences in any of the parameters when treated and untreated animals were compared (Id., p. 25). In follow-up studies, animals were exposed up to 150 days to EMF (60HZ, 200kV/m) and the cell proliferation response of peripheral blood lymphocytes to mitogens was assayed (Id., p. 25). The witness stated that there was no observable changes in either T or B lymphocyte responses to mitogens (Id., p. 25).

Bockman concluded his testimony by stating that comprehensive animal studies indicate exposure of intact animals to EMF similar to that produced by electric transmission lines produce no obvious deficit in immune cell function (Id., p. 25). With the exception of Odinstov's early unconfirmed study using Listeria, there is no evidence that

exposure to moderate or even stronger electric and magnetic fields adversely affects the host's immune system (Id., p. 25).

Cross Examination

When asked whether further research was necessary regarding the possible adverse health effects of EMF the immune and endocrine systems, Bockman explained that he thought that in the area of reproduction and development, adequate experiments had been done, and that in regard to calcium efflux experiments, he did not believe more research is needed because he wasn't sure that they addressed any relevant biologic issues (N.T. 974). He further explained that because research funds are limited, it was not necessary to do more research in this area of biology because it is not of very high priority (N.T. 974-975). He also explained that none of the research that has been done in this area has been done quite well implying that such research does not need to be repeated (N.T. 975). He added that he did not believe it was necessary to repeat bad or poorly done or poorly conceived experiments (N.T. 975).

Bockman volunteered that he believed that the most definitive study of EMF effect on reproduction that was done at Brookhaven National Laboratory where they studied three generations of animals, and several levels of electric and magnetic field exposure, one and ten gauss (N.T. 977). He further explained that they were not able to demonstrate any adverse effect on reproduction, growth and development

(N.T. 977). He explained that this experiment had been replicated by Rommereim in 1989 with similar results reported (N.T. 978). He stated that he beleived this particular experiment was so important because there is a whole sequence of endocrine functions that must occur for fertilization to be successful and then for the animal to carry the pregnancy and deliver a normal litter (N.T. 978).

Bockman then explained that there were several layers of calcium metabolism in the body and that at the gross level, there is shuffling between our dietary calcium and the bones and there is calcium economy or metabolism that goes on at the level of cells and also within cells (N.T. 999). He explained that most of the studies involve calcium at the microscopic level where calcium acts as a signal molecule in cell to cell functions (N.T. 999). He continued that the cell is receiving signals from the outside all the time either from electrical signals through nerve transmission or chemical signals like hormones (N.T. 999). He also explained that calcium also becomes a second messenger or signaling substance (N.T. 999). He explained that in order for a substance to be a good signaling substance, its level has to be lightly regulated or controlled because it is basically like a switch (N.T. 1000). He then explained that 95 plus percent is actually banked in the body's bones, sequestered away, and only a very small portion of calcium is banked in biologically active pools (N.T. 1000). He also noted that in addition to the switch

functions, calcium sometimes serves as glue because it has two positive charges (N.T. 1000). He continued that it appears able to bind a particular enzyme to the inside cell surface and thereby activates the enzyme (N.T. 1001).

Bockman then offered two important take-home lessons: 1) that calcium is an important signalling substance for cells and 2) only selected pools of calcium are important, the biologically active pool which is free or ionized inside the cell in cytoplasm (N.T. 1001).

When asked to resolve the conflicting results seen in calcium efflux studies, Bockman replied that researchers in these studies don't really know where the calcium is coming from but the references he cited in his testimony (Parkinson and Hands, and Hojevik from BEMS) show that the biologically important forms of calcium are not changing (N.T. 1002). Therefore, he testified, that the likelihood is that Blackman, Adey and Bawin are measuring the outflow of calcium from dead and dying, non-functional tissues, and the calcium being measured is probably just loosely attached to the outside of the cell (N.T. 1002). He explained that this was the reason that he believed that these researchers were not tracking biologically relevant pools of calcium within the cell (N.T. 1002). He also explained that the tissues were too thick, not perfused as would be tissues in the body (N.T. 1009). He added that Blackman himself indicated that the tissues no longer maintain normal neural function (N.T. 1010).

PHILIP COLE - Direct Testimony

Philip Cole, Department of Epidemiology, School of Public Health, University of Alabama, Room 203 Tidwell Hall, University Station, Birmingham, AL 35294, sponsored PECO Rebuttal Statement No. 2 as his direct testimony (N.T. 1078). He testified that he is a medical doctor, Professor of Epidemiology and Chairman of the Department of Epidemiology at the School of Public Health of the University of Alabama in Birmingham, and is the Associate Director for Epidemiology at the Comprehensive Cancer Center at the University (PECO Rebuttal Statement No. 2, p. 1). He explained that epidemiology is the scientific observation of human beings for the purpose of identifying the environmental causes of their diseases (Id., p. 1).

Cole testified that currently he is conducting several research projects in cancer epidemiology (Id., p. 3). He also explained that his epidemiological research for the past 25 years has focused on the epidemiology of cancer and on the relevant methodology for conducting such research (Id., p. 3). He testified he had published his research in over 130 articles on epidemiology, nearly all of which involved cancer epidemiology and the methodology of cancer epidemiology, and has served as a scientific reviewer or editor for several journals, including the American Journal of Epidemiology and Cancer Research (Id., p. 3).

Cole testified that the study of epidemiology is the study of humans in their everyday environments, and the major strength of epidemiology is that it pertains directly to human beings, and as such, facts established through epidemiologic research have direct implications for public health strategies, unlike most laboratory research (Id., p. 5). He explained that the great limitation of epidemiology is that it is a non-experimental science and, consequently, is highly susceptible to error (Id., p. 5). He believed that both the strengths and limitations of epidemiology must be recognized when conducting an evaluation of epidemiologic studies (Id., p. 5).

Cole then testified that epidemiologists recognize the imprecise and error-prone nature of epidemiology, and generally draw causal inferences only when there is a reasonably large number of independent studies with consistent findings (Id., p. 5). Even then, Cole stated, epidemiologists do not place substantial confidence in findings of weak associations where the magnitude of the reported "risk" may be less than epidemiologic studies can correctly identify (Id., p. 5). Cole explained that in epidemiology, the term causal inference means that the epidemiologic data is sufficiently strong and consistent that it is widely believed to be true that exposure to the agent of interest increases the risk of disease (Id., p. 6).

Cole then explained that epidemiologic data can establish a cause-effect relationship (Id., p. 6). Cole then

testified that two commonly known cause-effect relationships that were established with epidemiologic data are the relationship between cigarette smoking and lung cancer, and the relationship between certain types of asbestos and mesothelioma (Id., p. 6). He added that these relationships were eventually confirmed by laboratory evidence (Id., p. 6).

Cole also explained that unlike laboratory research, it is the nature of epidemiologic research to produce a pattern of mixed results (positive and negative results) even where there is no cause and effect relationship between the disease at issue and the agent under investigation (Id., p. 6). In fact, he continued, in the absence of a cause-effect relationship, epidemiologists would expect to find a large proportion of reported positive findings due to random chance alone (Id., p. 6).

When asked to explain how epidemiologists evaluate a body of cancer epidemiology research, Cole replied that application of the principles of epidemiology to assess the carcinogenic potential of an agent involves a three-step process (Id., p. 7). First, individual studies are examined to assess the quality, reliability and validity of the research results; second, the studies are examined collectively, giving appropriate weight to individual studies, to assess consistency and other important indicia of causality; and, third, the epidemiologic studies are considered in context with basic science research and other available information to assess the

coherence or biologic credibility of causal inferences (Id., p. 7).

Cole then defined the term "exposure" in epidemiology to mean contact with the environmental agent in question and ideally the method used to determine exposure is direct measurement (Id., p. 7). He added that if exposure cannot be measured directly, then epidemiologists use some substitute (sometimes called a surrogate or a proxy) as an indicator of exposure (Id., p. 7). Some commonly used surrogates are information from questionnaires, from employment records, and from death certificates (Id., p. 8). Cole testified that using surrogate data sources, inferences about the population's actual exposure are made based upon some supposed exposure (Id., p. 8). As an example, he stated that using occupational information from a death certificate, one might find that an individual who was listed as having worked as a service station employee had been exposed to gasoline fumes (Id., p. 8). One of the typical problems with surrogate measure is that it is often difficult to know if the surrogate is a reliable predictor of actual exposure (Id., p. 8). In the example above, he indicated that the service station employee may only have worked at the cash register, and may never have been exposed to gasoline fumes (Id., p. 8).

Cole stated his opinion that epidemiologic studies are only as good as their assessment of exposure, and that a lack of good data on exposure can throw the results of a study

into question (Id., p. 8). If there is no confidence in the actual exposure, it's unlikely there will be confidence in the results of the study (Id., p. 8). He added that evaluation of the surrogate is an important factor in the evaluation of epidemiological studies, both individually and as a group (Id., p. 9).

Cole then explained the types of epidemiological studies that have been conducted regarding EMF and cancer (Id., p. 10). For childhood cancer, the most important studies are the residential case-control studies while adult cancers also have been examined in residential studies, using both the case-control design and the retrospective follow-up ("RFU") design (Id., p. 10). Cole explained that there have also been numerous studies of adult cancers in the occupational setting which included case-control studies, proportionate mortality ratio ("PMR") studies, and retrospective follow-up studies (Id., pp. 10-11).

Cole then described the case-control method in which one identifies a group of people who have developed a disease, such as cancer, as the "cases" (Id., p. 11). A second group of people, known as the "controls," is then identified, which group consists of people who have not developed the disease of interest, but who in other ways are similar to the cases (Id., p. 11). Cole continued that having identified these two groups, one then seeks to describe the pattern of exposure to the agent of interest in each group, looking for similarities and differences in that exposure (Id., p. 11).

For example, Cole testified that case-control studies generally allow for good control over confounding, but added that not every case-control study, however, controls adequately for confounding (Id., p. 11). "Confounding" he explained means that the factor under study is not an actual cause of the disease but rather is only a marker of some true cause (Id., p. 11). As an example, he stated that some early studies seemed to show an association between coffee drinking and bladder cancer (Id., p. 11). He stated that because it is likely that coffee drinking does not cause bladder cancer, these studies were probably reflecting the fact that heavy coffee drinkers are, on average, heavy smokers, since smoking is a well established cause of bladder cancer (Id., p. 11). Cole then stated that the case-control study is difficult to conduct correctly and is prone to bias or error (Id., p. 11, 12).

Cole then described the published residential case-control childhood cancer studies related to EMF which to date there have been six: the studies by Wertheimer and Leeper (1979), Savitz (1978,1989), Fulton (1980), Tomenius (1986), and Myers (1988) and London (1991). Generally, these studies identified childhood cancer victims in a specific geographic area and time frame, as well as a group of controls in the same geographic area and time frame (Id., p. 12). The residences of the cases and controls were identified, and data was collected for each residence related to magnetic fields or some surrogate for magnetic fields (Id., p. 12).

The Wertheimer and Leeper study, which was conducted in Denver, was published in 1979 and was the first epidemiologic study on EMF and childhood cancer (Id., p. 12). It was the first published epidemiology study in this area and initially raised the question of whether exposure to magnetic fields is associated with an increased cancer risk (Id., p. 12). Wertheimer and Leeper used a surrogate for magnetic fields known as the "wiring code" in which the size, number, arrangement, and distance of electric lines are used to predict residential exposure to magnetic fields. These data are gathered visually (Id., p. 12). For example, the relative width of the electric lines might be estimated by simply looking at the wires from the street (Id., p. 12). Cole testified that in this study, Wertheimer and Leeper reported that the wiring code was associated with childhood cancers, including childhood leukemia (Id., p. 13).

However, Cole identified several problems with the Wertheimer/Leeper study: first, the cases and controls are of dubious comparability; second, the data results show a pattern that can only be termed as "inordinately consistent" as it is likely that the pattern resulted from a systematic bias in the study design or conduct; and third, the researchers did not use "blind" procedures when they assigned wire code classifications to the residences involved in the study (Id., p. 13). In his opinion, Cole found that these limitations of the Wertheimer and Leeper study render it non-persuasive (Id., p. 13).

Cole then cited the Fulton study (1980) in which Fulton attempted to replicate the findings of Wertheimer and Leeper concerning childhood leukemia by using the wiring code surrogate in a study of childhood leukemia in Rhode Island (Id., p. 14). Cole testified that Fulton found no relationship between childhood leukemia and wiring codes (Id., p. 14). The Fulton study also is an early study that has been subject to criticism. Cole found the findings and interpretation of the study to be unclear, and he considered it to be a negative, but non-persuasive study (Id., p. 14).

Cole then described the Myers study which was conducted in 1988 in the United Kingdom (Id., p. 14). Rather than using the wiring code surrogate, the Myers study used distance from power lines as a surrogate for magnetic field exposure, Cole stated (Id., p. 14). The Myers study, Cole testified, reported a slight increase in cancer risk for those living near a power line, but also reported a slight inverse association between estimated magnetic field strength and cancer risk (Id., p. 14). In other words, residences close to a power line were associated with a slightly smaller risk of cancer than those further away from a power line (Id., p. 14). He stated that the Myers study does not support the hypothesis that magnetic fields are related to childhood cancer (Id., p. 14). Cole also stated that because of certain limitations in the study, including its small size, the study also does not provide persuasive refutation of the hypotheses (Id., p. 14).

Cole then described a 1986 study Tomenius conducted in Sweden (Id., p. 15). He also used a "distance" surrogate, collected data on measured magnetic fields (Id., p. 15). He categorized a residence as "exposed" to magnetic fields if the residence was within 150 meters of an electrical installation, including power substations, transformers, electric railroads, high voltage wires, and subways (Id., p. 15). Cole explained that there were two major findings of importance to interpreting the Tomenius study: first, with regard to childhood leukemia, the Tomenius study found no association either for the distance surrogate or for measured magnetic fields; and second, Tomenius' data shows an inverse trend between distance of a dwelling from the installation and cancer risk and an inverse relationship between cancer risk and measured magnetic fields (Id., p. 15). Due in part to the inverse trend apparent in the Tomenius data, Cole concluded that the Tomenius study provides no support for the hypothesis that EMF's are related to an increased risk of childhood cancer and in fact, it provides some evidence against that hypothesis (Id., p. 15).

Cole then described the Savitz study, which was conducted in Denver in 1988, and collected data on the wiring code surrogate and childhood cancer (Id., p. 15). He explained that Savitz also collected data on actual measured magnetic fields and childhood cancer (Id., p. 15). In addition, he explained, Savitz collected data unrelated to magnetic fields,

such as parental smoking, breast feeding history, and traffic density on nearby streets (Id., p. 15). Cole testified that the Savitz study showed a marked improvement in design, conduct, and analysis over previous childhood cancer studies (Id., p. 16). Cole then testified the study also has limitations, several of which are pointed out by Dr. Savitz himself in his published paper (Id., p. 16). To date, however, this study should be considered one of the best done of the published studies on childhood cancer and EMF (Id., p. 16). He then reported that Savitz' data show no significant associations between cancer and measured magnetic fields, but they did show a few weak, irregular statistically significant associations between childhood cancer and wiring code surrogate (Id., p. 16). He stated that Savitz also has reported data from this study population showing similar weak associations between childhood cancer and failure to breast feed (Davis and Savitz, 1988), between childhood cancer and paternal smoking (John and Savitz, 1991), and between childhood cancer and high traffic density on nearby streets (Savitz and Feingold, 1989) (Id., p. 16). Cole explained that the Savitz study contains a large amount of data, and many comments on this study are possible (Id., p. 16). He commented that the pattern of data in the Savitz study, with no statistically significant associations between measured fields and cancer, and a few weak irregular associations between the wiring code and cancer, is consistent with nullness -- that is, with a lack of effect of

exposure to magnetic fields (Id., p. 16). However, he added, this pattern suggests a profile or risk factors that characterize children at greater risk of leukemia: parents who smoke, absence of breast feeding, residence near busy streets, etc. (Id., p. 17). Viewed in this larger context, he was hesitant to accept any of the weak reported associations, including the weak irregular associations with wiring code, as descriptive of a cause-effect relationship (Id., p. 17). Finally, he noted that the positive associations with the wiring code that Savitz did report are weaker than the associations reported by Wertheimer and Leeper (Id., p. 17). He concluded that the fact that the reported association is weaker in the relatively well-done Savitz study suggests that there is no true association between EMF and cancer underlying these statistical reports (Id., p. 17).

Cole then described the Peters study as a residential case-control study of childhood cancer conducted in California (Id., p. 17). Cole explained that the Peters study examined spot measurements of magnetic fields, 24-hour measurements of magnetic fields, and the wiring code (Id., p. 18). He stated that Peters found no association between either of the measures of magnetic fields and childhood cancer (Id., p. 18). With regard to the findings on measured magnetic fields, Cole testified that this study confirms the consistent findings in the published literature that there is no association between measured magnetic fields and cancer (Id., p. 18). With regard

to the findings on wiring code, he concluded that the weaker association between the wiring code and cancers continues the pattern of better-done studies reporting smaller associations, which again suggests that there is no true association between EMF and cancer underlying these statistical reports (Id., p. 18).

Cole then testified about ecological comparison. He explained that in an ecological comparison, one collects data on the general population, rather than on individuals within that population (Id., p. 20). For example, he offered that in this century cigarette smoking and lung cancer rose sharply during the same time frame, a fact that provides persuasive evidence that there is a causal relationship between the two events (Id., p. 20). This type of ecological comparison, he noted, while subject to limitations, can provide important information as to a suggested relationship between an agent and a disease (Id., p. 20). Asked whether he had conducted an ecological comparison for EMF and childhood cancer, Cole stated he had (Id., p. 20). He explained that if exposure to EMF was associated with, for example, childhood leukemia rates over that same time period would increase (Id., p. 20). Yet he observed childhood leukemia rates rose approximately 20% from 1950-1960, and it is probably true that most of that increase was not attributable to an actual increase in leukemia, but rather to improved diagnostic procedures (Id., p. 20). He continued that childhood leukemia rates have remained

essentially stable since 1960 (Id., p. 20). He testified that this ecologic comparison further supports the conclusion that exposure to EMF is not causally associated with childhood cancer (Id., p. 20). Cole then stated his overall conclusion concerning childhood cancer studies (Id., p. 20). He concluded that the epidemiologic literature on EMF, when viewed as a whole, provides no persuasive scientific support for the hypothesis that EMF causes cancer in children (Id., p. 22).

Cole then presented testimony on adult cancer studies which include residential studies similar in design to the childhood studies, as well as occupational studies. He identified four adult residential studies which have been conducted: Wertheimer and Leeper (1982), Severson (1988), Coleman (1985, 1989), and McDowall (1986) (Id., p. 23). He identified the first three of these are case-control studies, and the McDowall study is a retrospective follow-up study. He explained that Wertheimer and Leeper conducted a residential case-control study of adult cancer in Denver very similar in design to their childhood study, and with many of the limitations of that study (Id., p. 23). They reported a strong and consistent relationship between the wiring code and adult cancers (Id., p. 23). He explained that the remaining adult residential studies, including the case-control study by Severson in Washington State, the Coleman study in London and the RFU study by McDowall in East Anglia, England, reported no association between wiring code, distance from power lines, or

measured fields and adult cancer (Id., p. 23). Cole then stated his conclusion in regard to residential studies of adult cancer:

With the exception of the early, flawed report by Wertheimer and Leeper, the residential studies of adult cancer have been consistently negative for both actual measured fields and for magnetic field surrogates. I conclude that these studies provide no support for the hypothesis that EMF is associated with an increased cancer risk in adults.

(Id., p. 23).

Cole then described the occupational studies of adult cancer and EMF (Id., p. 24). The occupational studies use some form of occupational information, such as a job title, as a surrogate for magnetic field exposure (Id., p. 24). As an example he stated that occupational study might categorize all electricians as "exposed" to EMF (Id., p. 24). He explained the approach of using occupational information such as job titles has limitations (Id., p. 24). He explained that these studies might categorize all electricians as "exposed" to EMF; however, not all electricians will have exposure to EMF (Id., p. 24). He explained that those who do have exposure to EMF may also have exposure to industrial chemicals, welding solvents, or other potentially carcinogenic agents, thereby, confounding the study (Id., p. 24). He also explained that failure to control for confounders effects the evaluation of the individual studies, and the body of literature as a whole (Id., p. 24).

Cole then explained that some occupational studies have controlled for confounders, and cited as an example a brain cancer study done by Thomas in 1987 who despite the difficulty of controlling for confounders in an occupational study was able to distinguish electrical workers who were exposed to only electric and/or magnetic fields from electrical workers who had additional exposures (Id., p. 25). Thomas found no increased risk of brain cancer in workers exposed only to electric and/or magnetic fields, suggesting that exposure to EMF is not a cause of brain cancer (Id., p. 25). He stated that the Thomas results suggest that confounding should be considered a substantial factor in the evaluation of the occupational studies (Id., p. 25).

As to occupational case control studies, Cole testified that there were 19 non-residential case-control studies which have examined various indices of possible EMF exposure (Id., p. 25). He cautioned that these studies are useful, but it must be borne in mind that the case-control design is a difficult type of investigation to conduct (Id., p. 25). He also cautions that one major limitation is that none of the studies included measurements of EMF exposure (Id., p. 25). In addition, he explained that the men in these studies most likely were exposed to known or suspected carcinogens (Id., p. 25). Nonetheless, he stated that fourteen of these studies have reported some positive association between a surrogate of EMF exposure and cancer (Id., p. 25). He

noted that the Thomas study, which did control for confounders, was a case-control study (Id., p. 25).

Cole then commented on two studies by Matanoski, neither of which has appeared in the peer-reviewed literature (Id., p. 26). Cole explained that the first, and larger, of the studies is a nationwide case-control study of mortality in telephone line workers; and the second is a retrospective follow-up study of cancer incidence in telephone line workers, limited to data from the state of New York (Id., p. 26). He testified that he believed that there was not enough information available about the data and design of the Matanoski to conduct an epidemiologic evaluation, but preliminary results suggest that Dr. Matanoski observed 2-3 more cases than expected of male breast cancer amongst the New York state linemen (Id., p. 26). When evaluated in the context of the larger body of epidemiologic literature, he stated that these preliminary results from the Matanoski study as positive, but non-persuasive (Id., p. 26).

Cole then explained that proportional mortality ratio occupational studies have evaluated the proportion of workers presumptively exposed to EMF who die from cancer (Id., p. 26). These proportionate mortality ratio (PMR) studies generally relate to occupational titles found on the death certificates of persons employed in occupations where the researchers assume (without testing) that there was more exposure to EMF than is experienced by the general population (Id., p. 26). He

testified that a major limitation of PMR occupational studies is that spuriously high PMR's can emerge if the exposed workers have an overall mortality rate that is lower than that of the general population (Id., p. 26). He explained that this is typically observed in occupational settings (i.e., the "healthy worker" effect) and may yield the appearance of risk that is, in reality, artificially inflated (Id., p. 26).

Cole testified that of eight PMR studies, they are evenly divided between positive and negative (Id., p. 27). However, he cautioned these studies do not provide a reliable basis to infer causality, principally because of the inherent limitations of such studies (Id., p. 27). He explained that in this type of studies, slightly elevated cancer mortality rates are to be expected due to the deficit of mortality that is typically observed among active workers (Id., p. 27). The results of these studies are consistent with this expected phenomenon and, as such, are not helpful in answering the question of whether occupational EMF exposure is associated with cancer.

Cole then described retrospective follow-up studies (RFU) in which a group of subjects who presumably sustained moderate to heavy exposure to EMF over a long period of time (e.g., 5-25 years) are traced up to a recent point in time (Id., p. 27). He stated that the number of deaths within the group from specific diseases of interest are then compared with the number to be expected if they had died at the same rate a

the general population (Id., p. 27). He stated that in general, the principal advantage of RFU studies is that they usually are not biased to a large degree; and the principal disadvantage is that they are typically prone to confounding and may be imprecise given the relatively few deaths from any one particular cause (Id., p. 27). Cole also explained that while the retrospective follow-up studies are not without their problems and limitations, they generally are considered to be the most valid form of epidemiological research that has been conducted to address the question of whether cancer is linked to EMF exposure (Id., p. 27). He stated that one of the limitations of the RFU studies is that they evaluate EMF exposure using job titles (Id., p. 27). He stated in most other ways (i.e., absolute measures of disease risk; superior, less arbitrary control groups), however, they are more reliable than are proportionate mortality ratio or case-control studies (Id., p. 27). He reported that there have been 10 RFU studies and only one has reported positive results; he stated that this fact which provides strong support against the hypothesis that EMF exposure causes cancer (Id., p. 27). Cole then summarized the results of his review of the epidemiological studies on EMF and cancer:

The studies involving power frequency electric and/or magnetic fields and cancer show weakly positive to zero or negative associations. The studies that use the most acceptable design consistently have found no association between EMF and cancer. I conclude that

this body of studies does not support the hypothesis that EMF is associated with adult cancer, and that the best-designed and conducted studies provide strong support against that hypothesis.

(Id., p. 28).

Cole then offered his opinion about the relationship between power frequency electric and/or magnetic fields and cancer in humans:

Taken together, the epidemiologic reports fail to demonstrate any strong or consistent pattern of association between EMF and cancer among human beings. Indeed, even among the positive studies, findings are not supported by the internal characteristics of the data. The summation can only be that, to date, there is no demonstrated relationship between EMF and cancer in human beings.

(Id., p. 28).

He stated that he also was of the opinion that EMF's have not been demonstrated to be carcinogenic, and that the Woodbourne-Heaton 230kV transmission line poses no threat of cancer to persons in its vicinity (Id., p. 28).

EDWARD PAUL GELMANN - Direct Testimony

Edward Paul Gelmann of 3800 Reservoir Road, N.W., Washington, D.C. sponsored PECO Rebuttal Exhibit No. 3 as his direct testimony (N.T. 1210). Gelmann testified that he is a medical doctor, researcher, and teacher, specializing in medical oncology (PECO Rebuttal Statement No. 3, p. 1). He

also stated that he is Professor of Medicine, Professor of Anatomy and Cell Biology, and Chief of the Division of Medical Oncology at the Georgetown University Medical School in Washington, D.C. (Id., p. 1).

Gelmann then explained that oncology is a subspecialty of internal medicine that involves the study and treatment of cancer (Id., p. 1). He testified that 100 percent of his professional work is in the fields of molecular genetics, cellular biology, and cancer (Id., p. 5). Gelmann then described the basic structure and function of the cell:

[t]he cell is the basic building block of the human body. Cells make up all the systems of the body, including the muscular, skeletal, nervous, and circulatory systems. Within the cell is the nucleus, and within the nucleus are the chromosomes. The chromosomes contain the cell's DNA. DNA encodes the genetic information which provides a blueprint for all inherited characteristics. Genetic information is contained in discrete subunits of the DNA known as genes; for this reason, DNA is called the "genetic material."

* * *

DNA contains the essential information coding for all the cell's structural and functional elements. Change in the DNA molecule, i.e. genetic change, can have serious effects on cell processes and therefore on tissues and organisms. Subtle change in the DNA molecule can be responsible for making a normal cell become a cancer cell. DNA change is associated with all cancers. Cancer cannot occur without permanent changes to the cell's DNA known as "mutations." Change in the DNA molecule or other

molecules within the cell can also cause other adverse effects in the human body such as problems with reproduction, growth, metabolism, and development.

(Id., p. 6).

Gelmann then explained that genetic change is associated with cancer and stated:

[a] key point to understand about applying molecular and cellular biology to understanding cancer is that any agent that causes a "heritable" genetic change in the DNA can have adverse effects on the cell and the living organism. A heritable genetic change is a permanent change in the genetic material that is transmitted to "daughter cells," hence, when a particular cell with a heritable genetic change of the type that causes cancer divides, all subsequent cells will be cancer cells. It is most important to understand that genetic change is essential for normal cells to be transformed into cancer cells.

(Id., p. 7).

He also explained that:

[a]lthough change to DNA is an essential process in carcinogenesis, not all genetic changes result in cancer. We believe that most changes that occur in DNA do not result in cancer, or for that matter, in any demonstrable effects. Spontaneous changes in the genetic material do occur. Most of these changes have no consequence for the cell. The cell has repair mechanisms that can, to some degree, correct change to DNA, and many of the changes are corrected by these repair mechanisms. Repair mechanisms also have the capacity to correct genetic change which results from external stimuli.

(Id., p. 7).

Gelmann then testified that it is important to understand that "cancer" is a generic term used to describe many different types of diseases (Id., p. 7). He explained further that cancers of different organs have unique characteristics, and that different cancers also result from different causes (Id., p. 7).

Gelmann then testified that the primary way to determine whether an agent causes the type of DNA change that can lead to cancer or other adverse health effects is through the in vivo (whole animal) or in vitro (cellular) laboratory studies (Id., p. 8). He explained that in vitro research allows scientists to look for a change in the DNA molecule itself while studies with entire organisms, called "in vivo" studies, allow scientists to look for indicators of DNA change such as alterations in reproduction, growth, and development, or more importantly, to look for tumor formation, which is direct evidence of an agent's ability to cause cancer (Id., p. 8). One area of study involving EMF is mutational analyses which are tests that show whether a permanent change has occurred in the structure of the DNA molecule as a result of exposure to an agent (Id., p. 9). He explained that by studying an agent's ability to cause mutations, scientists can determine whether exposure to the agent causes the kind of changes in DNA that could lead to cancer or other adverse health effects (Id., p. 9). Gelmann then testified that the

results of the mutational analyses involving power frequency electric and magnetic fields indicate that exposure to 60HZ fields have no effects on mutations (Id., p. 9). As examples, he listed: Frazier et al. (1984) who found no effects on the frequency of DNA changes (or mutations) in hamster cells as a result of 24-hour or 48-hour exposure to power frequency fields; Trent (1987) who also found no effect of power frequency fields in his work with human colon cancer cells; and others, such as Reese (1988, 1990), who similarly found no indications of DNA change after exposure to power frequency electric, magnetic, or combined electric and magnetic fields (Id., p. 9).

Gelmann then criticized the DNA synthesis work done by Liboff (1984) because the laboratory test, or "assay" that was used did not measure DNA synthesis (Id., p. 9-10). He explained that the Liboff research measured uptake of tritiated thymidine, which may have had no relationship to DNA synthesis in the model used by Liboff (Id., p. 10).

Gelmann also testified on a study by Whitson et al. (1986) which looked at the relationship between electric and magnetic fields and DNA repair (Id., p. 10). He testified that Whitson first exposed cells to ultraviolet radiation in order to cause change to the DNA, and then exposed the cells to power frequency fields during the time that the cells were undergoing DNA repair (Id., p. 10). Gelmann explained Whitson found that DNA repair processes were not affected by exposure to power

frequency fields (Id., p. 11). Gelmann also stated that Frazier (1990) looked at another DNA repair process in the cell, and found no effect of power frequency electric and magnetic field exposure on the ability of cells to repair DNA damage (Id., p. 11).

Another area of research involved in EMF exposure involves chromosome studies, which Gelmann described as studies which evaluate whether there are breaks or other damage to the chromosome as a result of exposure to an agent (Id., p. 11). The importance of chromosome damage to possible health effects is that because chromosomes contain the DNA and change to DNA is necessary for cancer to occur, these studies provide information on an agent's potential to cause cancer or other adverse health effects (Id., p. 11).

Gelmann testified that a number of cancers, including chronic myelogenous leukemia and lymphomas, have been shown to be linked to specific acquired abnormalities in chromosomes (Id., p. 11). He stated that these studies show that power frequency electric and/or magnetic fields are not associated with damage to chromosomes (Id., p. 11). He cited some examples: 1) Cohen (1986) who conducted extensive studies with human blood lymphocytes and found no effect; 2) Livingston (1986) who studies cultured animal cells and human lymphocytes after exposure to 60HZ fields of 2,200mG and a range of electric field intensities, and found no effect of any field strength at exposure times up to 100 hours; and other

researchers, such as Rosenthal and Obe (1989), who found similar results with other cell lines using electric, magnetic, or combined electric and magnetic fields (Id., pp. 11-12). From his review of mutational analyses and chromosome studies, Gelmann concluded that they provide specific information on molecular and cellular events that are associated with cancer and other adverse health effects, and that the EMF research in those areas shows no DNA change or other cellular or molecular changes that could lead to cancer or other adverse health effects (Id., p. 12).

Gelmann then turned his attention and testimony to animal studies which examine the effects of an agent on whole organisms (Id., p. 12). He explained that some of the animal studies are conducted under controlled laboratory conditions, while others look at animals living directly beneath transmission lines (Id., p. 12). In these studies, he explained that animals are exposed to electric and magnetic fields throughout critical stages of reproduction and/or development, and the researchers then examine the parents and/or their offspring for adverse health effects (Id., p. 12). He explained that animal studies have a broader potential than studies on isolated cells to tell researchers about genetic change or other adverse effects on the cell and whether any such changes are related to an adverse health outcome (Id., p. 12). The animal studies look for effects on the whole organism, such as abnormalities in reproduction, growth, or

development, functions depend on the proper functioning of DNA (Id., p. 12).

Gelmann then gave an example of one experiment which he described as one of the best designed studies of this type is by Benz and Carsten (1987) (Id., p. 13). Benz and Carsten studies two strains of mice under two combined-exposure conditions: 10,000mG + 50kV/m and 3,000mG + 15kV/m and that thousands of mice were exposed over several generations (Id., p. 13). The researchers evaluated a number of health endpoints, including fertility, growth, development, and general health (Id., p. 13). This study consistently indicated no effects of electric and magnetic field exposure on any of the many health endpoints examined (Id., p. 13). He also explained that Benz and Carsten conducted an additional test which examined whether electric and magnetic fields had a toxic effect on bone-marrow stem cells (Id., p. 13). The results of this test showed no significant effects on the stem cells of the bone marrow, which would be important in regard to the development of leukemia (Id., p. 13).

Gelmann referenced another recent study by Lorimore et al. (1990) which exposed mice, normally susceptible to acute myelogenous leukemia, to magnetic fields of 200,000 MG and found no effect on their bone marrow cells. Leukemia is a disease that is associated with genetic change to bone marrow cells (Id., p. 13). He explained that if an agent causes leukemia, one would thus expect to see some effect on these cells (Id., p. 13).

Gelmann also identified a number of long-term multigenerational studies of avian, mammalian, and other species, such as those by Kowalczyk and Saunders (1990), Rommerein et al. (e.g., 1987, 1989, 1990), Walters and Carstensen (1987), Algers and Hultgren (1986), and others (Id., p. 14). He explained that they did not find any physiological abnormalities that would indicate DNA change or other adverse molecular or cellular effects from exposure to power frequency electric and/or magnetic fields (Id., p. 14).

Asked for his conclusions of his review of the animal studies, Gelmann testified that long-term animal studies using multiple species, strains, and sexes of organisms consistently provide no scientific basis to conclude that electric and/or magnetic fields cause cancer, adverse effects on reproduction, growth, or development, or other adverse health effects (Id., p. 14).

Gelmann then offered his direct testimony on tumor growth studies which he characterized as a direct test of cancerous properties of cells (Id., p. 14). In this type of research, which examines whether cancerous cells will form tumor when transplanted to an animal host, researchers either expose cells to the agent in question, then transplant those cells to the animal host, or they transplant cells to the animal host and then expose the entire animal to the agent of interest (Id., p. 14). He explained that by comparing the development of cancer in a group of control animals, scientists

can determine whether the agent has affected the growth of cancer in the animals (Id., p. 14).

Gelmann then testified that tumor growth studies have been conducted with power frequency EMF and as an example, offered a study by Chandra and Stefani (1979) which examined the growth of transplantable mammary tumor of mice (Id., p. 15). He explained that tumor cells were exposed to magnetic fields either in culture before transplantation or in the whole animal after a tumor of a suitable size had developed (Id., p. 15). He stated that no effect on the growth of the tumor was observed as a result of exposure (Id., p. 15). He also stated that studies by Kronenberg and Tenforde (1979), Thomson (1988), and others have also found no significant differences in tumor incidence or animal survival (Id., p. 15). Gelmann concluded that the tumor growth studies indicate that exposure to power frequency electric and/or magnetic fields, either before or after implantation of a tumor into the animal host, does not affect the development of the tumor (Id., p. 15).

In the field of other cellular research on EMF, Gelmann expressed familiarity with the work done by Goodman (Id., p. 16). He explained that Goodman has exposed various types of cells, including cells from insect salivary glands (these cells contain large molecular structures and some processes can be more easily observed in such cells) to pulsed fields, modulated fields, and power frequency fields (Id., p. 16). He stated that she has examined certain cellular

processes in those cells after exposure to the fields (Id., p. 16). He further explained that Goodman examined normal cell processes unrelated to the process of carcinogenesis (Id., p. 16). Gelmann stated Goodman has reported that some subtle changes in the uptake of RNA precursors may occur after exposure, but he emphasized that Goodman's work deals with normal cell processes unrelated to carcinogenesis (Id., p. 16). In addition, he explained that her work was done on cells in vitro, and the effects have not been shown to occur in humans (Id., p. 16). He also stated that even if the results that Goodman has observed do occur in humans, there would be no suggestion of an adverse health impact (Id., p. 16). He also stated that the changes that she has reported are trivial compared with innocuous events that occur everyday.

Gelmann also discussed experiments done by Marron (e.g., Marron, 1975, 1978, Greenebaum and Marron, 1982) which reported that, for certain slime molds, the length of the cell cycle was increased after exposure to power frequency fields (Id., p. 17). He explained that the results that Marron reported -- a lengthening of cell cycle in slime mold -- are the opposite of what one would expect to relate this result to the cancer process (Id., p. 17).

Gelmann also stated that he analyzed the research done by Byus and Adey on ornithine decarboxylase ("ODC") (Byus and Adey, 1987, 1988) (Id., p. 17). As with the Goodman work, this research does not fall within any of the categories of

research previously discussed, he stated (Id., p. 17). Gelmann explained that ODC is an enzyme involved in cellular growth, and that increased ODC activity exists in normal growing cells (Id., p. 17). It also exists, in much greater amounts, in cancer cells (Id., p. 17). He testified that Byus and Adey reported that exposure to modulated microwaves, and to 60HZ fields, resulted in a small, transient increase in ODC activity in some types of cultured cells, but not others (Id., p. 17). He explained that Byus and Adey's research on ODC does not indicate a carcinogenic effect of exposure to power frequency fields because the magnitude and timing of the ODC increases reported are inconsistent with a carcinogenic effect (Id., p. 18). He stated that Byus and Adey themselves have concluded that any suggestion of a carcinogenic effect from this research is speculative (Id., p. 18). He also noted that their research results on ODC indicate that exposure to EMF does not cause the kinds of changes to that enzyme that would be expected in a carcinogen (Id., p. 18).

Gelmann then criticized the calcium efflux work done by Bawin and Adey and Blackman (Id., p. 18). He explained that this research (e.g. Blackman, 1979, 1980, 1982, 1985, 1988, 1990, Adey and Bawin, 1982, Bawin and Adey, 1975, 1976, 1978) examined the question of whether exposure of modulated microwaves and to power frequency fields alters the amount of calcium that leaks out of slices of brain tissue (Id., p. 18). Gelmann stated that the results have been inconsistent: that

some researchers have reported an increase in calcium, others have reported a decrease in calcium, while still others have reported no change in calcium (Id., p. 18). Because of this inconsistency of results, he believed that the researchers likely are reporting an experimental artifact, rather than an effect of exposure to fields (Id., p. 18). Gelmann then stated that the calcium efflux results have no implications for cancer (Id., p. 18). He also stated that the calcium endpoint that was assayed in these experiments is not related in any known way to the process of carcinogenesis (Id., p. 18).

Gelmann also reviewed the studies on bone repair research and testified that most of the research involves pulsed fields (e.g., Bassett, 1981, 1982, 1984) which will not be created by the transmission line at issue in this case (Id., p. 19). He stated that there is limited research on bone repair using power frequency fields (Id., p. 19). Moreover, he stated bone repair is a normal process unrelated to carcinogenesis, and he noted that one does not observe an increase in cancer at bone healing sites, nor does one observe an increase in cancer when pulsed fields or power frequency fields are applied during bone healing (Id., p. 19).

As to the research conducted by Wilson and others on melatonin Gelmann stated that there are no data connecting melatonin levels to breast cancer causation in humans (Id., p. 19).

When questioned about the studies on cell proliferation, Gelmann testified that some reported an increase in cell proliferation, some reported a decrease, while others reported no effect (Id., p. 20). He stated that the Ross study, for example, reported decreased proliferation of cells in vitro, which is exactly the opposite of what one would expect from a carcinogen (Id., p. 20). Gelmann then testified that the cell proliferation studies as a whole do not report any consistent effect on cell proliferation (Id., p. 20). More importantly, however, he stated the tumor growth studies he described earlier provide a much more direct measure of whether exposure to power frequency fields affects cell proliferation in intact animals (Id., p. 20). He concluded that those studies consistently report that no such effect occurs as a result of exposure to power frequency fields (Id., p. 20).

Gelmann also stated that the work of Winters and Phillips did not involve cell proliferation as Dr. Liboff indicated in his written testimony (Id., p. 20). He explained that the assay used by Winters and Phillips is known as soft agar clonogenicity, which is unrelated to cell proliferation, and also is unrelated to the process of carcinogenesis (Id., p. 20). Gelmann testified that this work was severely criticized by its sponsor, the Scientific Advisory Panel of the New York State Power Lines Project because the soft agar assay is so imprecise that it does not provide meaningful data, that the assay does not correlate with any important clinical

parameter, and that there was a lack of rigid quality control in the experiment (Id., pp. 20-21). Gelmann agreed with those critiques of the study, and also with the panel's conclusion that: "Even if these results are valid, they cannot be extrapolated to cancer growth in humans" because the assay has no relevance to that issue (Id., p. 21). Gelmann then stated that the argument that biological effects must lead to adverse health effects is contrary to basic biological and medical facts (Id., p. 22). To illustrate, breathing fresh air causes an immense number of biological effects in the human, but the process of breathing does not cause cancer or other adverse health effects (Id., p. 22).

Gelmann concluded his testimony by stating that the extensive research on molecular and cellular biology and cancer provides no scientific basis to conclude that power frequency electric and/or magnetic fields cause, promote, or contribute to the development of cancer or other adverse health effects (Id., p. 22). He also testified that there was no scientific basis to conclude that the power frequency fields associated with the Woodbourne-Heaton line would cause adverse health effects including cancer (Id., p. 23).

Cross Examination

Gelman confirmed that cancer causation always involves a permanent change to DNA (N.T. 1152). He then explained that cancer promotion is usually caused by an agent which facilitates cell proliferation (N.T. 1153). He stated

that progression of cancer can happen all by itself (N.T. 1153).

Gelman explained the importance of the DNA repair mechanism and its relation to cancer (N.T. 1152). He explained that the normal cell through a number of different mechanisms can repair DNA (N.T. 1154). He then explained that not repairing DNA can result in a mutation, but whether the mutation is important or not (in causing cancer) is the next question (N.T. 1154).

MURRAY ROSENBERG - Direct Testimony

Murray Rosenberg, 1445 Gortner, St. Paul, Minnesota 55108, sponsored PECO Rebuttal Statement No. 4 as his direct testimony (N.T. 1212). Rosenberg testified that he is a biophysicist, a researcher and Professor of Genetics and Cell Biology, and a medical doctor (PECO Rebuttal Statement No. 4, p. 1). He explained that biophysics is the study of interactions between physical forces and biological material, and the physical analysis of biological systems (Id., p. 1). He also explained that currently he conducts research involving the processes by which cells in the body "communicate" with one another (Id., p. 3). In particular, he explained that he was interested in the purification of certain enzymes that are important in both normal cell function and in the development of cancer (Id., p. 3). Most recently, he conducted research in the area known as "electroconfirmational coupling," whereby

certain enzymes were exposed to electric and magnetic fields of different frequencies to determine whether the function of the enzymes could be modified (Id., p. 3). He confirmed that this research utilized 60 Hertz frequencies (Id., p. 3).

Rosenberg then testified as to the meaning of the term "frequency" as it related to electric or magnetic fields (Id., p. 6). He explained that one type of electric and magnetic field, known as a "sinusoidal" field, alternates from positive to negative and back to positive in a regular pattern (Id., p. 6). He explained that this infinitely repeating cycle is known as "alternating current" and the number of times that a field alternates in one second is its "frequency" (Id., p. 6). He then explained that frequency is measured in Hertz ("HZ") (Id., p. 6). Rosenberg then presented background material on the electromagnetic spectrum, explaining its energy and wavelength characteristics (Id., p. 7). He explained that each of the regions of the electromagnetic spectrum describes a different type of energy, with different characteristics and unique ways of interacting with biological material (Id., p. 9). He explained that fields from high voltage transmission lines and appliances would appear at the left end of the spectrum (Id., p. 9). He also explained that intensity refers to the magnitude of field strength at a given frequency, and no matter how high or low the milligauss level of a 60HZ magnetic field, it would remain a 60HZ field and its place on the electromagnetic spectrum would not change (Id., p. 9). He

stated that the field would retain the characteristics of its frequency, and would not be converted into some other frequency (Id., p. 9). Rosenberg then explained the biological effects of ionization radiation:

[i]onizing radiation is at the extremely high end of the electromagnetic spectrum, and this type of field is capable of transmitting very large amounts of energy sufficient to break chemical bonds in the molecules of the cells. This type of radiation can damage or kill the cell, and if certain types of damage to the nucleus of the cell are caused, a cell may acquire the genetic characteristics of cancer.

(Id., p. 10).

Rosenberg then testified that 60HZ fields are vastly different than ionizing radiation (Id., p. 10). He explained that the energy in power frequency fields is much less than one-trillionth of that found in ionizing radiation, and power frequency fields do not have sufficient energy to break chemical bonds in the cells like ionizing radiation (Id., p. 10). He stated that the mechanism of interaction by which ionizing radiation causes damage to tissues is dependent upon frequency and cannot be effected by power frequency fields (Id., p. 10). Rosenberg then explained that ultraviolet radiation is at the extremely high end of the ultraviolet range and the fields contain sufficient energy to damage DNA similarly to x-rays and other ionizing radiation (Id., p. 11). He explained that most of the ultraviolet range, however, has insufficient energy to break chemical bonds in molecules in the

cells, but molecules exposed to ultraviolet rays can experience a local heating effect (Id., p. 11). He explained that this heating results in sunburn (id., p. 11). Rosenberg then explained that exposure to any level of electric and magnetic fields from electric lines cannot interact with biological systems in the manner of ultraviolet light (Id., p. 11).

Rosenberg then stated that the range of frequencies for visible light is a very narrow band of visible light in the range of about 10^{14} to 10^{15} HZ (Id., p. 11). He stated that this is about a trillion times higher than the fields associated with electric lines, appliances and other electrical sources (Id., p. 11). He explained that visible light cannot disrupt chemical bonds, but it can excite electrons in certain receptor molecules in our eyes, which allows us to see (id., p. 11). He added that different bands in the spectrum correspond to different colors, as we see in a rainbow (Id., p. 11). Rosenberg explained that power frequency fields cannot cause this biological effect (Id., p. 12).

Rosenberg then explained that the range of frequencies in the infrared/microwave region spans from about a billion HZ to a trillion HZ (Id., p. 12). He testified that energy from microwave fields cannot disrupt chemical bonds, like x-rays, nor can they excite electrons in the eye, like visible light (Id., p. 12). Rosenberg stated that microwaves can, however, be absorbed in ways that increase the motion of molecules -- either internally, leading to a variety of

intramolecular bending motions, or as a whole, causing molecules in a solution to move faster, which is the equivalent of an increase in temperature (Id., p. 12). At sufficient intensities of microwaves, the practical effect is that the biological tissue is heated, which is the principle by which microwave ovens cook (Id., p. 12). Rosenberg stated that the microwave frequency used in microwave ovens (about 2.5 billion HZ) interacts specifically with the water molecules in the food and increases their movement (Id., p. 12). This increased movement leads to an increase in temperature (Id., p. 12). Rosenberg explained that the frequencies associated with transmission of electricity are far lower than microwave frequency, and the energy associated with 60HZ fields is about one billionth of that associated with the microwave region (Id., p. 13). Power frequency fields cannot interact with living systems in ways that are similar to microwaves (Id., p. 13).

Rosenberg then testified that radiofrequency and television waves are in the range of 10^5 to 10^9 HZ (Id., p. 13). He stated that there are no generally accepted biological effects from exposure to radio and television waves at environmental levels (Id., p. 13). He explained at very high intensities, however, some radiofrequency waves are used in conjunction with static fields in the medical diagnostic tool known as magnetic resonance imaging ("MRI") (Id., p. 13).

Rosenberg testified that power frequency fields do not break molecular bonds, like ionizing radiation, nor do power frequency fields interact with biological tissue in a manner similar to microwaves or the other regions of the electromagnetic spectrum (Id., p. 13). He stated that at field strengths associated with transmission lines like the Woodbourne-Heaton line, there are no accepted mechanisms by which power frequency fields can cause biological effects in living systems (Id., p. 13). Rosenberg also testified that it is not appropriate to rely upon research using these other frequencies (Id., p. 14).

Rosenberg then testified that power frequency fields are "sinusoidal" which is a term that refers to the shape of the fields as they alternate from positive to negative and back to positive (Id., p. 14). Rosenberg stated that there are a number of different types of fields other than sinusoidal fields (Id., p. 14). He explained that one type of field is generally known as a "pulsed" field (Id., p. 14). He explained that there are many types of pulsed fields, but each has a very different shape than the sinusoidal field associated with power transmission (Id., p. 14).

Rosenberg then described the relevance of the difference in wave form between pulsed fields and sinusoidal fields (Id., p. 16). He explained that in order to create the square or irregular shape of the pulsed field, it is necessary to blend, or mix, many different frequencies of sinusoidal

fields (Id., p. 16). He stated that these fields can range as high as several thousand HZ (Id., p. 16). He stated that a field that is "pulsed" 60 times a second will contain 60HZ sinusoidal fields, but it also will contain many other sinusoidal fields of very different frequencies (Id., p. 16). Rosenberg then testified that since the pulsed field contains many frequencies, if an effect is observed it is not possible to determine which frequency field caused that effect (Id., p. 16). He also stated that given the differences in frequency mechanisms and effects he discussed previously in his testimony, Rosenberg believed it was inappropriate to attempt to draw conclusions about power frequency fields based on a study using many frequencies or pulsed fields (Id., p. 16). He stated that a study on a particular pulsed field thus can only give information on that particular pulsed field (Id., p. 16).

Rosenberg then explained that a modulated field generally refers to a field at some higher frequency, such as microwave or radiofrequency, that had had its shape altered so that the outline of the field resembles the sinusoidal wave of a lower frequency (Id., p. 16). Rosenberg stated that studies using modulated fields do not provide information relevant to determining the effects of sinusoidal power frequency fields (Id., p. 16). He stated that the modulated field does contain certain characteristics of the lower frequency field, but it also contains the original, modulated frequency (Id., p. 16).

Rosenberg then explained the ion cyclotron resonance hypothesis as a hypothesis which suggests that very low magnetic fields enhance the movement of charged particles, called ions, through channels in the cell membrane (Id., p. 17). He stated that this hypothesis is one of several speculative models available in the published papers that attempt to establish a mechanism for explaining how power frequency fields might interact with biological tissue (Id., p. 17).

Rosenberg did not believe that ion cyclotron resonance provides an understanding of interactions between power frequency fields and biological tissue and disagreed with Liboff and his colleagues, who in their writings, have suggested that it might provide such an understanding (Id., p. 17). He stated that the ICR hypothesis, however, has a number of fundamental problems of theory that demonstrate that it is not an accurate description of any interaction between power frequency fields and biological tissue (Id., p. 17).

Before describing the problems with the ICR hypothesis, Rosenberg provided some background on cellular biology and physics (Id., p. 17). Rosenberg stated that as part of normal cell function, some biologically important charged particles, called ions, cross cell membranes through circular, or helical, openings in the cell membrane known as "channels" (Id., p. 17). He explained that it is those ions that are referred to in the phrase "ion cyclotron resonance"

(Id., p. 17). Rosenberg then testified that in physics, there is a well-understood phenomenon known as "cyclotron resonance" in which it is possible to calculate the precise frequency that will cause a particular particle which is travelling in a circular or helical path to undergo acceleration (Id., p. 17). He testified that the cyclotron resonance phenomenon only occurs when a particle or ion is travelling in a circular path (Id., p. 18). He also stated that it is possible to calculate, for a given ion and resonance frequency, the size of the circular path that must exist for the resonance effect to be possible (Id., p. 18).

Rosenberg then testified that Liboff's ICR hypothesis attempts to fuse these two concepts, suggesting that as ions pass through the helical openings in the cell wall the 60HZ magnetic field imparts energy to the ion with each cycle of the 60HZ field -- in effect "pushing" the ion 60 times each second (Id., p. 18). He indicated that the first problem with the ICR theory has to do with the size of the circular path that would be necessary for a 60HZ cyclotron resonance effect to occur with biological ions; a channel approximately 10 feet wide would be required to meet the theory's conditions for most ions (Id., p. 18). Because the actual cell wall channels are submicroscopic, the cyclotron resonance effect postulated by Liboff simply could not take place (Id., p. 18). He added that a frequency of about 6,000,000 HZ would be necessary to meet the theoretical cyclotron resonance conditions in the actual

channels in cell membranes, which is quite different from 60HZ (Id., p. 18). He also explained that another problem with the ICR theory is that the cyclotron resonance phenomenon can occur only if the ion or other particle travels in an uninterrupted circular or helical path; if the circular path is interrupted by collision with other particles, the effect is nullified (Id., p. 18). He explained that when an ion passes through the membrane of a human cell, however, it is in constant collision with other particles -- as many as a trillion per second -- and cyclotron resonance effect would be immediately nullified by any one of these collisions, each of which would affect the speed and direction of the ion, interrupting its circular path (Id., pp. 18-19). Rosenberg indicated that a third difficulty with the ICR hypothesis as applied to biological ions in the human cell has to do with the calculation of the resonance frequencies (Id., p. 19). He explained that if an incorrect mass of the ion is used in the ICR calculation, the results of that calculation will be incorrect (Id., p. 19). Rosenberg testified that Liboff's ICR hypothesis involves an incorrect calculation of the mass of the ion under study because the mass of the shell of water molecules which surrounds an ion as it passes through a fluid filled channel in the cell membrane is not taken into account (Id., p. 19). Rosenberg stated that taking into account all of the above criticisms, the problems with the ICR hypothesis strip it of any explanatory power to describe a mechanism of interaction between power frequency

fields and biological tissue (Id., p. 19). He explained that these and other problems with the ICR hypothesis have been recognized by Liboff and his co-workers in their publications on this subject (e.g., Liboff 1985), and by other authors addressing the ICR hypothesis (e.g., Halle 1988) (Id., p. 19).

Rosenberg also testified that the experiments which have been conducted to prove the ICR theory have not been successfully or consistently replicated and concluded that the ICR hypothesis remains unproven (Id., pp. 19-20). He believed that the ICR hypothesis had no implications for human health (Id., p. 20).

Rosenberg concluded his testimony by stating that exposure to power frequency fields does not cause any significant biological effects, and that exposure to electric and/or magnetic fields from the Woodbourne-Heaton 230kV line will not result in adverse health effects in humans (Id., p. 20).

CARTER VAN DYKE - Direct Testimony

Carter Van Dyke, 40 Garden Alley, Doylestown, PA 18901, sponsored PECO Rebuttal Statement No. 5 as his direct testimony (N.T. 1269). Van Dyke testified that he is a land use planner and landscape architect (PECO Rebuttal Statement No. 5, p. 1). He also testified that he is President of Carter Van Dyke Associates, which is a consulting firm specializing in land use planning and landscape architecture (Id., p. 1). He

stated that land use planning is the discipline involved with the orderly growth and development of cities, suburban areas, and rural areas, and explained that one primary purpose of land use planning is to develop integrated communities which can provide services, including utility services, to the population in a manner that does not disrupt the patterns of development in the community (Id., p. 1). Van Dyke explained that he had been asked to identify and evaluate land use implications associated with the Woodbourne-Heaton 230kV Line (Id., p. 3). He testified that his assessment was based on numerous resources, including all United States Geological Survey ("USGS") maps that contain a portion of the right-of-way of the Woodbourne-Heaton line; 1990 aerial photographs, prepared by the Delaware Valley Regional Planning Commission (DVRPC"), that contain information on land uses and natural features near the right-of-way; Federal Flood Insurance maps of that same area; and comprehensive plans and zoning maps of the municipalities through which the transmission line passes (Id., p. 3). He also stated that he personally viewed and photographed substantially the entire route of the transmission line to conduct a visual inspection of the adjacent land uses and natural features (Id., p. 3).

Van Dyke first identified two geographic study areas which he included in his land use assessment as the Regional Study Area (RSA"), and the Corridor Study Area ("CSA") (Id., p. 4). He explained that the Regional Study Area was defined

as all areas 2.5 miles on either side of the right-of-way for the Trenton Cutoff (Id., p. 4). He explained that the Woodbourne and Heaton substations are approximately 12.5 miles apart, and the RSA covers a geographic area of approximately 60 square miles (Id., p. 4). He then explained that the Corridor Study Area was defined as all areas 400 feet on either side of the right-of-way of the Trenton Cutoff, and the total area of the CSA is approximately 1,212 acres (Id., p. 4).

Van Dyke then explained that he conducted an inventory of three general types of land use: (1) utility facilities and corridors, (2) natural features, and (3) urban development (Id., p. 4). Within the Regional Study Area, Van Dyke identified numerous utility facilities and corridors, including arterial roadways, electric transmission and distribution facilities, and utility pipelines (Id., p. 5). These utility facilities were identified on various maps in Exhibit CVD-3 (Id., p. 5). Within the Regional Study Area, Van Dyke identified two types of natural features: (1) streams, waterways, and floodplains, and (2) undeveloped woodlands (Id., p. 5). These natural features were identified in Exhibits CVD-4 and CVD-5 (Id., p. 5).

Van Dyke then explained that in his inventory urban development was defined as areas with primarily moderate to high density residential development and associated service commercial facilities (Id., p. 5). The urban developments in the RSA are identified on Exhibit CVD-6 (Id., p. 5).

Portions of Van Dyke's direct testimony concerning alternate routes to the Woodbourne-Heaton 230kV line (Id., pp. 6-8) were stricken from the record (N.T. 1254-1255, 1265).

Van Dyke explained that his inventory for the Corridor Study Area (CSA) included: (1) existing zoning in the CSA, (2) existing land uses in the CSA, and (3) residential density and population within the CSA (Id., p. 8). He also explained that existing zoning in the Corridor Study Area was identified by reviewing local zoning maps of the jurisdictions in the Corridor Study Area (Id., p. 8). He testified that his review reveals the following breakdown of current zoning in the CSA:

Open Space	7.2%
Non-residential Development	44.6%
Industrial	37.4%
Commercial	4.2%
Institutional	3.0%
Residential Development	48.2%
High Density	0.0%
Moderate Density	39.0%
Low Density	9.2%

(Id., p. 9).

The zoning classifications within the CSA are identified on Exhibit CVD-7 (Id., p. 9).

Van Dyke then presented his inventory of the existing land uses in the Corridor Study Area (Id., p. 9). He explained that the actual existing land uses in the Corridor Study Area

were identified by visually reviewing 1990 aerial photographs for the entire area of the CSA and classifying all visible land uses within that area (Id., p. 9). He stated that his review reveals the following breakdown of land uses in the CSA:

Open Space	33%
Non-residential Development	31%
Industrial	22%
Transportation	3%
Commercial	3%
Utility	2%
Institutional	1%
Residential Development	22%
High Density	0%
Moderate Density	1%
Low Density	21%
Vacant Land	14%

(Id., p. 10).

The existing land uses within the CSA can be seen by reference to Exhibit CVD-8 (Id., p. 10). Van Dyke then explained that in his inventory of existing population he identified 289 dwelling units in the CSA (Id., p. 10). He also applied a blended persons-per-household factor to this number to determine the approximate population of the CSA as 867 persons (Id., p. 10). The estimated density of the CSA is approximately 0.238 dwelling units per acre, or 0.715 persons per acre, he testified (Id., p. 10).

Based upon the natural features and existing zoning classifications within the CSA, Van Dyke estimated that approximately 82 additional housing units possibly could be

constructed within the CSA, to house approximately 246 additional persons (Id., p. 11). If that potential development were fully realized, the CSA would have approximately 0.306 dwelling units per acre, and 0.918 persons per acre, he testified (Id., p. 11). Van Dyke then explained that high density urban development is generally considered to be in the range of 8-16 dwelling units per acre and 18-29 persons per acre (Id., p. 11). Therefore, he concluded that the Corridor Study Area is not generally categorized as a high density urban area, nor is it expected to reach that categorization even if the CSA becomes fully developed (Id., p. 11). He noted that the CSA does contain small concentrations of urban residential development, but the CSA as a whole generally displays low overall density (Id., p. 11).

Van Dyke then testified about his assessment of the potential impacts of energizing the line on both existing and projected future land uses (Id., p. 11). He explained that he assessed the potential impact on zoning patterns, existing land uses, and property valuation within the Corridor Study Areas (Id., p. 11). He then testified that the existing zoning designations of the Corridor Study Area are compatible with an adjacent utility use, and he did not expect any change in zoning to result from energization of the transmission line (Id., p. 12). He explained that certain zoning designations, including Industrial, Commercial, Institutional, and Open Space, are generally considered as per se compatible with an

adjacent utility use (Id., p. 12). Other zoning designations, including Residential, should be analyzed on the facts of the situation to determine whether they are compatible with an adjacent utility use (id., p. 12). He continued that compatibility should be understood in the context of the basic land use policy that utility services must be provided in coordination with urban growth (Id., p. 12). He expressed the opinion that while it is appropriate to review the compatibility of individual zones in a zoning impact analysis of a linear utility use such as a transmission line, compatibility of the corridor as a whole should be given greater weight in determining zoning compatibility (Id., p. 12).

Van Dyke also stated that the analysis indicates that the Residential zoned areas of the Corridor Study Area are also compatible with an adjacent utility use (Id., p. 12). He explained that the Trenton Cutoff has been a utility corridor for most or all of this century, and until the mid-1980's it contained an electrified railway (Id., p. 12). He testified that the existing Residential zoning designations should thus generally be understood to have been chosen as appropriate for proximity to a utility corridor, and in some cases specifically for proximity to a utility corridor, and in some cases specifically for proximity to a utility corridor with electrical facilities (Id., p. 12). He explained that given the site-specific history of the Corridor Study Area,

replacement of the previous electric utility function with an electric transmission function after a short hiatus is compatible with the existing Residential zoning (Id., p. 12). He concluded that he did not expect that any changes in zoning will occur as a result of energization of the Woodbourne-Heaton transmission line (Id., p. 13).

Van Dyke then testified that the existing land uses thus show a pattern of greater per se compatibility with adjacent utility use than the zoning designations would suggest (Id., p. 13). This assessment was based on the fact that approximately 78% of the Corridor Study Area is currently used for Industrial, Transportation, Commercial, Utility, Institutional, Open Space or Vacant Land purposes (Id., p. 13). Low density housing accounts for the remainder (Id., p. 13). He stated that while compatibility with an adjacent land use provides strong support for the conclusion that no adverse impacts will result from the adjacent land use, it is also appropriate to review potential specific effects to determine whether an impact is possible (Id., p. 13).

Van Dyke indicated that he is not a real estate appraiser, and that he had not conducted an appraisal of market values in this geographic area, but limited his comments to an evaluation of the available land use planning information as it relates to property values (Id., p. 13). He explained that the land use inventory demonstrates that approximately 22% of the Corridor Study Area is presently used for residences, almost

exclusively low density residences (Id., p. 13). He then explained that the residential uses within the CSA were developed in the immediate context of the existing rail utility corridor, on which transmission line poles and wires already existed and which until recently contained an electrified railway (Id., p. 13). He concluded that past and current market valuations for property in the CSA therefore already include market effects for proximity to a utility corridor (Id., p. 14).

Van Dyke then testified that current use of the utility corridor include an active high speed freight railway (Id., p. 14). He also testified that recent uses of the utility corridor included an electrified railway (Id., p. 14). He stated that it would be expected that the market for residential property in the CSA would already have compensated for these current and recent utility corridor uses (Id., p. 14). Additionally, Van Dyke stated that this utility corridor has had transmission poles and conductors since the 1930's, and that the market would also be expected to have compensated for these factors (Id., p. 14). Van Dyke concluded that from a land use planning perspective, it would not be expected that re-energization of electric facilities after a short hiatus would cause further market compensation (Id., p. 14). He stated that this was especially true when the current utility use is highly intrusive, as is the case with the existing high speed freight railway (Id., p. 14). He

reiterated that he would not expect any effect on market values from energization of the Woodbourne-Heaton line (Id., p. 14).

Van Dyke dismissed the suggestion that fear of health effects from electric and magnetic fields ("EMF") associated with the Woodbourne-Heaton line will cause a decrease in market value in homes proximate to the transmission line (Id., p. 14). He stated that this suggestion does not take into consideration the specific facts of this utility corridor and the region surrounding it (Id., p. 14). He explained that the Regional Study Area ("RSA") already contains numerous utility functions and corridors, including electric facilities (Id., p. 14). He stated that his assessment of the region did not reveal any adverse effects on land use, zoning, or property values in the areas adjacent to those utility uses (Id., p. 14). He stated that in addition, the fact that numerous utility functions and corridors already exist in the RSA suggests that the existence of a utility function, especially when placed on an existing utility corridor should not be viewed as a unique or unusual event for this region (Id., pp. 14-15).

Van Dyke stated that he would not expect any unique or unusual impacts, such as a decrease in property values to occur after energization of the Woodbourne-Heaton line (Id., p. 15). He then stated virtually every residential area contains some feature that will dissuade some prospective purchasers (Id., p. 15). He stated that some prospective purchasers in the Corridor Study Area may consider the EMF

issue, among many other issues, in deciding whether to purchase in the area, but this does not suggest, however, that the market or the market value will be affected, but rather only that the issue might be considered (Id., p. 15). He then indicated that his analysis of this region does not reveal any impacts on land use, zoning, or property values that would suggest that such consideration of the EMF issue, if it is occurring, has had any effect on these land use factors (Id., p. 15).

As to potential impact of energizing the Woodbourne-Heaton line on future land uses, Van Dyke would not expect any impact on future land uses (Id., p. 15). He also explained that his analysis of potential future residential growth in the CSA shows a very limited growth potential whether or not the line is energized (Id., p. 15). He stated that this provides strong reason to believe that his comments on the existing residential areas will be equally applicable to future uses, and he expected no impacts on future land uses (Id., p. 15).

In his concluding remarks to his testimony, Van Dyke stated that there is a fundamental relationship between growth and development, and the need for providing essential utility services (Id., p. 16). He also stated that when growth occurs or is planned to be encouraged by local land use and zoning, utilities, including the transmission and distribution of a reliable source of electricity, is required to be coordinated with that growth (Id., p. 16). He added that the Woodbourne-

Heaton 230kV transmission line is an excellent example of a proper implementation of that coordination (Id., p. 16). He stated that the choice of an existing utility corridor as the route for the Woodbourne-Heaton line allows coordination of this utility use with an area that, by definition, already has been coordinated with utility use, and avoids any necessity of creating a new, disruptive corridor (Id., p. 16). He explained that due largely to this fundamental compatibility with adjacent uses, he viewed the possibility of adverse land use impacts from energization of the transmission line to be minimal at most, and most likely to be inconsequential (Id., p. 16).

JAMES MICHAEL SILVA - Direct Testimony

James Michael Silva, of ENERTECH Consultants, Campbell, California, sponsored PECO Rebuttal Statement No. 6 as his direct testimony (N.T. 1309). He testified that he is a research engineer, specializing in assessing exposure to extremely low frequency (ELF) electric and magnetic fields (EMF) (PECO Rebuttal Statement No. 6, p. 1).

Silva testified that he is President of ENERTECH Consultants, a scientific consulting firm that specializes in applied research projects, engineering, exposure assessment, and the development of electric and magnetic field measurement instrumentation and computer software (Id., p. 3). Silva explained that exposure assessment means the evaluation of

people's exposure to electric or magnetic fields through measurement, modeling, calculations, or other techniques (Id., p. 3). Silva then described three areas of research work that ENERTECH has conducted related to electric and magnetic fields (Id., p. 3). He explained that ENERTECH conducts applied research projects involving electric and magnetic field exposure assessment; develops instrumentation for evaluation of electric and magnetic fields and conducts a variety of measurement programs throughout the world; and develops computer software for calculating field levels and for modeling electric and magnetic field environments and exposure (Id., p. 3). He also indicated that for measuring fields and conducting exposure assessment, ENERTECH's research team has developed portable instrumentation known as the EMDEX system (Electric and Magnetic Digital Exposure meter), a portable instrument that can be worn on the belt for measuring and recording magnetic fields (Id., p. 4). He stated that with the EMDEX system, measurements can be taken over a period of time and the results stored for several hours up to day (Id., p. 4). Later, he explained, a graphic computer printout of the magnetic fields can be produced (Id., p. 4). He explained that ENERTECH has also developed a new EMDEX II, a smaller version of the original EMDEX for personal exposure assessment that can fit into a shirt pocket, and the new EMCALC computer software package that is used with the EMDEX II (Id., p. 5).

Silva testified that in this proceeding, he was asked to conduct an independent evaluation of common magnetic field levels that people encounter in their everyday lives in Philadelphia and at some locations near the route of the Woodbourne-Heaton 230kV transmission line, and to generally compare the measured magnetic field levels in Pennsylvania to those that people can routinely encounter from a variety of sources (Id., p. 8). He also stated that he was asked to evaluate the design and exposure assessment aspects of the Woodbourne-Heaton 230kV project to ascertain which features of this project, if any, are consistent with the concept of prudent avoidance described, among other places, in a 1989 paper published by the U.S. Office of Technology Assessment (OTA) (Id., p. 8). Silva then described the physical characteristics of electric and magnetic fields:

A field is a space or region in which an influence can be said to exist. For example, a temperature field is said to exist in the space around a hot or cold object. Two types of fields are produced by 60 Hertz (Hz) devices: electric fields and magnetic fields. All electric devices, including electric power lines and even household appliances, can produce these fields.

(Id., p. 8).

He also explained that:

the earth itself has a static or DC electric field of about 0.15kV/m. Static electric fields can also result from taking off a sweater or walking across a carpet. Induced body voltages as high as 4,000 to 8,000 volts (and

higher) have been measured for walking across a carpet. In addition to an electric field, the earth has a static magnetic field. In Southeastern Pennsylvania the earth's magnetic field is about 560 milligauss.

(Id., p. 8).

He stated that since earth's fields are primarily static fields rather than alternating fields, they do not necessarily compare directly with 60HZ AC fields (Id., p. 9).

Silva then explained that Hertz (Hz) was a unit of frequency related to the number of alternations or cycles of a wave during a period of time (Id., p. 9). He stated that AC (alternating current) electric power transmission lines in the United States operate at 60HZ (Id., p. 9). Silva then described a 60HZ electric field as being associated with the voltage on the conductors (energized wires) of an electric power line or device. He stated that one of the characteristics of a 60HZ electric field is that it decreases with distance away from the source, and noted that electric fields are also easily shielded by objects such as trees (Id., p. 9). He explained that electric fields are a function of the voltage on the line, phasing, the geometry or configuration of the device, and distance away from the source of the fields (Id., p. 10).

Silva then described a 60HZ magnetic field as the field associated with the flow of electric current (or amperes) on electric lines or devices (Id., p. 10). He stated that one

of the characteristics of a 60HZ magnetic field is that it decreases with distance away from the source, and he noted that magnetic fields are not easily shielded by objects such as trees (Id., p. 10).

Silva then stated that electric and magnetic fields are created whenever there is a flow of electricity, and that household wiring, electric transmission and distribution facilities, lighting, appliances, and office equipment are all common sources of electric and magnetic fields (Id., p. 10). He then stated that the field is higher close to the source of the field and attenuates (decreases) with distance from the source; the fields attenuate more quickly with distance away from household appliances than from power lines (Id., p. 10). Silva then provided Exhibit JMS-2 which illustrated a range of magnetic field levels associated with common household appliances in operation (Id., p. 11). He explained that the range reflects variations in the field levels among different brands of appliances and also variations depending on how far away the appliance is from the measuring point during normal use (Id., p. 11). He further explained that an appliance used near the head region would give a higher exposure to the head and a lower exposure at waist level, with the maximum value being where the appliance is touched (Id., p. 11). Silva testified that many appliances are only used for a relatively short length of time, and the field level does quickly decrease with distance away from the appliance (Id., p. 12). He

explained that each activity and each location can have its own sources of electric and magnetic fields that people encounter, and people in moving from place to place and from one activity to the next can experience a continuous or almost continuous range of exposures in a typical day (Id., p. 12).

Silva testified that in preparation for these proceedings, he took some magnetic field measurements in Southeastern Pennsylvania (Id., p. 12). He explained in September, 1991 ENERTECH took a series of measurements at locations in Southeastern Pennsylvania using the EMDEX II meter (Id., p. 13). He explained that in Southeastern Pennsylvania, continuous EMDEX II measurements were made during a routine walk through several common locations in the city of Philadelphia and also during a walk through various locations in and around Langhorne Borough, which is near the Woodbourne-Heaton line (Id., p. 13). He explained that Exhibit JMS-3 is a copy of the actual printout from the data recorded by the EMDEX II during the walk through Langhorne Borough which shows a continuous plot of magnetic field levels encountered during a walk around some typical locations in the vicinity of Langhorne Borough (Id., p. 13). He explained that Exhibit JMS-4 is a copy of the actual printout from the magnetic field measurement data recorded during the walk around Philadelphia (Id., p. 13).

Silva then briefly summarized the magnetic fields recorded during the walk around Langhorne Borough:

Exhibit JMS-3 shows a continuous plot of the measurement results recorded at 1.5 second intervals during a 3 1/2 hour walk through various locations in the Langhorne Borough area. The field levels in a local grocery store and another convenience store range from about 1-12mG. Magnetic fields in a nearby shopping mall range from a fraction of 1mG to 30mG. In a nearby amusement park the fields ranged from less than 1mG to over 60mG.

(Id., p. 13).

Silva then summarized the magnetic fields in Exhibit JMS-4 which shows a continuous plot of the magnetic field levels recorded at 1.5 second intervals during a 4 hour walk around various locations in Philadelphia (Id., p. 14). He stated the fields are generally in the range of less than 1mG to tens of mG, with some locations up to 100-250mG, and one location in a shopping mall with a reading of 760mG (Id., p. 14). He stated that he did not know the sources of all the different magnetic fields recorded (Id., p. 14). He stated that frequently it is not possible without a more detailed investigation to identify the variety of sources encountered in everyday life (Id., p. 14). He testified that the levels of fields that were measured in Southeastern Pennsylvania are similar to levels he measured at other locations in towns across the United States (Id., p. 14).

Concluding his testimony on magnetic fields, Silva testified that:

Exposure to magnetic fields results from a variety of situations and sources

routinely encountered in everyday life. Although no precise measure of exposure has been identified, it is apparent that any individual's total exposure will be composed of the many common exposures at home, at work, at businesses, at school, at recreation, and at other locations. Some of the exposures to appliances and other electric devices can have a significant temporal component. For example, a clock radio, fan or even water pipes (with ground currents) located near the bed or a living room chair can bring people near everyday field sources for longer than a brief period.

(Id., pp. 14-15).

Silva then testified on the concept known as "prudent avoidance" which was advanced by researchers at Carnegie-Mellon University most recently in a 1989 report sponsored by the Congressional Office of Technology Assessment (OTA) and a brochure distributed by Carnegie-Mellon University (Id., p. 15). He described prudent avoidance as one possible framework for analyzing exposure to electric and magnetic fields, and for considering actions that might alter exposure to electric and magnetic fields (Id., p. 15). He explained that prudent avoidance incorporates several assumptions from exposure assessment: we do not know which aspect of exposure, if any, is important in discussions of EMF and health; it is not clear if dose is cumulative; or whether short-term high levels of exposure are different from long-term lower levels of exposure (Id., p. 15). He also stated that prudent avoidance is based on the assumption that health effects from exposure to

electric and magnetic fields have not been demonstrated (Id., p. 15). Prudent avoidance he stated is a concept that recognizes that a scientific determination cannot be made that changes in EMF levels will have any effect on health, and thus prudent avoidance advocates only a modest effort in making such changes (Id., p. 15).

When applying the concept of prudent avoidance to transmission facilities, Silva testified that it is appropriate to evaluate design features of the transmission facility (Id., p. 16). He stated that the design features of a transmission facility can affect the electric and magnetic fields that are associated with the facility (Id., p. 16). He explained that to evaluate whether a transmission facility is consistent with the concept of prudent avoidance, a person thus should have a good understanding of transmission line design, what engineering factors affect fields, and the relative feasibility, reliability, and cost of different engineering options (Id., p. 16). In addition, he explained that calculation and measurement experience is necessary to properly evaluate field levels and provide a context for understanding what effect, if any, prudent avoidance strategies will have on exposure (Id., p. 16).

Silva then explained that routing of the transmission line should also be considered, and in addition, it is appropriate to consider whether the transmission facility meets existing field standards that are "similarity-based" (Id.,

p. 16). He testified that he evaluated the Woodbourne-Heaton 230kV project with respect to prudent avoidance, and specifically reviewed the design, routing, and field levels for this transmission line (Id., p. 16). He concluded that each of these elements has features that are consistent with the concept of prudent avoidance, he testified (Id., p. 16).

Silva explained that the design for this 230kV project is a compact delta (or triangular) configuration (Id., p. 17). He stated that this type of line configuration is known to produce fields that are generally lower than other typical configurations (Id., p. 17). He also stated that the phase transpositions (rolls) used to mitigate induction effects on the railroad tracks and signal equipment will result in more balanced (equal) phase currents (little or no net current), thereby producing lower magnetic fields (Id., p. 17). He explained that these design considerations result in lower field levels at modest effort, and are consistent with the concept of prudent avoidance (Id., p. 17).

Silva then testified that the Woodbourne-Heaton 230kV project uses an existing right-of-way (ROW), previously used by an electric railroad and currently used by a diesel railroad, that follows a near-linear route between the Woodbourne and Heaton substations (Id., p. 17). He stated that this use of an existing utility corridor that was previously used for an electrified railway also avoids the creation of a new utility corridor (Id., p. 17). An additional feature of this route

choice is that it allows re-use of the existing poles on the ROW previously used for electric power supply by the railroad, which is an important factor leading to use of the compact delta configuration and phase rolls, which themselves are consistent with prudent avoidance, he stated (Id., p. 17). Taking these factors into consideration, he concluded that the routing of this transmission line is consistent with the concept of prudent avoidance (Id., p. 17).

Silva then testified that the "similarity-based" approach to prudent avoidance, suggests that the EMF from transmission lines be similar to the levels from other transmission lines (Id., p. 18). He explained that this approach was used in developing the field standards in New York State and Florida (Id., p. 18). He stated that the fields that will be associated with the Woodbourne-Heaton 230kV project are not materially different from other 230kV transmission lines already in operation in Pennsylvania and throughout the United States (Id., p. 18). He stated that the fields that will be associated with the Woodbourne-Heaton line also are lower than the New York and Florida standards, thereby consistent with the similarity-based approach to prudent avoidance (Id., p. 18).

Silva then testified that the concept of prudent avoidance is a general framework that suggests modest efforts to reduce field exposure, and should be understood to be oriented toward that result, rather than toward any required method of achieving that result (Id., p. 18). He explained

that where, as here, the design and routing of the transmission line result in lower fields at modest cost consistent with prudent avoidance, the concept of prudent avoidance does not require that any specific decisional or temporal process must be followed in achieving that result (Id., p. 18).

Silva also explained that prudent avoidance is a concept that allows us to act and move forward while research continues (Id., p. 19). Delaying projects because of the current state of scientific knowledge thus runs contrary to the basic assumptions of prudent avoidance, he stated (Id., p. 19).

In concluding his testimony, Silva stated that in comparison to other, similar transmission lines, there is nothing unique or unusual about the fields associated with the Woodbourne-Heaton 230kV transmission line (Id., p. 19). He testified that the electric and magnetic field levels associated with the line are within the range that people routinely encounter in everyday life from a variety of sources (Id., p. 19). He testified that the 230kV project will meet existing field standards in other states, and it has design and routing features consistent with the concept of prudent avoidance (Id., p. 19).

Cross Examination

Silva did not walk along the route of the proposed transmission line in making his measurements of fields in Langhorne Borough (N.T. 1312).

Silva offered an analogy from the Office of Technology Assessment's report to explain prudent avoidance: the report suggested buying an appliance which had a very low field levels, but the "prudent" part of prudent avoidance is waiting to buy the new appliance until the old appliance wore out (N.T. 1319).

Silva testified that the life of an appliance depends on the appliance: electric blankets last 5 years while major appliances last 10 to 15 years (N.T. 1320). Silva testified that the average life of a transmission line is 30 to 40 years (N.T. 1320).

DAVID A. ROSENBAUM - Direct Testimony

David M. Rosenbaum sponsored OCA Statement No. 2A as his direct testimony on surrebuttal (N.T. 1372).

In his direct testimony, Rosenbaum presented a mathematical formula for calculating odds ratios (OCA Statement No. 2A, p. 3, note 1).

Cross Examination

On cross examination, Rosenbaum was asked to use the formula appearing in his direct testimony to calculate odds ratios for the Savitz and Peters epidemiological studies (N.T. 1397-1410). The calculations were introduced into evidence as PECO Cross Exhibits 5(a) and 5(b) (N.T. 1417).

Redirect Examination

On redirect, Rosenbaum identified an error at lines 11 through 14 of his direct testimony at page 4 (N.T. 1420).

DAVID E. JANES - Direct Testimony

David E. Janes sponsored OCA Statement No. 1A as his direct testimony on surrebuttal (N.T. 1426). In his direct testimony, Janes expressed the opinion that additional research is needed to resolve the role melatonin plays in carcinogenesis (OCA Statement No. 1A, p. 1). Although, he stated, that its role in human physiology may not be understood, melatonin is physiologically active in mammals (Id., p. 2). Because exposure to extremely low frequency electric and magnetic fields affects melatonin levels in mammals and melatonin levels affect the incidence of chemically induced breast tumor incidence in rats, Janes felt it was important to establish by direct experiment whether exposure to fields affects tumor incidence in rats and then whether the results from these animal experiments could be extrapolated to humans (Id., p. 2). He also believed this research was necessary in light of the recent study by Demers et al., who reported an association between occupational exposure to EMF and breast cancer in men (Id., p. 2).

Cross Examination

Janes explained that in the Demers study, Demers collected occupational work histories (N.T. 1445).

PHILIP COLE - Direct Testimony

Philip Cole presented oral direct testimony as PECO's witness (N.T. 1462). Cole then presented his critique of the Demers study on breast cancer and occupational exposure to EMF (N.T. 1468). He explained that a title classification was used (N.T. 1468). He stated that Demers used no measures of magnetic fields and made no effort to impute to categories what the likely level of magnetic field exposure in a category would be (N.T. 1468). He also stated that Demers used the weakest approach for selecting controls -- random digit dial (N.T. 1470). Demers also attempted to look at duration of exposure as related to duration of employment in these supposedly exposed occupational categories (N.T. 1470). Demers found there was no effect reported with either intensity or duration (N.T. 1470).

The third limitation Cole found with the Demer's study was that it was that even if the job titles were associated with risk related to EMF, the groups who exhibited the highest risk were people who held these jobs prior to the age of 30 and to those people who held their jobs for more than 30 years (N.T. 1472-1473). Cole also observed if the Demers study was valid it would act as an initiator and not as a promoter of cancer (a late stage carcinogen) as the existing positive epidemiological information suggests (N.T. 1472). Cole did not find the study to be credible (N.T. 1472).

When questioned about the observation that the association between EMF and childhood cancer and leukemia grows weaker in going from the Wertheimer study to the Savitz study to the Peters study, Cole stated that he didn't know of any circumstance where the association grows weaker with the passage of time in epidemiological data and the association becomes to be accepted as valid (N.T. 1479). He also made the point that the association which he described as becoming weaker is not between the wire code and leukemia, but between magnetic fields and leukemia because wire code is the surrogate (N.T. 1479).

Cross Examination

On cross examination, Cole stated he did not believe the Demers study was one involving electromagnetic fields and breast cancer in men because he considered a study of occupational titles to have an ephemeral relationship to electromagnetic fields exposure (N.T. 1492).

Cole then testified that there is a vast body of knowledge regarding how carcinogens act both in animals and in human beings and he stated he knew of no exceptions to the following: that risk is a function of cumulative exposure, with some very small exceptions implying plateauing of risk (N.T. 1497). He explained that once initiation [of cancer] had occurred, further initiation was not required, but it is the probability of initiation which is a function of the degree of cumulative exposure to the initiator (N.T. 1501).

Cole also testified that concept of an initiator, a promoter, complete carcinogen and a growth enhancer has never been shown to exist in human beings, but are a set of constructs useful in trying to understand why carcinogens operate at different times in a person's life relative to the time of diagnosis (N.T. 1502). He stated it was his understanding that proponents of the idea that magnetic fields cause cancer support the notion that it is a late stage carcinogen (N.T. 1502, 1503). He concluded that if the Demers study was taken to be valid, it must be interpreted as supporting EMF as having an initiating role in cancer which is inconsistent with the role that has been attributed to magnetic fields by proponents of the association in the past (N.T. 1504).

Recross Examination

On recross, Cole was asked exceptions to his rule that the risk of cancer is a function of cumulative exposure (N.T. 1523). He answered that ionizing radiation is an exception in that delivered to a body in a high dose there may be a killing effect rather than a transforming effect (N.T. 1524). He continued that risk rises to a certain point and then plateaus and may even fall off (N.T. 1524).



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April 20, 1992

VIA FEDERAL EXPRESS

ORIGINAL

Mr. John G. Alford, Secretary
Pennsylvania Public Utility Commission
Commonwealth & North Streets
Harrisburg, Pennsylvania 17105-3265

Re: Letter of Notification of
Philadelphia Electric Company
Relative to Reconductoring and
Rebuilding Existing Line to Operate
as a Woodbourne-Heaton 230 kV Line
in Bucks and Montgomery Counties;
Docket No. A-110500F055

Dear Secretary Alford:

Enclosed for filing on behalf of Pennsylvania Power & Light Company are an original and nine (9) copies of "Main Brief of Pennsylvania Power & Light Company" in the above-captioned matter. As shown on the Certificate of Service, copies have been served on the parties.

Very truly yours,

Jesse A. Dillon

Enclosures

ORIGINAL

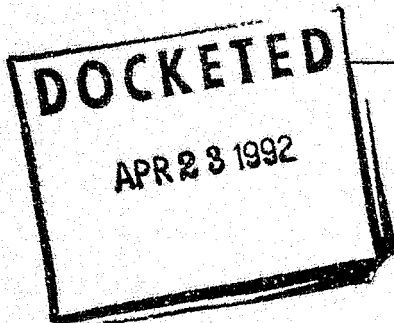
BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION OF
PHILADELPHIA ELECTRIC COMPANY RELATIVE
TO RECONDUCTORING AND REBUILDING THE
EXISTING LINE TO OPERATE AS A WOODBOURNE-HEATON
230 KV LINE IN BUCKS AND MONTGOMERY COUNTIES

Docket No. A-110500F055

TO ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN

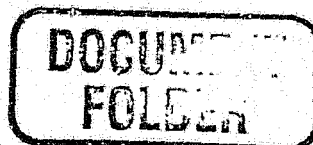
MAIN BRIEF
ON BEHALF OF
PENNSYLVANIA POWER & LIGHT COMPANY



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Dated: April 21, 1992



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I. PROCEDURAL HISTORY

By order entered February 9, 1990, the Pennsylvania Public Utility Commission ("Commission"), pursuant to its transmission line construction and siting regulations codified at 52 Pa. Code §§ 57.71, et seq., granted Philadelphia Electric Company ("PECO") authority to reconstruct an existing 138 kV electric transmission line to operate as a Woodbourne-Heaton 230 kV line in Bucks and Montgomery Counties. Letter of Notification of Philadelphia Electric Company relative to reconductoring and rebuilding the existing line to operate as a Woodbourne-Heaton 230 kV line in Bucks and Montgomery Counties, Docket No. A-110550F055 (February 9, 1990).

Seven months later, on September 14, 1990, certain persons filed an "Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval" of the order entered February 9, 1990.

By order entered March 8, 1991, the Commission denied the Petitioners' "Emergency Petition," and the Petitioners appealed the Commission's order to Commonwealth Court.

By order entered May 24, 1991, Commonwealth Court remanded this case to the Commission for "a hearing on the question of whether they [the Petitioners] will be adversely

affected by the reconductoring of the high tension electrical line at issue in this case." Small, et al. v. Pa. P.U.C., No. 761 C.D. 1991 (May 24, 1991).

By order entered June 14, 1991, the Commission reopened the record at Docket No. A-110550F055 "for a hearing and determination of the sole issue of whether the Petitioners will be adversely affected by the reconductoring of this former Conrail transmission line."

On July 11, 1991, Pennsylvania Power & Light Company ("PP&L") filed a Petition to Intervene in this proceeding, which was granted by Administrative Law Judge Herbert Smolen ("the ALJ") in an order dated August 7, 1991.

Also on July 11, 1991, a telephonic prehearing conference was held, and by order dated July 18, 1991, the ALJ established a hearing schedule and ruled on certain discovery and procedural matters.

Hearings were held on August 15, September 6, September 19, September 20, October 15, October 16, November 19, November 20, November 22, December 16, December 17, 1991, and February 7, 1992, at which the Office of Consumer Advocate ("OCA"), PECO and the Petitioners, now known as "Protestants," presented voluminous record evidence including 15 statements and over 1500 pages of transcripts on the question of whether the Protestants would be

"adversely affected" by the reconductoring of the Woodbourne-Heaton line. There was extensive testimony on the issue of whether power frequency electric and magnetic fields ("EMF" or "EMFs")^{1/} from the reconductored line posed any human health hazard to Protestants. To date, this represents the most extensive EMF proceeding that has been litigated before this Commission.

^{1/} The term power frequency electric and magnetic fields, abbreviated herein as EMF or EMFs, refers to sinusoidal electric and magnetic fields of 50-60 Hertz frequency, that are produced by the transmission, distribution and use of electricity.

II. INTRODUCTION

PP&L, as an intervenor in this proceeding, does not intend to submit an extensive brief duplicating the efforts of other parties to this proceeding but instead is filing this main brief which addresses only the issue, raised by Protestants, of whether EMFs pose any health hazard to humans. PP&L follows this issue closely and believes that it may be able to provide useful input on this extremely complex issue.

The fact that PP&L has focused its main brief only on the issue of whether EMFs pose a human health hazard should not be interpreted as either agreement or disagreement with positions of any of the parties on any other issues in this proceeding. Further, PP&L reserves the right to respond, in its reply brief, exceptions and reply exceptions, to any or all of the issues raised in the main briefs of the other parties to this proceeding.

III. SUMMARY OF ARGUMENT

Contrary to Protestants' assertion, science has not demonstrated that EMFs pose a human health hazard despite the questions that have been raised about the health effects of EMFs. Neither generally accepted scientific reasoning nor the numerous independent and governmental scientific panels which have reviewed the scientific literature on EMFs support Protestants' assertion that EMFs pose a human health hazard. The Commission should conclude that there is insufficient evidence upon which to conclude that EMFs pose any human health hazard.

IV. ARGUMENT

A. Contrary to Protestants' Assertion, Science Has Not Demonstrated That EMFs Pose any Human Health Hazard

At the outset, it should be noted that PP&L recognizes that questions and concerns have been raised about possible health effects of EMFs. As a company, PP&L strives to provide electricity in a safe, reliable and economical manner. PP&L is concerned about the welfare of our customers, our employees and the public in general, and PP&L is taking actions to address and respond to the questions and concerns that have been raised about EMFs. As part of PP&L's comprehensive EMF program, PP&L has been following the scientific evidence relating to EMFs very closely. Based on what PP&L has seen to date, the large body of scientific evidence does not demonstrate that EMFs cause harmful health effects.

However, in this case, Protestants, through the use of "science," assert that EMFs pose a health hazard to humans. Protestants St. No. 2, p. 5; Tr. 777-79. Given this assertion by Protestants and its potentially serious consequences, if correct, it is crucial to examine carefully their assertion in light of the factual evidence, valid scientific reasoning and acceptance of their assertion within the scientific community.

Webster's New Collegiate Dictionary defines the term "science" as "possession of knowledge as distinguished from misunderstanding; knowledge obtained from study or practice." Webster's New Collegiate Dictionary 1026 (1979). However, under the current state of the law in the United States, a "scientific" expert can be introduced to support almost any position before a court or other regulatory body, regardless of whether that expert's position is generally accepted by the scientific community or whether that expert's position is based on otherwise valid scientific reasoning. See e.g., Black, A Unified Theory of Scientific Evidence, 56 Fordham L. Rev. 595, 597-98, et seq.; Huber, Junk Science in the Courtroom, Forbes, July 8, 1991, pp. 68-72; "Review and Outlook, Science Fights Back", The Wall Street Journal, January 7, 1992.

When examined carefully for factual evidence, valid scientific reasoning and for acceptance of their conclusion within the scientific community, Protestants' assertion that EMFs pose a human health hazard fails. Put simply, despite the public concern over EMFs by some persons and the possibility of related health effects, the body of "knowledge obtained from study and practice," in other words science, does not present evidence of any human health hazard from EMFs. Further, a number of independent governmental

entities and scientific panels which have conducted scholarly, scientific examinations of the EMF issue have concluded that the large body of scientific evidence accumulated to date does not demonstrate that EMFs pose a human health hazard. However well-intentioned, Protestants' incorrect assertion is not based on "possession of knowledge," in other words science, and therefore must be based "misunderstanding." Further, Protestants' incorrect assertion is not accepted within the scientific community.

1. Protestants' Assertion that
EMFs Pose a Human Health Hazard

In order to thoroughly consider the serious allegation made by the Protestants, it is necessary to first examine Protestants' assertion and the factual basis for such contention. As part of their case in this matter, the Protestants presented the direct testimony of a Dr. Abraham R. Liboff, a Professor of Physics at Oakland University, a state university located about 20 or 30 miles north of Detroit in Oakland County, Michigan. Protestants St. No. 2, p. 1; Tr. 756.

In his statement, Dr. Liboff testified that, in his opinion, there is a "hazard to humans" from power frequency magnetic fields. Protestants St. No. 2, p. 5. Dr. Liboff testified that his opinion was based in part on the gradual acceptance of epidemiological evidence (Protestants St.

No. 3, p. 3; Tr. 777), and in part on the results of laboratory experiments, specifically altered cell responses and bone repair studies (Protestants St. No. 2, p. 3; Tr. 778). In addition, Dr. Liboff testified that his opinion was supported by his hypothesis of a biophysical mechanism, known as Ion Cyclotron Resonance ("ICR"). Protestants St. No. 2, pp. 5-6; Tr. 780-784.

In other words, Dr. Liboff's opinion that EMFs pose a hazard to human health is: (1) based on the epidemiologic evidence; (2) based on the results of laboratory studies; and (3) bolstered by Dr. Liboff's ICR mechanism hypothesis. Each of these three prongs of support for this opinion by Dr. Liboff must be examined individually.

2. Generally Accepted Scientific Reasoning Does Not Support Protestants' Assertion that EMFs Pose a Human Health Hazard

a. Contrary to Protestants' Witness Liboff, the Epidemiologic Evidence Does Not Provide a Basis to Conclude that EMFs Pose a Human Health Hazard

1. Testimony of Dr. Philip Cole

In response to Dr. Liboff's testimony, PECO presented the testimony of Dr. Philip Cole, Professor of Epidemiology and Chairman of the Department of Epidemiology at the School of Public Health of the University of Alabama at Birmingham, who received his Dr.P.H. degree from Harvard University. PECO Reb. St. No. 2, pp. 1-5. Dr. Cole, a

well-known epidemiologist who has published over 130 articles on epidemiology, explained the background and limitations of the science of epidemiology and the epidemiologic research on EMFs and cancer.

Specifically, regarding the science of epidemiology generally, Dr. Cole explained that:

1. Epidemiology is the study of humans in their everyday environments. PECO Reb. St. No. 2, p. 5.
2. Epidemiology is a non-experimental and imprecise science, and is therefore highly susceptible to errors. Therefore, when suggested risks of low magnitude are involved, epidemiologists draw inferences of cause and effect only when there is a reasonably large number of independent studies with consistent findings. Id. at p. 5.
3. It is the nature of epidemiologic research to produce both positive and negative results even where there is no cause and effect relationship between disease and an agent (such as EMF). Therefore, there is a need for consistency in results and strong associations, as opposed to weak associations, when assessing epidemiologic studies of human cancer. Id. at pp. 6-7.

4. Application of epidemiology to evaluate the carcinogenic potential of an agent involves a three-step process of: a) examining individual studies for quality reliability and validity; b) examining the studies collectively, giving weight to the studies, assessing consistency and other indicia of causality and c) considering the epidemiology in the context of basic science research to assess the biologic credibility of casual inferences. Id. at p. 7.
5. There are potentially serious problems with interpretation of EMF epidemiologic studies given the use of surrogate measures of exposure (surrogate measures are the types used in the EMF epidemiologic studies). Id. at pp. 7-9.
6. Conclusions from epidemiologic research must take into account the results of all relevant studies, considering the strengths and the weaknesses of each study on its own merits and the strengths and weaknesses of each individual study in the context of the entire body of literature. Id. at p. 9.

Dr. Cole explained the epidemiologic research regarding EMF and cancer. Dr. Cole explained that he

reviewed all of the approximately 50 epidemiologic studies involving EMF and cancer and all of the secondary literature in this area. Id. at pp. 10-11. Dr. Cole explained the two types of epidemiologic research in this area: research into EMF and childhood cancer; and research into EMF and adult cancer.

Dr. Cole's review of this literature was summarized in a detailed, ten-page review of the epidemiological studies on EMF and childhood cancer, including examination of the design, nature, strengths and weaknesses of case-control epidemiological studies (Id. at p. 11); examination of the results, strengths and weaknesses of each study (Id. at pp. 12-18); and the issues of consistency of results, biologic plausibility and ecologic comparison (Id. at pp. 18-20). As a result of the application of the generally recognized and accepted guidelines for the evaluation of epidemiology studies, Dr. Cole concluded that the epidemiology provides no persuasive scientific support for the hypothesis that EMF causes cancer in children, stating as follows:

Looking at the childhood cancer studies as a whole and recognizing the degree of validity of individual studies within that group, I conclude that there is no demonstrated increased risk of childhood cancer when actual electric or magnetic fields were measured. When surrogates such as the wiring code have been used in the childhood studies, the data have shown a pattern of mixed results between

weak positive and negative outcomes. This is a pattern of random association in a non-experimental science, not the pattern of cause and effect. Long term time trends of EMF exposure and leukemia in children in this country are not consistent with a cause-effect relationship. Finally, neither theoretical considerations nor animal studies are available to support a cause-effect hypothesis. I conclude that the epidemiologic literature on EMF, when viewed as a whole, provides no persuasive scientific support for the hypothesis that EMF causes cancer in children. Id. at pp. 20-21.

To provide further insight into his reasoning, Dr. Cole also undertook a detailed, six-page review of the epidemiological studies on EMF and adult cancer, including examinations of the results, strengths and weaknesses of the adult residential studies (Id. at pp. 23); and examination of the limitations, results, strengths and weaknesses of the adult occupational studies (Id. at pp. 24-27). Dr. Cole concluded that the epidemiological data does not support the hypothesis that EMF is associated with adult cancer and, in fact, provides support against any such hypothesis, stating as follows:

The studies involving power frequency electric and/or magnetic fields and cancer show weakly positive to zero or negative associations. The studies that use the most acceptable design consistently have found no association between EMF and cancer. I conclude that this body of studies does not support the hypothesis that EMF is associated with adult cancer, and that the best-designed and conducted studies provide strong support against that hypothesis. Id. at p. 28.

Dr. Cole also discussed the draft EPA report on cancer and EMF, which is currently undergoing review and possible revision by EPA. Environmental Protection Agency (EPA), Evaluation of the Potential Carcinogenicity of Electromagnetic Fields: Review Draft. Office of Research and Development EPA/600/6-90-005B, Washington, DC, October 1990. He noted the criticisms of various governmental entities both within EPA and outside EPA who have criticized the draft document, including, among other criticisms, statements that:

Currently available information is insufficient to conclude that electric and magnetic fields are carcinogenic.

* * * *

The EPA document has serious flaws and needs to be rewritten.

* * * *

All reviewers agreed that the human epidemiologic data to date did not support the sweeping conclusions made in the EPA document. Id. at p. 22.

Dr. Cole concluded that because the draft EPA document was still undergoing the peer review process and was being criticized severely it should be afforded "little if any weight" in evaluating the epidemiological data. Id. at p. 22.

In conclusion, based on all of the above, Dr. Cole concluded that:

Taken together, the epidemiologic reports fail to demonstrate any strong or consistent pattern of association between EMF and cancer among human beings. Indeed, even among the positive studies, findings are not supported by the internal characteristics of the data. The summation can only be that, to date, there is no demonstrated relationship between EMF and cancer in human beings. Id. at p. 28.

2. Comparison with Testimony of Dr. Liboff

Dr. Cole's careful, thoughtful, detailed, scientific review of the body of epidemiologic evidence and the strengths and weaknesses thereof contrasts sharply with Dr. Liboff's offhand statement that his opinion "is based upon my gradual acceptance of the epidemiologic data, with each new report strengthening the ones before it." Protestants St. No. 2, p. 5.

Dr. Liboff's only "examination" of the actual epidemiological evidence in this case consists of a paragraph of rhetoric about the criticisms that numerous scientists have voiced regarding the epidemiologic data to date. Protestants St. No. 2, p. 3. Of course, Dr. Liboff has not the experience or training to assess epidemiological studies, and Dr. Liboff's brief, uncritical "interpretation" of the epidemiological data simply does not rise to the level of

serious scientific scrutiny, such as that presented in the testimony of Dr. Cole.^{2/}

For instance, Dr. Liboff's bald, unsupported assertion that each new epidemiologic report "strengthens the one before it" is incorrect. As Dr. Cole explained, in epidemiology, it is expected that if a reported statistical association in one study is truly showing an association that is occurring in the real world, that association will become stronger, not weaker, as the design and conduct of subsequent studies improve. PECO Reb. St. No. 2, p. 17. Dr. Cole correctly explained that the reported associations between wire code (a surrogate for magnetic field exposure) and cancer have weakened as more thorough studies have been undertaken, and, in fact, there has never been a statistically significant association reported between measured magnetic fields and cancer. Id. at pp. 17-18; Tr. 1479-80.

Further, Dr. Liboff's "analysis" completely discounts the possibility, always present in all epidemiological research, that confounding factors or random associations could be the cause of the reported associations between surrogates for EMF and cancer. See PECO Reb. St.

^{2/} It is interesting to note that, as evidenced by several pieces of correspondence to the ALJ and counsel, Protestants were unable to produce an epidemiologist to review the epidemiologic literature or to rebut the scientific review of epidemiology undertaken by Dr. Cole.

No. 2, pp. 11-12; Tr. 16. Dr. Liboff states, in an extremely defensive manner, that critical scientific review of the EMF epidemiological evidence is just some sort of "hysterical, non-scientific evaluation" designed to "explain away" "politically sensitive" and "unpleasant" correlations due to the "money involved." Protestants St. No. 2, p. 3. To the contrary, any science which cannot stand the light of critical, meaningful, scientific review by scientific peers is worthless, regardless of speculative political or financial ramifications.

In summary, review of the record in this case provides little or no basis whatsoever for concluding that the epidemiologic evidence provides support for an opinion that EMFs pose a human health hazard. Dr. Liboff's uncritical, non-scientific statements about the epidemiology are simply no substitute for a critical, thoughtful scientific review of the epidemiology, such as that presented by Dr. Cole.

b. Contrary to Protestants' Witness Liboff,
the Laboratory Evidence Does Not Provide
Support for an Opinion that EMFs Pose a
Human Health Hazard

1. Testimony of Dr. Richard S. Bockman
and Dr. Edward Gelmann

In response to Dr. Liboff's testimony, PECO presented the testimony of Dr. Richard S. Bockman, and Dr. Edward Gelmann (PECO Reb. St. Nos. 1 and 3).

Dr. Bockman, a medical doctor, researcher and teacher in the fields of endocrinology and immunology, is head of the Endocrine Service and the Endocrine Bone Service at the Hospital for Special Surgery of the Cornell University Medical College, is a Professor of Medicine at Cornell University Medical College, and holds an Adjunct appointment at the Memorial Sloan Kettering Institute for Cancer Research, one of the leading cancer research centers in the United States. PECO Reb. St. No. 1, pp. 1-4.

Dr. Gelmann, a medical doctor, researcher and teacher, specializing in medical oncology and working in the fields of molecular genetics, cellular biology and cancer, is Chief of the Division of Medical Oncology, Professor of Medicine and Professor of Anatomy and Cell Biology at Georgetown University Medical School. PECO Reb. St. No. 3, pp. 1-5.

Dr. Bockman conducted an independent review of the scientific literature related to extremely-low frequency ("ELF") electric and magnetic fields as it relates to endocrinology and immunology to determine whether EMFs cause adverse effects on human endocrine or immune system function. PECO Reb. St. No. 1, p. 5. In arriving at his conclusions, Dr. Bockman reviewed over 200 primary research papers and many reviews, summaries and reports. Id. at p. 5.

Regarding the endocrine system, Dr. Bockman reviewed the EMF research in four categories: (1) research relevant to the neuroendocrine system, including research on perception, the arousal responses, neurochemicals and calcium metabolism (Id. at pp. 6-14); (2) research relevant to endocrine gland function (Id. at pp. 14-15); (3) research relevant to biological rhythms (Id. at pp. 15-18); and (4) research relevant to reproduction and development (Id. at p. 18).

Regarding the research on EMF and the neuroendocrine system, Dr. Bockman explained that the experimental data show that animals, including humans, can perceive EMF through external cues such as auditory noise or, at sufficiently high electric field levels, through hair movement, and that perception can result in a measurable arousal response similar to the arousal response found in response to everyday stimuli. Id. at p. 14. Such response is transient, normal, and does not indicate adverse health consequences. Id. at p. 14. Dr. Bockman also explained that some neurotransmitter levels can show subtle changes after EMF exposure, but such changes also are consistent with a normal recognition response to the perceived stimulus. Id. at p. 14. Dr. Bockman also explained that the research on calcium metabolism does not indicate change in biologically important calcium. Id. at p. 14.

In conclusion, Dr. Bockman stated as follows regarding the research on EMF and the neuroendocrine system:

the research indicates that exposure to EMF can cause subtle, transient biological changes in the neuroendocrine system. These biological changes are consistent with a normal perception or recognition response and do not indicate that exposure to EMF is harmful. Id. at p. 14.

Regarding the research on EMF and endocrine gland function, Dr. Bockman explained the research on EMF effects on hormones and concluded that:

Even with prolonged exposure to significant electric and magnetic fields, these hormones are not elevated in the blood and the data indicate that animals are not stressed by these fields. Id. at p. 15.

Regarding the research on EMF and biological rhythms, Dr. Bockman evaluated research on biological rhythms, including circadian rhythms, and the research on such rhythms relating to EMF and concluded that:

Substantial research has been conducted regarding EMF and major biological rhythms, such as the rhythm in body temperature, eating patterns, sleep/wake cycle, (Ehret et al. 1980) and hormones such as prolactin and growth hormone. (Quinlan et al. 1985) None of these major biologic rhythms was shown to be altered by exposure to EMF. Id. at p. 16.

In addition, Dr. Bockman commented directly on certain research on changes in the circadian rhythm of certain neurotransmitters, concluding that these results "do not indicate a harmful effect on biological rhythms." Id. at

p. 16. Finally, Dr. Bockman specifically addressed the body of research on the circadian rhythm of the hormone melatonin in rats, concluding that:

There are no known or reported biologic consequences of the reported change in dark cycle melatonin levels, either in rats or humans. Nor is there evidence of any effect of EMF on any other major biologic rhythm or any other hormone. It is important to reiterate that these effects on the melatonin rhythms are not associated with changes in other major biologic rhythms such as sleep/wake cycles, body temperature, eating patterns, or the circadian release of other hormones. Also, it should be noted that the reported changes in dark cycle melatonin levels are limited to rats exposed to electric fields, not magnetic fields. In addition, when human subjects were studied, there was no reported decrease in pineal melatonin levels. Consequently, it cannot be said that the rat melatonin study provides a basis for concluding that power frequency electric or magnetic fields leads to adverse effects on human biologic rhythms. Id. at p. 10.

Regarding the research on EMF and reproduction and development, Dr. Bockman explained that research into reproduction and development reflect in a "most sensitive manner" effects on endocrine organ function, reviewed this research and concluded that:

The issue of EMF effects on reproduction and development has been examined extensively and there is no persuasive scientific evidence that exposure to power frequency fields has any adverse effects on reproduction, development, or related endocrine function. Id. at p. 21.

Relating to the immune system, Dr. Bockman reviewed the EMF research regarding both endocrine-regulated immune functions (Id. at pp. 22-23) and immune system function generally (both in vitro and in vivo research) (Id. at pp. 23-25). Regarding the research on EMF and the immune system, Dr. Bockman concluded that:

The comprehensive animal studies indicate that exposure of intact animals to EMF similar to those experienced under AC power lines produces no obvious deficit in immune cell function. With the exception of Odinstov's early unconfirmed study using L. monocytogenes, there is no evidence that exposure to moderate or even strong power frequency electric and magnetic fields adversely affects the host's immune system. Id. at p. 25.

In sum, based on his experience, training and review of the research literature, Dr. Bockman concluded that:

1. Electric fields experienced directly under AC power transmission lines are below or just at the threshold of perception for most animals and man. There is no evidence that humans can perceive 60 Hertz magnetic fields at levels that far exceed the levels associated with transmission line absent external cues.
2. Electric field strengths several times greater than the threshold for perception may cause an initial arousal response. However, this response fades rapidly and the animals habituate to such fields. Chronic exposure to such fields causes no obvious abnormality in neurologic function or behavior. There is no evidence that such fields elicit a stress response.

3. There is no evidence that power frequency electric or magnetic fields alter intracellular calcium levels or that calcium acts as a transducer of EMF effects on nerve, endocrine or immune cells.
4. There is no scientific basis to conclude that power frequency electric or magnetic fields have any significant effects on circadian rhythms involving body functions or critical pituitary hormones.
5. There is adequate experimental data to show that EMF do not adversely affect complex endocrine system function needed for successful reproduction, growth or development.
6. Immune cell viability and function is not significantly affected by exposure to EMF and no adverse effects have consistently been demonstrated in intact animals.
7. My overall conclusion is that there is no basis to conclude that power frequency electric and/or magnetic fields have adverse effects on the health and function of the endocrine or immune systems. Id. at pp. 26-27.

Dr. Gelmann conducted an independent review of the scientific literature related to electric and magnetic fields as it relates to cancer and molecular and cellular biology in order to assess whether EMFs cause adverse genetic, molecular and/or cellular effects that could lead to cancer or other adverse health effects. PECO Reb. St. No. 3, p. 5.

Dr. Gelmann first provided background on cellular biology, molecular genetics and cancer, including the struc-

ture and function of cells and how research in these areas can help scientists understand the causes and development of cancer or other adverse health effects. Id. at pp. 6-8.

Dr. Gelmann then reviewed the EMF research on molecular genetics and cellular biology in five areas, (1) mutational analyses; (2) chromosome studies; (3) animal studies; (4) tumor growth studies; and (5) other cellular research raised by other parties. Id. at pp. 18-21.

Regarding mutational analyses (tests showing whether permanent change, also known as mutation, has occurred in the structure of the DNA molecule as a result of exposure to an agent), Dr. Gelmann explained that numerous mutational analyses "indicate that exposure to 60 Hz fields have no effects on mutations." Id. at p. 9. Dr. Gelmann also specifically questioned the interpretation placed by Dr. Liboff on his study of DNA synthesis. The assay used by Liboff may have had no relationship to DNA synthesis. Id. at pp. 9-10. In addition, Dr. Gelmann reported that studies indicated that EMF exposure did not affect natural DNA repair processes. Id. at pp. 10-11.

Regarding chromosome studies, Dr. Gelmann explained that these studies evaluate whether there are breaks or other damage to chromosomes (which contain DNA) as a result of exposure to an agent. Dr. Gelmann concluded that EMFs

"are not associated with damage to chromosomes." Id. at p. 11.

Based on this explanation of chromosome studies and his previous explanations of mutational analyses.

Dr. Gelmann concluded that:

Mutational analyses and chromosome studies provide specific information on molecular and cellular events that are associated with cancer and other adverse health effects. The EMF research in those areas shows no DNA change or other cellular or molecular changes that could lead to cancer or other adverse health effects. Id. at p. 12.

Regarding animal studies (looking for the effects of agents on whole organisms), Dr. Gelmann describes that there are a number of such studies which examined numerous health issues including fertility, growth, development, general health, bone marrow, and other physiological abnormalities. Id. at pp. 13-14. Dr. Gelmann then concluded that:

Long-term animal studies using multiple species, strains, and sexes or organisms consistently provide no scientific basis to conclude that electric and/or magnetic fields cause cancer, adverse effects on reproduction, growth, or development, or other adverse health effects. Id. at p. 14.

Regarding tumor growth studies (which are relevant to some cancerous properties of cells), Dr. Gelmann explained that these types of studies, both in cell cultures and in whole animals, had been conducted but had not found

any differences for tumor incidence or animal survival related to exposure to EMFs. Id. at p. 14-15. Dr. Gelmann then concluded that:

The tumor growth studies indicate that exposure to power frequency electric and/or magnetic fields, either before or after implantation of a tumor into the animal host, does not affect the development of the tumor. Id. at p. 15.

Regarding other cellular research discussed in the testimony of other witnesses in this proceeding, Dr. Gelmann discussed: (1) research on protein synthesis and RNA transcription (Id. at pp. 15-16); (2) research on slime molds (Id. at pp. 16-17); research on ornithine decarboxylase ("ODC") (Id. at pp. 17-18); research on calcium efflux in brain tissue slices (Id. at p. 18); research on bone repair (Id. at pp. 18-19); research on melatonin (Id. at p. 19); research on cell proliferation (Id. at pp. 19-20); and research on soft agar clonogenicity (Id. at pp. 20-21). In all of these types of research, Dr. Gelmann concluded that the research was either unrelated to the process of carcinogenesis; created no suggestion of an adverse health impact; was inconsistent in its results; or did not provide a pathway by which exposure to EMF could cause cancer in humans. Id. at pp. 15-20.

Based on this extensive review of the large body of literature reviewed, Dr. Gelmann explained his overall evaluation as follows:

There is a substantial body of well-done research examining known processes and endpoints related to carcinogenesis, including mutations, chromosomal change, whole animal tumor formation, and tumor growth in intact animals. This research on processes that are known to be related to carcinogenesis has consistently shown that exposure to power frequency fields does not affect the process of carcinogenesis.

In addition to this body of literature on processes involved in carcinogenesis, there is a body of research that examines processes and endpoints unrelated to carcinogenesis. Some of this research has reported that exposure to power frequency fields can cause measurable change in the endpoint studied. As noted earlier in my testimony, many of these studies are subject to individual criticism based on the design or conduct of the study. More importantly, a careful analysis of the studies demonstrates that, even if the reported results of these studies are valid, they do not indicate that exposure to power frequency fields affects carcinogenesis. The endpoints studied are simply not related to that process.

* * * *

The number of biological endpoints is not the relevant issue. The question is whether the processes that are involved are related to an adverse health outcome. To illustrate, breathing fresh air causes an immense number of biological effects in the human, but the process of breathing does not cause cancer or other adverse health effects. The argument that biological effects must lead to adverse health is contrary to basic biological and medical facts. Id. at pp. 21-22.

Based on this evaluation, Dr. Gelmann concluded that:

The extensive research on molecular and cellular biology and cancer provides no scientific basis to conclude that power frequency electric and/or magnetic fields cause, promote, or

contribute to the development of cancer or other adverse health effects. This is consistent with the conclusions reached by independent scientific commissions and agencies that have reviewed this research, such as the American Institute of Biological Sciences, the Virginia Department of Health, the Maryland Department of Natural Resources, and the California Department of Public Health. Id. at p. 22.

2. Comparison With Testimony of Dr. Liboff

Again, as was the case with the epidemiology, Dr. Liboff's brief, off-hand and uncritical allegations about the laboratory studies contrast sharply with the critical, scientific review that was conducted by Drs. Bockman and Gelmann.

Several examples are instructional. Dr. Liboff states that "Marron et al showed that such fields can affect cell cycle." Protestants St. No. 2, p. 2. However, Dr. Liboff neglected to explain the results that Marron reported, namely that for certain slime molds (amoeba), the length of the cell cycle was increased after exposure to power frequency EMFs, PECO Reb. St. No. 2, p. 17. Further, Dr. Liboff neglected to explain that this result, lengthening of cell cycle, is the opposite (a slowing of cell division) of what would relate to the cancer process (increased cell division). Id. at p. 7. Finally, Dr. Liboff admitted on the stand that he would not be the one to try and "draw direct implications for human health" from this experiment

on slime molds (amoeba). Tr. 835. Notwithstanding this admission on cross-examination, Dr. Liboff actually made such an implication in his direct testimony.

Dr. Liboff also states that "Goodman et al showed that protein synthesis is affected." Protestants St. No. 2, p. 2. However, Dr. Liboff neglected to mention that Dr. Goodman's work, which involved exposing various types of cells in laboratory dishes to pulsed, modulated and power frequency fields, examined ordinary, normal cell processes not specifically related to the process of carcinogenesis. PECO Reb. St. No. 3, p. 15. Dr. Liboff also failed to distinguish the fact that even if this research is accurate, there would be no suggestion of any adverse health impact because the results reported are trivial when compared to innocuous events occurring constantly such as hair growth. Id. at p. 15.

Dr. Liboff states that "Bawin et al found that calcium efflux from brain tissue is enhanced, etc. etc." Protestants St. No. 2, p. 2. However, Dr. Liboff failed to state that the results of that research have been inconsistent, with some researchers reporting increased calcium efflux some reporting decreased calcium and some reporting no change. PECO Reb. St. No. 3, p. 18; Tr. 803-805. Dr. Liboff neglected to explain that the endpoint of these

studies, namely calcium efflux, does not relate in any known way to the process of carcinogenesis. Id. at p. 18. On cross examination, Dr. Liboff admitted that the experiment involved the infusion of chick brain tissue slices in laboratory dishes with radioactive calcium and the measurement of how much radioactive calcium leaks into the environment under exposed or non-exposed conditions, and that, therefore, he could not make the extrapolation of the results to health effects in humans. Tr. 802, 805.

Dr. Liboff states that "[E]vidence has been published indicating that embryological changes occur in chick eggs and in fish eggs following exposure to weak ELF magnetic fields." Protestants St. No. 2, p. 4. However, on cross-examination, Dr. Liboff admitted that these results related to pulsed fields, not power frequency fields (which are sinusoidal in shape). Tr. 826-27; PECO Reb. St. No. 1., pp. 19-20. In addition, Dr. Liboff neglected to mention published studies in which chick embryos exposed to power frequency sinusoidal EMFs failed to demonstrate effects on any of the reproduction and development endpoints studied. Id. at p. 20.

Dr. Liboff also makes several oblique references to studies of melatonin, a hormone produced by the pineal gland:

Still another laboratory finding with great implications for human health are the results of Dr. Bary Wilson indicating endocrine changes connected to the pineal gland in animal and human following electromagnetic exposure. Protestants St. No. 2, p. 4.

The possibility exists that one of the pathways affected may result in breast cancer... Protestants St. No. 2, p. 4.

Dr. Russell Reiter, of the University of Texas, looking at the magnetically induced changes in melatonin output by the pineal gland, has asserted that at least some sleep disorders should be regarded as caused by the electromagnetic environment. Protestants St. No. 2, p. 5.

Again, Dr. Liboff's "analysis" neglects many important facts and makes several key omissions:

1. Dr. Liboff neglects to explain melatonin.

Dr. Bockman explained that:

Melatonin is a hormone that is produced by the pineal gland. The pineal gland has no known function in human beings: one theory holds that it is a vestigial gland that no longer serves a biologically significant function in humans. Melatonin produced by the pineal gland is one of several neurologic hormones that is known to have a distinct rhythm that is tied to the daylight/darkness cycle. Specifically, it has been shown that melatonin levels in rats are suppressed by light and increase with darkness. PECO Reb. St. No. 1, p. 17.

2. Dr. Liboff himself admits that he doesn't even know for sure if the pineal gland is part of the endocrine (glandular) system. Tr. 834.

3. Dr. Liboff fails to consider or explain the results of the melatonin research, the fact, as explained by Dr. Bockman, that no deleterious health effects on the animals were documented, and the fact that the reported exposure to was an electric and not magnetic fields.

Dr. Bockman explained that:

Under highly artificial laboratory conditions where experimental rats are deprived of normal environmental cues, electric field exposure has been reported to produce a small decrease and time delay in the expected nightly rise in pineal gland melatonin levels. At least 3 weeks of fixed, artificial laboratory conditions were needed to elicit this response and within 3 days of removing the rats from these artificial conditions, normal melatonin rhythms were reestablished. No deleterious effects on the health of the animals were observed in the study, and no study has demonstrated any such biological effect of magnetic field exposure. PECO Reb. St. No. 1, p. 17.

4. Dr. Liboff fails to note that in more recent studies from the same institution, investigators were unable to find any differences in melatonin levels as a result of electric field exposure. Dr. Bockman explained that:

In a more recent study, the investigators reported that they failed to find any differences in pineal melatonin or melatonin metabolic

levels in animals exposed to field strengths of 10 to 65 kV/m (Grotta et al., 1991). Similarly, an investigator recently reported that baboons exposed to 60 Hz, 6 kV/m and 500 mG fields showed no changes in nocturnal melatonin levels (Rogers et al., 1991). PECO Reb. St. No. 1, pp. 17-18.

5. On cross-examination, Dr. Liboff admitted that Dr. Reiter had not published any papers on sleep disorders, but had published only on melatonin levels. Tr. 832.

6. Finally, Dr. Liboff failed to distinguish the fact that there are no scientific data (as opposed to speculation) connecting melatonin levels to breast cancer causation in humans. PECO Reb. St. No. 3, p. 19. This paucity of data exists despite 65 years of research into endocrine causes of breast cancer.

Tr. 1464-68.

Dr. Liboff also alleged, as if it were accepted scientific fact, that:

"Graham and Cohen have reported evidence of changes in human heartbeat in a group of men exposed to 60 Hz magnetic fields for short periods of time." Protestants St. No. 2, p. 5.

However, as explained by Dr. Bockman, Dr. Liboff failed to note that the "report" was merely an abstract of work in

progress and unpublished, (and obviously non-replicated as well), a point that the authors of the study as careful scientists are the first to point out. Tr. 1043. In addition, OCA's witness Mr. David E. Janes, stated that the scientific evidence showed that cardiovascular function was unaffected by EMF exposure and cited a final, published study supporting such conclusion. OCA St. No. 2, p. 6.

Dr. Liboff's testimony also contains "reference to "bone repair studies." Protestants St. No. 2, p. 3. In making such reference, however, Dr. Liboff neglected to mention that most of the bone repair research involves pulsed fields which are not the type which are created from transmission of electric power, and that there is only limited research on bone repair using power frequency fields. PECO Reb. St. No. 3, p. 19. Further, as Dr. Gelmann explained during cross-examination, the only randomized trial study on cell proliferation and bone repair that he could find concluded there was no effect of EMFs on bone repair. Tr. 1194-96. In addition, Dr. Liboff failed to explain that bone repair is itself a normal process unrelated to the development of cancer, and researchers have not observed an increase in cancer at either non-field treated bone healing sites, or field-treated bone healing sites. PECO Reb. St. No. 3, p. 19.

These numerous flaws completely destroy Dr. Liboff's conclusion that the laboratory evidence supports his overall opinion that EMFs pose a health hazard to the public. To the contrary, as clearly shown by the testimony of Drs. Bockman and Gelmann, the large body of laboratory evidence to date simply does not support any conclusion that EMFs pose a human health hazard.

c. Contrary to Protestants' Witness Liboff, the Claims For Ion Cyclotron Resonance Do Not Provide Support For an Opinion that EMFs pose a Human Health Hazard

Dr. Liboff seeks to bolster his contention that EMFs pose a health hazard through the use of a hypothesis of a physical mechanism by which EMFs could create biological effects. Protestants St. No. 2, pp. 5-6. This hypothesis, known as Ion Cyclotron Resonance ("ICR"), postulates that very weak magnetic fields enhance the movement of charged particles, called ions, through channels in the cell membrane. Such a postulation is necessary, according even to Dr. Liboff, because the magnetic fields are too weak to invoke any known mechanism for interaction with biological organisms. Tr. 775, 781-82.

However, Dr. Liboff, in his direct testimony regarding his ICR mechanism, neglected to explain this hypothesis and wants us to take his contention on faith

rather than experimental verification. Nor did he seek to assure us that he was at all objective about his own hypothesis. In neglecting to explain the fundamental problems with his hypothesis, he reveals himself to be incapable of fairly presenting his hypothesis.

1. Testimony of Dr. Murray Rosenberg

In rebuttal, PECO presented the testimony of Dr. Murray Rosenberg, a biophysicist, medical doctor and researcher with a Ph.D. degree in Applied Physics and an M.D. degree, both from Harvard University. Dr. Rosenberg is Professor of Genetics and Cell Biology at the University of Minnesota, has a medical practice at the Aspen Medical Clinic in St. Paul, Minnesota, and is a Visiting Professor at Brown University Medical School. PECO Reb. St. No. 4, pp. 1-6.

Dr. Rosenberg provided background on the electromagnetic spectrum and the waveform and shape of various types of fields. PECO Reb. St. No. 4, pp. 6-17. Next, Dr. Rosenberg explained ICR. Id. at p. 17. Dr. Rosenberg explained ICR as follows:

Certain background on cellular biology and physics must first be provided to understand the basis for my comments. As part of normal cell function, some biologically important charged particles, called ions, cross cell membranes through circular, or helical, openings in the cell membrane known as "channels." It is those ions that are referred to in the phrase "ion cyclotron resonance." In physics,

there is a well-understood phenomenon known as "cyclotron resonance" in which it is possible to calculate the precise frequency that will cause a particular particle which is traveling in a circular or helical path to undergo acceleration. The best known practical application of this theory is the use of very high frequency electromagnetic fields to accelerate particles in the giant particle accelerators that are used to study atomic structure. The cyclotron resonance phenomenon only occurs when a particle or ion is travelling in a circular path. It is also possible to calculate, for a given ion and resonance frequency, the size of the circular path that must exist for the resonance effect to be possible.

The ICR hypothesis attempts to fuse these two concepts, suggesting that as ions pass through the helical openings in the cell wall the 60 Hz magnetic field imparts energy to the ion with each cycle of the 60 Hz field -- in effect "pushing" the ion 60 times each second. PECO Reb. St. No. 4, pp. 17-18.

Dr. Rosenberg pointed out three insurmountable obstacles to Dr. Liboff's ICR hypothesis which Dr. Liboff neglected to mention. PECO Reb. St. No. 4, pp. 18-19. Dr. Rosenberg explained that the first of these problems is that the circular or helical path that the biological ions would have to travel for a 60 Hz cyclotronic resonance effect would be very wide, approximately 10 feet, but cellular channels are submicroscopic and measured in angstroms (an angstrom is one 10-billionth of a meter). Id. at p. 18; Tr. 1229-34.

The second of these problems explained by Dr. Rosenberg is that the ICR phenomena can occur only if

the ion or other particle travels in an uninterrupted circular or helical path. Id. at p. 18. Dr. Rosenberg explained that this is why giant particle accelerators are carefully constructed (to remove virtually all air molecules thereby producing a vacuum) so that unintended collisions cannot occur that would dissipate the energy imparted to the ion. Id. at p. 18. However, Dr. Rosenberg explained that, in biological tissues, ions are in constant collision with as many as one trillion particles per second, and that these trillions and trillions of collisions would nullify any cyclotronic resonance effect on the ion. Id. at pp. 18-19.

The third problem with ICR explained by Dr. Rosenberg was the calculation of the resonance frequencies. Dr. Rosenberg explained that the mass of the ion that was used in the ICR calculation assumes that no other molecules are surrounding the ion when it travels through the cell membrane. However, in reality, ions in cells are surrounded by water molecules which substantially alter the effective mass of the ion, thereby undermining the theoretical calculations upon which Dr. Liboff bases his ICR hypothesis. Id. at p. 19.

2. Comparison with Testimony of Dr. Liboff

Contrary to Dr. Rosenberg, Dr. Liboff unqualifiedly cited ICR as support for his opinion that EMF poses a human health hazard, even though Dr. Liboff himself considers his

ICR hypothesis to be "wild" (Tr. 784). Dr. Liboff merely assumes that the large and unanswered problems with his hypothesis such as those raised by Dr. Rosenberg, will somehow be resolved in the future by some new theory. PECO Reb. St. No. 4, p. 19; Tr. 783.

Obviously, as concluded by Dr. Rosenberg, ICR must be viewed as nothing more than "a speculative attempt to establish a mechanism with very good reasons for believing that this mechanism does not and cannot occur in actual biological tissue." Id. at p. 19.

Although Dr. Liboff contends that he has laboratory evidence supporting his hypothesis, the cited "experiments" on rats and single-celled organisms known as diatoms have not been replicated by scientists outside of Dr. Liboff's group. Id. at p. 20. Tr. 783-799. In addition, Dr. Liboff's work on lymphoma cells is contradicted by other cell proliferation studies (PECO Reb. St. No. 3, pp. 19-20) and tumor growth studies, which are better measures of cell proliferation, consistently report no EMF effects (PECO Reb. St. No. 4, p. 20). Therefore, the ICR hypothesis is far from being either a serious model with any theoretical or empirical basis. Dr. Liboff himself admitted that scientists progress from a hypothesis (such as ICR) to a model to an accepted theory. Tr. 782-783. ICR has not progressed along this sequence at all.

Dr. Rosenberg concluded his examination of ICR by explaining that for all of these reasons "the ICR hypothesis" is "highly speculative" and "has no implications for human health." Id. at pp. 20-21.

d. Evidence Submitted by the Office of
Consumer Advocate Does Not Support
Protestants' Assertion that EMFs Pose a
Human Health Hazard

The review of evidence in this case in this brief above has focused primarily on the evidence submitted by Protestants, in the form of the cursory testimony by Dr. Liboff that there is a presently known "hazard to humans" for power frequency EMFs (Protestants St. No. 2, p. 5), and PECO's careful, detailed rebuttal testimony to Dr. Liboff's contentions (PECO Reb. St. Nos. 1, 2, 3 and 4). However, it should be noted at this point that the Office of Consumer Advocate ("OCA") also submitted evidence in this proceeding, and OCA's witnesses do not support Protestants' assertion of a human health hazard.

OCA submitted the testimony of Mr. David E. Janes and Dr. David M. Rosenbaum. Mr. Janes reviewed the biological literature on EMFs and concluded that: (1) in his opinion, there was sufficient evidence to show that "weak"

EMFs^{3/} do produce subtle "effects" on biological systems;
(2) the mechanisms producing the effects are not known;
(3) effects seen in cells and cellular systems in the laboratory cannot be directly extrapolated to animals or humans;
(4) the connection between any biological effects of EMFs and any harm to human health is unclear; (5) but that the possibility of harmful effects could not be summarily or categorically rejected. OCA St. No. 1, p. 10.

Dr. Rosenbaum reviewed the epidemiologic research of EMFs, concluded that the epidemiology is "far from conclusive" and "very confused," about potential health effects of EMF and made certain policy recommendation based on his conclusions and the conclusions of Mr. Jones. OCA St. No. 2, pp. 3, 5 and 8.

Thus, OCA's position in this proceeding is far different from that of Protestants' Witness Liboff, who claims there is a presently-known human health hazard from EMFs. Again, OCA's testimony is just another example of how

^{3/} Those with electric field strengths below 8.0 kV/M and magnetic field strengths below 5,300 mG, according to Mr. Janes. It should be noted that the maximum expected EMF levels at the edge of the right-of-way for the proposed line, under even emergency conditions, would be 1.2 kV/M and 70 mG, and would ordinarily be expected not to exceed 1.2 kV/M and 25 mG. PECO Direct St. No. 2, pp. 7-9.

far afield Dr. Liboff's position really is. In this proceeding, OCA's witnesses testified that there is no way at present to connect any subtle biological effects of EMFs to human health hazards (OCA St. No. 1, p. 10). In contrast, Dr. Liboff, virtually on his own, claims to have definitely established the existence of a human health hazard from EMFs.

e. Conclusion as to Whether Generally
Accepted Scientific Reasoning Supports
Protestants' Assertion that EMFs Pose
a Human Health Hazard

Based on examination of the extensive, scientific evidence in this case submitted in the form of testimony of Drs. Cole, Bockman, Gelmann and Rosenberg, as well as Dr. Rosenbaum and Mr. Janes, as contrasted by the testimony of Dr. Liboff, the only conclusion that can be reached is that the presently-available scientific information simply does not support Protestants' assertion that EMFs pose a human health hazard. For the many reasons listed above, Dr. Liboff's assertions simply do not pass the test of critical scientific reasoning and review.

3. Numerous Independent and Governmental Scientific Panels Which Have Reviewed the Scientific Literature on EMFs and Possible Health Effects Do Not Support Protestants' Contention that EMFs Pose a Human Health Hazard

In addition to reviewing primary scientific literature, such as reports of published experiments in peer-reviewed journals, one other way of determining whether there is general scientific acceptance of a position, such as Dr. Liboff's, is to examine the publically-available reports of scientific and governmental panels of scientific experts independent of the utility industry which have reviewed the scientific literature. When these reports are reviewed, it is clear that the numerous independent scientific and governmental panels which have reviewed the scientific literature on EMF and possible health effects have concluded that there is no present scientific basis upon which to conclude that EMFs pose a human health hazard. See, e.g., PECO Reb. St. No. 3, p. 22; Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval, Docket No. A-110550F055; Order adopted March 6, 1991, p. 13.

One report that has been mentioned in this proceeding is a publically-available draft report prepared by staff of the United States Environmental Protection Agency ("EPA") on the potential carcinogenicity of EMFs. Environmental

Protection Agency (EPA), Evaluation of the Potential
Carcinogenicity of Electromagnetic Fields: Review Draft.

Office of Research and Development EPA/600/6-90-005B,
Washington, DC, October 1990. However, as explained in the
direct testimony of Dr. Cole, this draft report, while it
has been made public, is still undergoing the rigorous
peer-review process, and the draft report itself cautions
"Draft: Do Not Quote or Cite." PECO Reb. St. No. 2, p. 21.
In addition, Dr. Cole explained that this report has been
roundly criticized by the panels of scientists routinely
assigned to conduct such peer-review. PECO Reb. St. No. 2,
p. 22. Such criticisms have been previously noted in this
brief, and citations to the publically-available critical
reports mentioned by Dr. Cole are as follows:

Committee on Interagency Radiation Research
and Policy Coordination (CIRRPC); Letter from
Chairman A. L. Young to Erich W. Bretthauer at
EPA, August 5, 1991.

Science Advisory Board (SAB). Final
RAC/NIEMFS Report Re: Potential
Carcinogenicity of Electromagnetic Fields,
January 29, 1992.

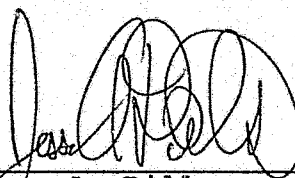
These final governmental reports, prepared in response to
the draft EPA report, strongly contend that the scientific
evidence does not show that electric and magnetic fields are
carcinogenic. See PECO Reb. St. No. 2, p. 22.

Accordingly, review of the numerous independent and governmental scientific panels which have completed final reviews of the scientific literature on EMFs and possible health effects provides no support for Protestants' contention that EMFs pose a health hazard.

V. CONCLUSION

For all of the foregoing reasons, the Administrative Law Judge and the Pennsylvania Public Utility Commission should find that there is insufficient evidence in the record of this proceeding upon which to conclude that EMFs pose any human health hazard.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Jesse A. Dillon", is written over a horizontal line.

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Dated: April 21, 1992

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION OF :
PHILADELPHIA ELECTRIC COMPANY :
RELATIVE TO RECONDUCTORING :
AND REBUILDING THE EXISTING : Docket No. A-110500F055
LINE TO OPERATE AS A WOOD- :
BOURNE-HEATON 230 KV LINE IN :
BUCKS AND MONTGOMERY :
COUNTIES :

CERTIFICATE OF SERVICE

I hereby certify that I have this date served a true copy of the foregoing filing entitled "Main Brief on Behalf of Pennsylvania Power & Light Company" on the following in accordance with the requirements of 52 Pa. Code §1.54:

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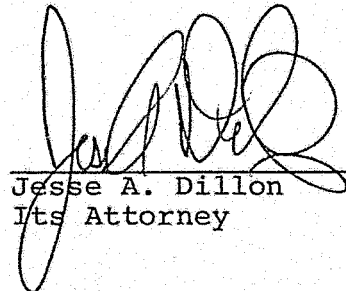
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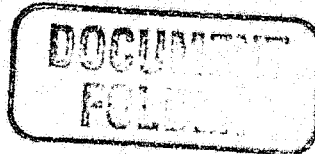
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SECRETARY'S OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

Dear Mr. Alford:

Enclosed are an original and nine copies of Philadelphia Electric Company's Initial Brief in the Woodbourn-Heaton proceeding. Copies have been served on the ALJ and all parties today.

Respectfully yours,

Ward L. Smith

Ward L. Smith

cc: (via Overnight Mail)
Hon. Herbert S. Smolen
Robert J. Sugarman, Esquire
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Patricia Krise Burket, Esquire
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CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

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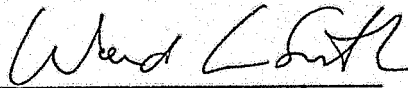
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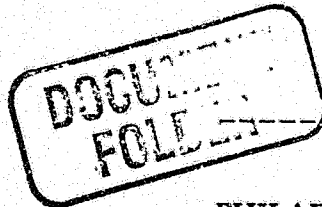
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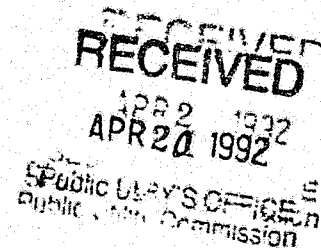
BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Letter of Notification of
Philadelphia Electric Company
Relative to Reconstructing and
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Line to Operate as a Woodbourne-
Heaton 230 kV Line in Montgomery
and Bucks Counties

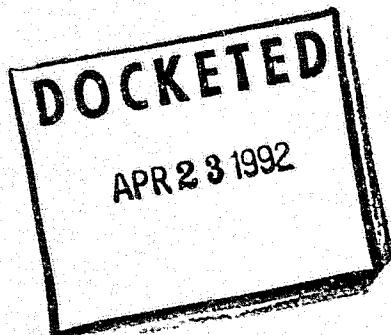
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A-110550, F. 055



INITIAL BRIEF OF
PHILADELPHIA ELECTRIC COMPANY



BEFORE ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN



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**BEFORE THE
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Rebuilding of the Existing 138 kV	:	Docket No.
Line to Operate as a Woodbourne-	:	A-110550, F. 055
Heaton 230 kV Line in Montgomery	:	
and Bucks Counties	:	

**INITIAL BRIEF OF
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BEFORE ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN

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STATEMENT OF THE CASE

This reopened hearing involves a challenge to the Pennsylvania Public Utility Commission's ("Commission") approval of Philadelphia Electric Company's ("PECO") request to reconductor and energize an existing, de-energized, transmission line. The 230 kV transmission line ("Woodbourne-Heaton line" or "the line") will be used to electrically connect the Woodbourne and Heaton substations, which are located approximately 12 miles apart in Montgomery and Bucks counties. The line traverses approximately 12.3 miles of an existing utility right-of-way, owned by Conrail, which is in active use for rail freight. PECO acquired its right-of-way, and the right to use the poles from Conrail's existing 138 kV transmission line, through negotiations with Conrail in 1989.

The Commission approved PECO's Letter of Notification on February 9, 1990. More than 6 months later, certain local residents ("Protestants") petitioned the Commission to reopen the record, stating that they had not received notice of PECO's plan to reconductor the line and that they desired to present evidence against the line. The Commission denied Protestants' petition and Protestants appealed to the Commonwealth Court.

The Court found that "it is clear that Petitioners, as neighboring property owners, will be affected" by the line, and ordered the Commission to hold a hearing "on the question of whether they will be adversely affected by the reconductoring of the high tension electrical line. . . ." May 24, 1991 Order by Judge Palladino at 1-2.

These hearings were convened to take evidence on that issue. All parties have now been fully heard on issues of potential adverse effect. Protestants claim that they have proven the existence of adverse health and land use effects that cause this line to fail to meet the Commission's standards for approval of a transmission line. PECO's position is that the line meets the Commission's standards for approval and thus the Commission should issue an order reconfirming its 1990 approval of PECO's Letter of Notification.

HISTORY OF THE PROCEEDING

The Commission's evaluation of PECO's proposal to upgrade this transmission line began 29 months ago. The history of the proceeding can be briefly summarized by reference to the following key events:

November 21, 1989 -- PECO files Letter of Notification requesting Commission approval to reconductor the existing Conrail 138 kV line as a 230 kV line.

February 9, 1990 -- Commission issues Order approving PECO's Letter of Notification. ("February 9 Order")

September 4, 1990 -- Protestants file petition asking the Commission to reopen the record in the Woodbourne-Heaton proceeding.

March 8, 1991 -- Commission issues Order denying Protestants petition. ("March 8 Order")

April 2, 1991 -- Protestants file petition with Commonwealth Court requesting review of Commission's Order.

April 4, 1991 -- Protestants file petition with Commission requesting stay of construction pending appeal.

May 8, 1991 -- Commission issues Order denying Protestants' request for a stay.

May 24, 1991 -- Judge Palladino of the Commonwealth Court orders the Commission to hold a hearing "on the question of whether they [Protestants] will be adversely affected by the reconductoring" of the Woodbourne-Heaton line. ("Court Order")

June 14, 1991 -- Commission issues Order that a hearing be held on "the sole issue of whether the Petitioners will be adversely affected by the reconductoring of this . . . line." ("June 14 Order")

July 18, 1991 -- ALJ Smolen issues prehearing Order addressing scope of issues and burden of proof for the hearings. ("ALJ Order")

August 15, 1991 -- Evidentiary hearings commence.

February 7, 1991 -- Evidentiary hearings completed, with record consisting of over 1500 pages of transcript, 200 pages of written testimony, and 40 exhibits.

STATEMENT OF QUESTIONS INVOLVED AND BURDEN OF PROOF

Questions Involved

The Commission may not approve a transmission line unless it finds that there is a need for the line, that the line "will not create an unreasonable risk of danger to the health and safety of the public," and that the line "will have minimum adverse environmental impact, considering the electric power needs of the public, the state of available technology and the available alternatives." 52 Pa. Code § 57.76.

Protestants were granted this reopened hearing to present evidence on their claim that the Woodbourne-Heaton line will cause adverse health and land use impacts that warrant disapproval of the line under these Commission standards. *See* Court Order at 2, June 14 Order at 2, ALJ Order at 3. The scope of this reopened hearing is limited to that sole issue. *Id.*

Evidence was heard on three questions within that scope: (1) whether the construction, operation, and maintenance of the line will cause adverse safety impacts that warrant disapproval of the line, (2) whether electric and/or magnetic fields ("EMF" or "power frequency fields") associated with the line will cause adverse health impacts that warrant disapproval of the line, and (3) whether the line will cause adverse land use impacts that warrant disapproval of the line. The record is clear that no such adverse effects have been demonstrated.

In addition, evidence was presented responding to Commissioner Rhodes' June 14, 1991, request that the record contain information on EMF levels, line design, and mitigation. ("Rhodes Request").

The Commission has ruled that it has no jurisdiction over alleged decreases in property values. *See e.g.* March 8 Order at 10, n.9. Protestants' witness Mr. Turner offered testimony, subject to argument, that the line will cause a decrease in property values. Protestants argue that they should be allowed to present this testimony as long as they do not actually ask the Commission to give them financial remuneration for the alleged decreases in property value. T.S. at 104-06.

The Commission need not reach Protestants' argument. As demonstrated in the Argument section of this brief, Protestants have not proven that the line will decrease property values or that any such decreases will cause adverse land use impacts that warrant disapproval of this line.

Burden of Proof

The Commission's regulations provide two procedures for obtaining Commission approval to construct and operate a transmission line. When the line will be built on an existing utility corridor, as with the Woodbourne-Heaton line, approval may be sought through a Letter of Notification that addresses the need for the line and the safety considerations that have been incorporated into the line. 52 Pa. Code § 57.72(d). When a new utility corridor will be established, an Application must be filed. The Application must address need and safety, and also must describe projected environmental impacts, including land use impacts, efforts which will be made to minimize those projected impacts, and reasonable alternative routes for the line. 52 Pa. Code § 57.72.

PECO was assigned the burden of proof for issues of potential adverse impact, including safety issues, that normally would be addressed in a Letter of Notification pursuant to Commission Rule 57.72 (d)(4). ALJ Order at 3-4.

Protestants and the Office of Consumer Advocate (the "OCA") were assigned the burden of proof for issues raised by them that are not required to be addressed in a Letter of Notification. ALJ Order at 4. Protestants and the OCA were specifically assigned the burden of proof for "their respective contentions concerning . . . health effects from EMF." *Id.* Letters of Notification are not required to address land use issues. 52 Pa. Code §§ 57.72(c)(7) and (d)(4)(i). The burden of proof for land uses issues thus also lies with Protestants and the OCA.

SUMMARY OF TESTIMONY

Twelve days of hearings were held in this proceeding over a period of 7 months. The record consists of more than 1500 pages of transcript, 200 pages of written testimony, and 40 exhibits. Testimony was heard from 22 individual Protestants, from company personnel, and from 10 expert witnesses appearing on behalf of Protestants, the OCA, and PECO. The record contains reference to hundreds of studies, scientific reviews, books, and other published documents.

The 22 individual Protestants who testified in this case discussed a variety of issues. Three issues, however, were addressed by all Protestants. First, each Protestant identified the location of their property in relationship to the line. The closest property line was identified as 37 feet from the transmission line, T.S. at 179, while the furthest property line was identified as approximately 600 feet from the transmission line. T.S. at 164.

Second, each Protestant told the Commission their reason for protesting the line. For example, William Cohen testified that he became "fearful" of EMF after reading a number of scientific papers -- some of which he candidly admitted were too technical for him to understand -- and speaking to scientists. T.S. at 215. Elaine Kupcinski testified that she became concerned after reading material sent to her by PAUSE. T.S. at 494-95. Other Protestants similarly stated that they had become concerned about health or property value effects after reading material from PAUSE, in magazines or newspapers, or from watching television. *See e.g.*, T.S. at 139, 147, 166, 441.

Third, each Protestant told the Commission what they plan to do when the line is energized. Some stated that they will measure field levels on their property before deciding whether to do anything. *See e.g.*, T.S. at 145. Others stated that they intend to curtail use of their property, sell their houses, or even abandon their property. *See e.g.*, T.S. at 138, 234, 280.

Mr. Ron Oedemann, a PECO engineer who is a Senior Member of the Institute of Electrical and Electronics Engineers ("IEEE"), testified that the

construction, maintenance, and operation of the line meet all applicable requirements of the National Electrical Safety Code ("NESC") and the Commission's safety regulations. PECO Direct Statement No. 1 ("Oedemann Direct") at 2, 9.

Mr. Oedemann also presented the information on line design requested by Commissioner Rhodes. The line has a "compact delta" design built on the existing Conrail transmission line poles. Oedemann Direct at 5. Mr. Oedemann also described three designs that have been used on other transmission line rights-of-way: the "flat," "vertical," and "longer-span delta" designs. Mr. Oedemann testified that none of these designs provides any safety advantages over the compact delta design. *Id.* at 13. Use of a flat, vertical, or longer-span delta design for the line would have required installation of new poles along the length of the right-of-way. *Id.* at 12. The horizontal and longer-span designs would have required acquisition of additional right-of-way. *Id.* None of these designs could have been used for the entire length of the transmission line due to height restrictions near an adjacent airport. *Id.* Mr. Oedemann also testified that use of any of these designs would have cost of millions of additional dollars compared to the compact delta design. *Id.* at 13.

Mr. Charles Boeggeman, a PECO engineer who is Chairman of PECO's EMF Task Force, presented the information on electric and magnetic field levels requested by Commissioner Rhodes. Mr. Boeggeman explained that electric fields, which are measured in "kilovolts per meter" ("kV/m"), and magnetic fields, which are measured in "milligauss" ("mG"), are associated with all uses of electricity. PECO Direct Statement No. 2 ("Boeggeman Direct") at 5. Mr. Boeggeman explained that magnetic field levels depend upon several factors, including the amount of electric current present and the distance from the source of fields. For example, he testified that the fields associated with appliances can range from 0.1 mG to as much as 20,000 mG, depending upon which appliance is used and how close to the appliance measurements are taken. *Id.*

Mr. Boeggemann conducted computer-assisted calculations of the electric

fields and magnetic fields that will be associated with the line, out to 300 feet on either side of the line. Boeggeman Direct at 5-10. Under normal operating conditions, magnetic fields associated with the line will be less than 26 mG at the edge of right-of-way, and less than 0.65 mG at a distance of 300 feet. *Id.* at 9, PECO Exh. No. 2 at 6, 8. The electric fields associated with the line will be approximately 1.2 kV/m at the edge of the right-of-way. Boeggeman Direct at 7. Mr. Boeggeman also calculated the electric and magnetic field levels for the flat, vertical, and longer-span delta designs. Mr. Boeggeman's calculations demonstrated that the compact delta design results in lower field levels than any of the other designs. Boeggeman Direct at 11-12, PECO Exhibit No. 2 at 15-29.

J. Michael Silva presented information about the magnetic fields that people encounter in everyday life. Mr. Silva is one of the world's leading experts in the evaluation of human exposure to EMF. He has conducted exposure assessment projects around the world for electric utilities, school districts, state, federal, and international government agencies such as the Cancer Control Agency of British Columbia, universities such as Stanford University, and Kaiser Permanente Hospitals. PECO Rebuttal Statement No. 6 ("Silva Rebuttal") at 7. Mr. Silva developed the EMDEX personal dosimetry meter, which is the state-of-the-art instrumentation for measuring magnetic field exposures. He also supervised development of the ExpoCalc computer program, which is one of the primary computer programs that is used to calculate electric and magnetic fields from transmission lines. *Id.* at 3. He is currently conducting EMF exposure assessment research with the National Cancer Institute, Johns Hopkins University, and the University of North Carolina. *Id.* at 7.

Mr. Silva described the common sources of electric and magnetic fields, such as household wiring, lighting, transmission and distribution facilities, and appliances. Silva Rebuttal at 10. Mr. Silva also made actual magnetic field measurements at various public locations in Langhorne and Philadelphia to provide context on magnetic field levels. Mr. Silva measured magnetic fields from a fraction of a mG to 760 mG, with many fields in the range of 1-10 mG. *Id.* at 13-14,

Exh. JMS-3, Exh. JMS-4.

Mr. Silva compared the fields from the line with the fields routinely encountered in everyday life, as well as with those associated with other transmission lines, and stated that:

"In comparison to other, similar transmission lines, there is nothing unique or unusual about the fields associated with the Woodbourne-Heaton 230 kV transmission line. The electric and magnetic fields that will be associated with the Woodbourne-Heaton line are in the same range as levels from other similar 230 kV lines. The magnetic field levels associated with the 230 kV line are within the range that people routinely encounter in everyday life from a variety of sources."

Silva Rebuttal at 19.

Mr. Silva also addressed the question of whether the line is consistent with the concept of "prudent avoidance," which is "one possible framework for analyzing exposure to electric and magnetic fields, and for considering actions that might alter exposure to electric and magnetic fields." Silva Rebuttal at 15. Mr. Silva is an electrical engineer and a senior member of the IEEE with extensive experience designing transmission facilities. *Id.* at 1-2,6. Mr. Silva combined this experience with his exposure assessment expertise to evaluate the design, route, and field levels of the line and concluded that the line is consistent with the concept of prudent avoidance. *Id.* at 17-18.

Ronald Turner appeared on behalf of Protestants to discuss land use issues. Mr. Turner reviewed population growth and urbanization in municipalities through which the line passes. He concluded that the area is undergoing "continued urbanization," and that this should be a "significant factor" in deciding whether to energize the line. Turner Statement at 1. Mr. Turner did not, however, attempt to determine whether the area immediately adjacent to the line is experiencing "continued urbanization." T.S. at 547, 552, 554-55.

Mr. Turner also testified that the line will have adverse land use impacts. Mr. Turner testified that, since the right-of-way had been in use as a utility corridor for nearly a century and the electric transmission line poles had been in place during

the period of "rapid urbanization," he would limit his analysis to impacts of EMF associated with energizing the line. Turner Statement at 5. Mr. Turner stated that he did not know the EMF levels that will be associated with the line, T.S. at 548, but concluded that those fields will be a nuisance, *id.* at 5, cause decreased property values, and lead to adverse land use impacts. *Id.* at 5-6.

Finally, Mr. Turner discussed the concept of "prudent avoidance." He stated that he believes that application of prudent avoidance to this line is appropriate, and recommended that prudent avoidance should be implemented by delaying energization of the line. Turner Statement at 7-8.

Carter Van Dyke also testified about land use issues. Mr. Van Dyke is a land use planner and landscape architect with graduate level training in those disciplines. PECO Rebuttal Statment No. 5 ("Van Dyke Rebuttal") at 1. He is a Licensed Professional Planner and a registered landscape architect. *Id.* Mr. Van Dyke has prepared land use codes and comprehensive plans and has developed land use guidance documents for housing developments and for linear projects such as highways. *Id.*

Mr. Van Dyke conducted a land use study of the region, including all of the municipalities discussed by Mr. Turner. Mr. Van Dyke referred to this area as the "Regional Study Area", or "RSA." Mr. Van Dyke's study included analysis of existing utility facilities, natural features, and urban development in the region. Van Dyke Rebuttal at 4-5. In addition, Mr. Van Dyke conducted a detailed analysis of land uses within the "Corridor Study Area," or "CSA," which is a corridor 400 feet on either side of the transmission line right-of-way. Mr. Van Dyke visually analyzed aerial photographs of the entire length of the line to identify all land uses within the CSA. *Id.* at 9, T.S. at 1251-52, Exhibit CVD-8. His analysis of the CSA included detailed descriptions of existing zoning, existing land uses, and residential density and population both now and projected for the future. *Id.* at 8-11.

Mr. Van Dyke explained that his analysis of the CSA demonstrated that it is not a high density urban area. Van Dyke Rebuttal at 11. Mr. Van also analyzed the

restrictions created by natural features, existing zoning restrictions, and existing land uses within the CSA and calculated the number of additional residential units that could be constructed within the CSA. *Id.* He concluded that the CSA would not reach high density even it became fully developed. *Id.*

Mr. Van Dyke testified regarding whether energizing the line will cause adverse land use impacts. He explained that, when the existing zoning and land uses adjacent to the line were established, the existing utility corridor was being utilized for both a high-speed freight railway and the transmission of electricity. Van Dyke Rebuttal at 12-13. Mr. Van Dyke explained that the existing land uses and structures thus were specifically chosen as appropriate for close proximity to these utility functions. *Id.* Mr. Van Dyke concluded that continued use of the right-of-way as a utility corridor, including energization of the line, will not affect the current zoning and land uses. *Id.* at 11-15.

Mr. Van Dyke also addressed the issue of property values. Mr. Van Dyke explained that, since the existing residential uses near the transmission line were developed in the immediate context of an existing utility corridor which contained transmission poles and conductors and a highly intrusive high-speed freight railway, the market would already have fully compensated for proximity to utility functions. Van Dyke Rebuttal at 13-14. Mr. Van Dyke also examined all major existing utility functions in the 60-square mile Regional Study Area to determine whether they have had adverse impacts on land use, zoning, or property values. His assessment "did not reveal any adverse effects on land use, zoning, or property values in the areas adjacent to those utility uses." Van Dyke Rebuttal at 14.

On the question of whether exposure to EMF has been demonstrated to cause adverse human health effects, Protestants presented the testimony of Dr. Abraham Liboff. Dr. Liboff is not a medical doctor. T.S. at 756-57. His training is in physics. T.S. at 752-55. Dr. Liboff testified regarding research on cellular biology, Protestants' Statement No. 2 ("Liboff Statement") at 2, endocrinology, *id.* at 4-5, reproduction, *id.* at 3, immununology, *id.* at 6, and epidemiology. *Id.* at 3-4.

Dr. Liboff described several in vitro studies (in which researchers look at cells in glass dishes) that reported biological changes after exposure to EMF. Liboff Statement at 2-3. He briefly referred to "bone healing" studies. *Id.* at 1-2. He stated that he has had a "gradual acceptance" of certain epidemiology studies. *Id.* at 5. He concluded that there is a "common thread" running through these studies and that exposure to EMF is a "hazard to humans." Liboff Statement at 4-5.

Dr. Liboff also testified that the fields from transmission lines are "simply too small to invoke any conceivable mechanism," Liboff Statement at 2, and that he and other physical scientists have thus been motivated to try to identify a mechanism. T.S. at 781. Dr. Liboff described his own hypothesis, known as "ion cyclotron resonance." ("ICR"). Dr. Liboff stated that, while he believes in ICR and is an "advocate" of it, T.S. at 782, it should at this point only be considered a hypothesis. T.S. at 780.

The Office of Consumer Advocate presented the testimony of two witnesses, David Janes and Dr. David Rosenbaum of Risk Analysis Corporation. Mr. Janes, whose training is in physics, T.S. at 371, offered his opinions on the EMF research from endocrinology, molecular genetics, and cellular biology. OCA Statement No. 1 ("Janes Statement") at 6-9. Mr. Janes testified that the body of research on EMF is "large" and has "investigated a wide variety of biological effects in humans, animals, and cellular systems." Janes Statement at 6. Mr. Janes also testified that "many things are unaffected by exposure to weak electric and magnetic fields, including: growth and development, morbidity, blood cell populations, serum chemistry, and cardiovascular function." *Id.* Mr. Janes also testified "some" biological effects occur after exposure to EMF, *id.*, and concluded that: "[T]he possibility of harmful effects cannot be summarily or categorically rejected, and concerns about harmful effects are legitimate." Janes Statement at 10. In surrebuttal, Mr. Janes expressed the opinion that further EMF research would be justified. Janes Surrebuttal Statement at 1-2.

Dr. Rosenbaum, whose training is also in physics, T.S. at 301-02, testified about epidemiology. Rosenbaum Statement at 3-5. Dr. Rosenbaum concluded with regard to the epidemiological research on EMF that: "In general, the picture is very confused. It is not even clear that even if exposure to power lines does increase the risk of cancer, it is the average magnetic field that is the cause." *Id.* at 5.

Dr. Rosenbaum also testified as to his views on "prudent policy in the face of such uncertainty." Rosenbaum Statement at 6-8. Dr. Rosenbaum testified that, in his opinion, it would be preferable to increase public participation in transmission line siting decisions, and discussed factors that he believes should be evaluated before transmission line siting decisions are reached. *Id.* Dr. Rosenbaum did not, however, recommend that the Commission delay energization of the Woodbourne-Heaton line or otherwise alter its existing approval of that line.

Four nationally recognized scientific and medical experts presented evidence on EMF health issues on behalf of PECO.

Dr. Murray Rosenberg addressed the EMF research in the area of physics. Dr. Rosenberg is a medical doctor and a Ph.D. physicist. Dr. Rosenberg is Professor of Genetics and Cell Biology at the University of Minnesota, where he conducts biophysics research. He was chosen as the first director of the federal government's program to establish biophysics as a science in the United States. Dr. Rosenberg was also chosen as the first director of the National Science Foundation's program to stimulate interest in the biophysics study of human cells. PECO Statement No. 4 ("Rosenberg Rebuttal") at 1-5.

Dr. Rosenberg reviewed the "electromagnetic spectrum," including ionizing radiation, microwaves, and radiofrequency waves, as well as the power frequency fields that will be associated with the Woodbourne-Heaton line. He explained that each region of the spectrum "has unique biological properties" and that 60 Hz power frequency fields are very different from fields at frequencies other than 60 Hz. Rosenberg Rebuttal at 10-14. Dr. Rosenberg also explained the difference between

"sinusoidal" fields, such as those that will be associated with the line, and "pulsed" fields and "modulated" fields, which will not be produced by the line. *Id.* at 14-17. He explained that such pulsed and modulated fields contain many frequencies far different from 60 Hz fields, and that "it is inappropriate to attempt to draw conclusions about power frequency fields based on a study using many frequencies." *Id.* at 16.

Dr. Rosenberg also addressed Dr. Liboff's "ion cyclotron resonance" hypothesis and explained that it has a "number of fundamental problems . . . that demonstrate that it is not an accurate description of any interaction between power frequency fields and biological tissue." Rosenberg Rebuttal at 17. After reviewing those problems at both the theoretical and experimental levels, Dr. Rosenberg concluded that: "the ICR hypothesis has no implications for human health." *Id.* at 20.

Dr. Edward Gelmann addressed the molecular genetics and cellular biology research. Dr. Gelmann is a medical doctor specializing in the study and treatment of cancer. He is Professor of Medicine, Professor of Anatomy and Cell Biology, and Chief of the Division of Medical Oncology at the Vince Lombardi Cancer Center at Georgetown University Medical School. Dr. Gelmann has conducted research on the cellular and molecular biology of human cancer for the past 15 years, first at the National Cancer Institute, now at Georgetown. PECO Rebuttal Statement No. 3 ("Gelmann Rebuttal") at 1-3, Exh. EG-1 at 1.

Dr. Gelmann explained that a large body of 60 Hz research has been conducted on molecular genetics and cellular biology issues. In particular, extensive research has been conducted on biological endpoints involved in the process of carcinogenesis. This research has included mutational analyses, chromosome studies, animal studies, and tumor growth studies. Gelmann Rebuttal at 8.

Dr. Gelmann explained that an agent cannot cause cancer if it does not cause mutations in the cell's DNA. Gelmann Rebuttal at 6. Mutational analyses have determined that power frequency fields do not cause DNA mutations. *Id.* at 9.

Chromosomes contain the DNA, and studies of an agent's effect on chromosomes thus tell whether an agent has potential to cause cancer. Chromosome studies have shown that EMF is not associated with damage to chromosomes. *Id.* at 11. Studies on whole animals have "a broader potential" to observe abnormalities in functions such as reproduction, growth, or development, that would be affected by genetic change. Extensive animal studies "provide no scientific basis to conclude" that EMF causes cancer or any other adverse health effect. *Id.* at 14. Tumor growth studies are a direct test whether exposure to an agent affects the development or progress of cancer. The EMF tumor growth studies indicate that exposure to EMF, "either before or after implantation of a tumor into the animal host, does not affect the development of a tumor." *Id.* at 15.

Dr. Gelmann also reviewed the cellular and molecular research that had been referred to by Dr. Liboff and Mr. Janes, such as the research by Goodman, Adey, and Marron. E.g., Gelmann Rebuttal at 16. Dr. Gelmann reviewed the design, findings, and implications of each study individually. He concluded about this research that:

"[A] careful analysis of the studies indicates that, even if the results are valid, they do not indicate that exposure to power frequency fields affects carcinogenesis. The endpoints studied are simply not related to that process."

Gelmann Rebuttal at 21.

Dr. Gelmann concluded that:

"The extensive research on molecular and cellular biology and cancer provides no scientific basis to conclude that power frequency electric and/or magnetic fields cause, promote, or contribute to the development of cancer or other adverse health effects. This is consistent with the conclusions reached by independent scientific commissions and agencies that have reviewed this research, such as the American Institute of Biological Sciences, the Virginia Department of Health, the Maryland Department of Natural Resources, and the California Department of Public Health."

Gelmann Rebuttal at 22.

Dr. Richard Bockman addressed the scientific research in the fields of endocrinology and immunology. Dr. Bockman is a medical doctor specializing in endocrinology and immunology. He also holds a Ph.D. in biochemistry. He is

Professor of Medicine at Cornell University Medical College and Head of the Endocrine Service and the Endocrine Bone Service at Cornell Medical School's Hospital for Special Surgery, where he conducts endocrine research. PECO Rebuttal Statement No. 1 ("Bockman Rebuttal") at 1-2.

Dr. Bockman reviewed a broad range of research on the endocrine and immune systems. With regard to the endocrine system, that review encompassed research on the neuroendocrine system, including perception events, neurochemicals, and calcium metabolism, as well as research on endocrine gland function, biological rhythms, and reproduction and development. With regard to the immune system, Dr. Bockman reviewed research on endocrine-regulated immune functions, as well as in vitro (cells in glass dishes) and in vivo (live animal) research on the immune system. Dr. Bockman provided his evaluation of that body of research:

"My overall conclusion is that there is no basis to conclude that power frequency electric and/or magnetic fields have adverse effects on the health and function of the endocrine or immune systems."

Bockman Rebuttal at 27.

Dr. Philip Cole addressed the EMF research in the area of epidemiology. Dr. Cole is a medical doctor who also holds a doctorate in Public Health. Dr. Cole is Professor and Chairman of Epidemiology at the School of Public Health at the University of Alabama at Birmingham, and the Associate Director for Epidemiology at the Comprehensive Cancer Center at the University. Dr. Cole has provided epidemiologic assistance to agencies such as the International Agency for Cancer Research, and has received prestigious international honors, such as the Grand Prix Lacassagne from the French Cancer Society, for his epidemiological research. In his 25 years as a cancer epidemiologist, Dr. Cole has published over 130 papers reporting the results of his own epidemiological research. PECO Rebuttal Statement No. 2 ("Cole Rebuttal") at 1-4.

Dr. Cole reviewed in detail each of the published epidemiological studies on EMF and childhood cancer, exploring the strengths and weaknesses of each. Cole

Rebuttal at 11-18. He concluded that the best-done studies -- and all of the studies with data on actual measured magnetic fields -- do not support a conclusion that exposure to EMF is related to cancer. *Id.* at 18.

Dr. Cole also commented on the recent draft EPA report on EMF and cancer, and noted the severe criticisms of that draft report that have been issued during the ongoing review process. For example, the National Cancer Institute commented with regard to the EPA report that:

"Four staff members, all well-versed in epidemiologic studies, reviewed the above document and written comments are provided. All reviewers agreed that the human epidemiologic data to date do not support the sweeping conclusion made in the EPA document. In our judgment the conclusions presented remain scientifically unsound and unnecessarily alarming."

Cole Rebuttal at 22. Dr. Cole concluded that the EPA report should be "treated as a secondary source that is still in the process of review, and I give it little if any weight in my evaluation of the epidemiologic data." *Id.*

With regard to the entire body of epidemiological research, Dr. Cole concluded that:

"Taken together, the epidemiologic reports fail to demonstrate any strong or consistent pattern of association between EMF and cancer among human beings. Indeed, even among the positive studies, findings are not supported by the internal characteristics of the data. The summation can only be that, to date, there is no demonstrated relationship between EMF and cancer in human beings."

"Since I am of the opinion that EMF's have not been demonstrated to be carcinogenic, I believe that the 230 kV transmission line poses no threat of cancer to persons in its vicinity."

Cole Rebuttal at 28.

In sum, seven witnesses presented evidence on EMF and health. One witness, Dr. Liboff, concluded that EMF has been demonstrated to be a "hazard to humans." No other witness in this proceeding concluded that EMF is a hazard to humans.

SUMMARY OF ARGUMENT

This proceeding generated a substantial record on all potential impacts of energizing the Woodbourne-Heaton line. That record evidence clearly shows that:

- The line meets all applicable safety requirements.
- The design of the line resulted in the lowest magnetic field levels of all available designs.
- The magnetic fields that will be associated with the line are in the same range as those encountered in everyday life.
- Protestants failed to meet their burden of proving that the line will have adverse land use impacts that warrant disapproval of the line.
- Protestants failed to meet their burden of proving that the line will have adverse health impacts that warrant disapproval of the line.
- The line is consistent with the concept of prudent avoidance.

In short, after a full hearing on adverse effect issues, Protestants have not shown that the line fails to meet the Commission's standards for approval. Thus, the Commission should reconfirm its approval of the line.

ARGUMENT

I. The Line Meets the Commission's Safety Regulations

The National Electrical Safety Code is the industry standard for safe operation of transmission facilities. It provides for the safe construction, operation, and maintenance of transmission lines, and protects both the public and those operating and maintaining the transmission line. The safety provisions of the NESC are continuously monitored by 25 independent organizations, including the American National Standards Institute and the Institute of Electrical and Electronics Engineers ("IEEE"). The Commission has adopted the NESC as the standard for safe operation

of transmission lines in Pennsylvania. 52 Pa. Code § 57.26, Oedemann Direct at 8-9.

Mr. Ron Oedemann, who is a Senior Member of IEEE, is PECO's Lead Project Engineer for the Woodbourne-Heaton transmission line. Oedemann Direct at 2-3. Mr. Oedemann supervised the construction of the line. *Id.* at 3. Mr. Oedemann testified that the Woodbourne-Heaton line meets all applicable safety requirements of the NESC. *Id.* at 8-10.

Protestants did not offer any evidence that the line was constructed, or will be operated and maintained, in an unsafe manner.

II. The Data on Magnetic Field Levels Demonstrate That the Line Should Be Energized

A. The Compact Delta Design Used by PECO Results in the Lowest Field Levels of the Available Designs

Commissioner Rhodes, in a June 14, 1991 statement, requested "discussion of the line design employed and whether mitigation of EMF has been maximized by the Company's efforts."

The line employs a design known as the "compact delta" configuration. Oedemann Direct at 6. There are three other conventional designs that are used for 230 kV transmission lines: flat, vertical and longer-span delta. *Id.* at 11, T.S. at 57.

Mr. Boeggeman presented detailed data on the electric fields and magnetic fields that would be associated with each of these designs. PECO Exhibit No. 2, Tables 3 and 4. His calculations demonstrated that the "compact delta" configuration resulted in the lowest fields. Boeggeman Direct at 12-13.

Protestants did not offer any evidence that any technically feasible line design could have resulted in lower field levels than those from the compact delta design.

B. The Magnetic Fields From the Line Are in the Same Range as Typical Transmission Line Fields and Are Similar to Those Encountered in Everyday Life

Mr. J. Michael Silva presented information on the sources and range of

magnetic fields that are encountered in everyday life. Based on information from his published studies of magnetic field measurements, Mr. Silva demonstrated that magnetic fields from appliance use range as high as hundreds of milligauss. Exh. JMS-2. Actual magnetic field measurements at various public locations in Langhorne and Philadelphia demonstrated magnetic fields in the range of 1-760 mG. Silva Rebuttal at 14, Exh. JMS-3, Exh. JMS-4.

Mr. Boeggeman presented the results of calculations on the fields that will be associated with the line. For the "loading" conditions that will exist for over 90% of the time, magnetic fields at the edge of the right-of-way will not exceed 26 mG, and will be substantially less than that at distances further from the line. Boeggeman Direct at 6-9. The highest magnetic field level, which would occur only in an emergency situation for four hours per year, if at all, will not exceed 71 mG at the edge of the right-of way. *Id.* at 9.

Mr. Silva summarized his conclusions regarding the magnetic fields from the Woodbourne-Heaton line:

"In comparison to other, similar transmission lines, there is nothing unique or unusual about the fields associated with the Woodbourne-Heaton 230 kV transmission line. The electric and magnetic fields that will be associated with the Woodbourne-Heaton line are in the same range as levels from other similar 230 kV lines. The magnetic field levels associated with the 230 kV line are within the range that people routinely encounter in everyday life from a variety of sources."

Silva Rebuttal at 19.

III. Protestants Did Not Meet Their Burden of Proving That the Line Will Cause Adverse Land Use Impacts Sufficient to Warrant Disapproval of the Line

A. Mr. Turner's Land Use Study Is Flawed and Provides No Reasonable Basis for Reaching Any Conclusions Regarding Land Use

Protestants' witness Mr. Turner asserted that energizing the Woodbourne-Heaton line will result in adverse land use impacts.

Mr. Turner testified that the "continued urbanization" in the area near the

line was an "essential basis" for his conclusion that the line will have adverse land use impacts, T.S. at 521, and that the question of how much urbanization had occurred near the line is a "significant factor" in determining whether to energize the line. Turner Statement at 1. Yet Mr. Turner did not even analyze the area immediately adjacent to the line to determine whether it is urbanized. T.S. at 547, 552, 554-55. Instead, he analyzed urbanization patterns solely for entire townships adjacent to the line, and as a result based his recommendations on data for geographic areas as far distant from the Woodbourne-Heaton line as 4.5 miles away. T.S. at 546.

Mr. Van Dyke analyzed urbanization patterns in the regional area reviewed by Mr. Turner. Van Dyke Rebuttal at 4, Exh. CVD-2. In addition, he conducted a detailed analysis of urbanization in the areas immediately adjacent to the Woodbourne-Heaton line, in the course of which he reviewed aerial photographs of the entire length of the line and individually all land uses within 400 feet on either side of the right-of-way (the Corridor Study Area). Van Dyke Rebuttal at 9-10, Exh. CVD-8. He then analyzed the natural features, existing zoning, and existing land uses in the Corridor Study Area to determine how much additional urbanization and population growth could occur if the CSA became fully developed. *Id.* at 11. Based on that detailed analysis, he concluded that the area near the line "is not generally categorized as a high density urban area, nor is it expected to reach that categorization even if the CSA becomes fully developed." Van Dyke Rebuttal at 11.

Mr. Turner's analysis dealt with only one issue -- the land use implications of EMF that will be associated with the Woodbourne-Heaton line. Turner Statement at 5. Yet Mr. Turner did not even know the field levels that will be associated with the Woodbourne-Heaton line. T.S. at 548.

Mr. Turner did not even review the land uses for the full length of the line. Mr. Turner only examined a portion along the center of the right-of-way covered by four Delaware Valley Regional Planning Commission ("DVRPC") aerial

photographs. T.S. at 1252. As Mr. Van Dyke testified, an analysis of the entire length of the line requires use of 14 DVRPC aerial photographs. T.S. at 1251.

Mr. Turner testified that he expects "off-site impacts" of EMF to increasingly fall under local jurisdiction. Turner Statement at 4. He stated that EMF from the line will conflict with local zoning. *Id.* at 4. And he stated that this analysis was "an essential part" of his conclusion that the line will have adverse impacts on zoning and land uses. T.S. at 520. Yet Mr. Turner admitted that he was not aware of any existing conflicts with zoning ordinances. T.S. at 613. Nor did he identify any zoning in the area immediately adjacent to the line with which the line "conflicts."

Mr. Van Dyke, on the other hand, conducted a detailed evaluation of zoning in the Corridor Study Area immediately adjacent for the entire length of the line. Van Dyke Rebuttal at 8-10, Exh. CVD-7. He testified that the existing zoning in the Corridor Study Area was developed while the right-of-way contained an energized transmission line and an operating freight railway. Van Dyke Rebuttal 12. He stated that the zoning adjacent to the line does not conflict with a linear utility use such as a transmission line. *Id.* And he concluded that continued use of the right-of-way for that purpose will not have any adverse effect on zoning or associated land uses. *Id.*

Mr. Turner's land use "study" was in several fundamental ways flawed and imprecise. Consequently, it provides no reasonable basis for reaching any conclusions about land use impacts of energizing the Woodbourne-Heaton line.

B. Protestants Did Not Prove that the Line Will Cause Decreased Property Values

Mr. Turner was the only witness who claimed that energizing the line will cause a decrease in property values. Mr. Turner is not an appraiser, real estate agent, or real estate broker. T.S. at 560. He has not conducted any appraisal to determine whether market values are lowered after energization of an existing, de-energized transmission line. T.S. at 560. In fact, he had no market data of any sort related to the geographic area near the Woodbourne-Heaton line. T.S. at 560.

Instead, Mr. Turner based his opinion that property values will decrease on interviews with some of the Protestants in this proceeding. T.S. at 567. It can be assumed that the Protestants told Mr. Turner that they were concerned over whether market devaluation would occur. Indeed, Protestants already had testified at length about that issue. *See e.g.* T.S. at 280. During that testimony, Mr. Sugarman assured the ALJ that Protestants' testimony was not being offered to prove the fact of devaluation. T.S. at 190-191. That testimony does not gain probative value on that issue by being told to Mr. Turner, rather than directly to the Commission.

Mr. Turner also spoke to some local real estate agents, in what he candidly referred to as a "non-scientific" survey. T.S. at 568. Mr. Turner indicated that he often relies upon such interviews, but his practice in that regard does not alter the fundamental nature of this information: secondhand impressions of information that in the first instance was not collected in any systematic, scientific manner.

Moreover, the fact that some people told Mr. Turner that they are concerned about property values does not establish that property values will actually decrease. As Mr. Van Dyke explained:

"Virtually every residential area contains some feature that will dissuade some prospective purchasers. For example, lack of proximity to schooling, or close proximity to a commercial use, might have that effect. Some prospective purchasers in the Corridor Study Area may consider the EMF issue, among many other issues, in deciding whether to purchase in the area. This does not suggest, however, that the market or the market value will be affected, but rather only that the issue might be considered. . . . [M]y analysis of this region does not reveal any impacts on land use, zoning, or property values that would suggest that such consideration of the EMF issue, if it is occurring, has had any effect on these land use factors."

Van Dyke Rebuttal at 15.

Mr. Turner also read some articles from journals, magazines, and newspapers. T.S. at 571-79. For example, he relied upon one paragraph from an article in *Fortune* magazine about one real estate agent in Houston who had reported a decrease in property values. T.S. at 572-73. None of the articles, however,

contained information about this transmission line or about this geographic area. T.S. at 571-79. Mr. Turner was unable to state that these articles contained information about the market effects of energizing an existing, de-energized transmission line on a utility right-of-way. E.g., T.S. at 573. And the studies relied upon by Mr. Turner actually concluded that transmission line construction does not affect property values. T.S. at 571, 574, 576, 577, 579.

Mr. Van Dyke addressed Mr. Turner's claims about property values. Mr. Van Dyke conducted a detailed evaluation of the actual land uses in the Corridor Study Area and determined that the residential units in that area were developed in the context of the existing utility corridor, which until 1986 included an active transmission facility, and which still contains a highly intrusive high-speed freight railway. Van Dyke Rebuttal at 13-14. He concluded that: "Past and current market valuations for property in the CSA therefore already include market effects for proximity to a utility corridor." *Id.*

Mr. Van Dyke also evaluated all utility uses, including transmission lines, in the immediate region, to determine whether those existing utility functions had an effect on property values, land use, or zoning. *Id.* His evaluation "did not reveal any adverse effects." *Id.*

In sum, Mr. Turner's property value opinion was based on some articles he read – articles that demonstrate that property values are not affected by proximity to transmission lines – and some conversations with people, including the Protestants in this case. Mr. Van Dyke, however, conducted an analysis of actual land use patterns and property values in the Corridor Study Area and in a 60-square mile area around the line and found that such decreased property values simply do not occur near utility facilities in the area.

C Protestants' Witness Mr. Turner Only Speculated as to Whether the Line Will Cause Adverse Land Use Effects

Mr. Turner claimed that the line will have adverse land use impacts: "In summary, until the uncertainty and differences of opinion are settled, there is a high probability that values will decline, disinvestment will occur and changes in land use, which are contrary to local policy and zoning, will result in the areas immediately adjacent to the transmission lines." Turner Statement at 6.

The first step in Mr. Turner's opinion is that "there is a high probability that values will decline." Mr. Turner had no market data to support that opinion. T.S. at 560. He did not report any analysis of property values near utility functions in this area. And as already demonstrated, the support he did rely upon provided no basis for such a conclusion.

The next step in Mr. Turner's opinion is that "disinvestment will occur." "Disinvestment" refers to a situation in which one feels compelled by circumstance to sell property at a loss. T.S. at 561. "Disinvestment," of course, only exists if property values decrease. In addition, Mr. Turner's statement is merely a general description of the phenomenon of disinvestment. He provided no support for his conclusion that disinvestment will occur near this line.

The next step in Mr. Turner's opinion is that "changes in land use . . . will result in the areas immediately adjacent to the transmission line" from the alleged disinvestment. Yet Mr. Turner had not even conducted an analysis of land uses near the line. E.g., T.S. at 547, 542.

Mr. Turner concluded that these alleged changes would be "contrary to local policy and zoning." Yet Mr. Turner admitted that there was no existing policy or zoning on EMF. T.S. at 624. And Mr. Turner was quite clear as to the nature of his opinion that local zoning could someday conflict with the line:

"Let me be very precise. . . . I speculate that you could have an unusual circumstance . . . where the areas within the rights-of-way are regulated by the PUC and the external effects would be regulated by the adjacent and surrounding communities."

T.S. at 624-25. (emphasis added.)

In short, Mr. Turner provided no data, studies, information or other support for his conclusion that disinvestment would occur after energization of the line. He provided no support for the proposition that, if some disinvestment were to occur, it would be of sufficient magnitude to cause changes in the local land use patterns. He "speculated" that if such changes did occur they would be in conflict with some not-yet-enacted zoning. He did not even suggest that, if such conflicts were to occur, they would be adverse. In short, Mr. Turner's conclusion was reached by piling one speculation on top of another until he reached dizzying heights.

Mr. Van Dyke, however, conducted a detailed analysis of land uses and zoning in the Corridor Study Area. He analyzed land use patterns, zoning, and property values adjacent to utility functions in the region. And he concluded based on that detailed analysis that proximity to utility functions has not adversely affected land uses in the region, and will not adversely affect land uses near the Woodbourne-Heaton line. Van Dyke Rebuttal at 5, 11-15.

D. Protestants Did Not Prove that the Line Will be a Nuisance or that Such a Conclusion Would be Sufficient to Warrant Disapproval of the Line

Mr. Turner claimed that this transmission line should be termed a "nuisance." Mr. Turner defined nuisance to mean "a use of property or course of conduct that interferes with the legal rights of others by causing damage, annoyance and inconvenience." T.S. at 610. Mr. Turner testified, however, that he was "absolutely not" using the word nuisance in its legal sense. T.S. 700. In fact, under Pennsylvania law a government regulated and approved public facility cannot constitute a public nuisance, as long as it is operated within the terms of its authorization. See Borough of Collegeville v. Philadelphia Suburban Water Co., 377 Pa. 636, 105 A. 2d 722 (Pa. Supreme Ct. 1954).

One basis for Mr. Turner's "nuisance" conclusion was interviews he had with the Protestants in this proceeding. T.S. at 611. It is not surprising that Protestants

would tell Mr. Turner that they believe that the line will cause them damage, annoyance, or inconvenience. That information, however, is merely a restatement of their pleadings in this proceeding, in which they have asked the Commission to evaluate whether those concerns justify delaying the line. It is not entitled to any weight as proof that Protestants will be adversely affected by energizing the line.

The second basis for Mr. Turner's "nuisance" conclusion was some articles he read. T.S. at 611. The articles that Mr. Turner relied upon to conclude that the line will be a nuisance are the same articles that he relied upon for his conclusion that the line will decrease property values. Compare T.S. at 612 with T.S. at 571-79. Those articles, however, demonstrated that property values are not affected by transmission lines. T.S. at 571-79. And, as discussed in the previous section of this brief, the full record in this case demonstrates that the line will not decrease property values. The articles that Mr. Turner read thus provide no support for terming the line a "nuisance."

The final basis for Mr. Turner's "nuisance" conclusion was a proposed local zoning ordinance that Mr. Turner said would term EMF a nuisance. T.S. at 612. Mr. Turner made it clear that he is not aware of any existing zoning ordinances that termed EMF a nuisance. T.S. at 613. And it would be irrelevant if he had done so. Electric transmission lines are not subject to local zoning ordinances, Upper St. Clair v. Delaware and Hudson Railway Company, 19 Pa. Commonwealth Ct. 59, 339 A. 2d 155 (1975), and the Commission has specifically ruled that such is the case for this line. March 6 Order at 10.

In short, Mr. Turner had no reasonable basis for terming the Woodbourne-Heaton line a "nuisance." And given Mr. Van Dyke's conclusions that the line will not adversely effect property values or existing or future land uses or zoning, Van Dyke Rebuttal at 15, it is clear that energizing the line will not result in any adverse land use impacts that could support such a characterization.

IV. Protestants Did Not Meet Their Burden of Proving That the Line Will Cause Adverse Health Impacts Sufficient to Warrant Disapproval of the Line

Only one witness in this proceeding -- Dr. Liboff -- claimed that exposure to EMF from the Woodbourne-Heaton line will cause adverse human health effects.

A. No Witness Claimed That Electric Fields Are a Hazard to Humans

It was uncontested that electric fields from the line will not cause any adverse human health effects. E.g. Bockman Rebuttal at 25 (immune system), *id.* at 27 (endocrine system), Gelmannn Rebuttal at 22 (carcinogenesis). In fact, the only witness who claimed that power frequency fields from the Woodbourne-Heaton line will cause adverse human health effects -- Dr. Liboff -- specifically excluded electric fields from the scope of that opinion, stating that he did not take a position one way or another as to whether electric fields are hazardous to humans. T.S. at 835.

B. Dr. Liboff Based His Recommendation Against Energizing the Line on Incorrect Information About the Magnetic Field Levels From the Line

On redirect examination, Dr. Liboff was asked the basis for recommending that the line should not be energized. He responded:

"I've looked at the calculations on the magnetic fields at the edge of the right of way, and I conclude that even under a moderate load the magnetic field is just surprisingly high."

"And I've been asked a number of times to come and get involved in situations like this where a line is either under consideration, or other aspects of the line, and I don't believe I've ever seen a case where I believe the numbers I saw were, at the edge of the right of way, something like 50, 60 mG. They're very, very high."

T.S. at 918.

Dr. Liboff was simply incorrect. Under normal loading conditions, the magnetic fields at the edge of the right-of-way will not exceed 26 mG. Boeggeman Direct at 8, PECO Exh. 2 at 6-9. The 50-60 mG magnetic field levels that Dr. Liboff

referred to will be associated with an emergency loading condition that is expected to exist for a maximum of four hours per year, if at all. Boeggeman Direct at 9; PECO Exhibit 2 at 6-9. And those magnetic field levels are not "very, very high." As Mr. Silva testified: "The magnetic fields that will be associated with the Woodbourne-Heaton line are in the same range as levels from other similar 230 kV lines." Silva Rebuttal at 19.

In sum, Dr. Liboff's recommendation against energizing the Woodbourne-Heaton line was simply based on incorrect information regarding the size and comparative strength of the magnetic fields from the line.

C Dr. Liboff Based His Opinion on Inapplicable Pulsed Field and Microwave Studies

Dr. Liboff stated that one basis for his "hazard" opinion was laboratory research showing "altered cell responses" -- although he was quite clear that these studies, by themselves, cannot establish a health hazard. T.S. at 845. Rather, according to Dr. Liboff, these studies provide a reason for believing that the epidemiological results prove a hazard, because there is a "common thread" between the bodies of research -- power frequency fields. Liboff Statement at 4.

Careful review of the research relied upon by Dr. Liboff demonstrates that no such "common thread" exists. As Dr. Murray Rosenberg the medical doctor and biophysicist explained, pulsed fields and microwaves are very different from the power frequency fields that will be associated with the Woodbourne-Heaton line, and "it is inappropriate to attempt to draw conclusions about power frequency fields" from studies using those microwaves or pulsed fields. Rosenberg Rebuttal at 16. Even Dr. Liboff admitted that it would be "premature" to say that pulsed fields and sinusoidal fields interact with biological tissue in the same way. T.S. at 775-76

Yet, in reaching his conclusions Dr. Liboff relied upon numerous studies that used fields different from those that will be associated with the line. E.g., "bone healing" studies (pulsed), Gelmann Rebuttal at 19; Takahashi on DNA synthesis

(pulsed), T.S. at 807; Delgado and Leal's chick embryo studies (pulsed), Bockman Rebuttal at 19; the "Henhouse" studies (pulsed), T.S. at 826-27; calcium "efflux" (microwaves) Gelmann Rebuttal at 12.

In short, Dr. Liboff's opinion of a health "hazard" was based on studies that have nothing to do with the fields that will be associated with the line.

D. Science Has Not Established That a Mechanism of Interaction Exists Between Magnetic Fields and Biological Tissue

The record in this proceeding was uncontested -- no mechanism of interaction between magnetic fields and biological tissue has been established. Dr. Murray Rosenberg, who is a medical doctor and biophysicist, stated that the models for such mechanisms are "highly speculative at best." Rosenberg Rebuttal at 21. Mr. Janes stated that the models that have been offered to explain a mechanism are "speculative." Janes Statement at 9. Even Dr. Liboff, while stressing that his comment must be kept in context, T.S. at 781, unmistakeably said:

"The power input of these signals is simply too small to invoke any conceivable mechanism."

Liboff Statement at 1-2. In fact, it is this lack of an explanatory mechanism that has motivated Dr. Liboff to conduct his ongoing quest to find a mechanism. T.S. at 781.

Dr. Liboff is convinced that a mechanism will someday be found -- and he thinks that his "ion cyclotron resonance" ("ICR") hypothesis will provide that mechanism. Dr. Liboff's ICR hypothesis deals with the question of how certain biological "ions" move through channels in cell membranes, and whether that process can be affected by magnetic fields. Rosenberg Rebuttal at 17. Dr. Liboff candidly admitted that ICR is a "wild" and "radical" idea. T.S. at 784-85. And he admitted that ICR is just an hypothesis -- that is, an idea to be experimentally and theoretically tested. T.S. at 780, 783-84.

There already have been numerous attempts to establish ICR through experiments. Liboff Statement at 5-6, T.S. at 785-789, 906-914. Dr. Murray Rosenberg,

the medical doctor and biophysicist who appeared on behalf of PECO, explained that this extensive body of experiments has failed to establish that ICR actually occurs in biological tissue:

"The body of experiments, when viewed as a whole, has not proven that the ICR hypothesis is valid. Many of the attempts by researchers outside of Dr. Liboff's group to experimentally confirm his results have been unsuccessful. (E.g., Parkinson 1989, Carstensen 1987). In one of the sets of experiments that have been conducted by researchers outside of Dr. Liboff's group -- the calcium efflux experiments -- the researchers have found contradictory results, with one group reporting an increase in calcium efflux, another group reporting a decrease in calcium efflux, and a third group reporting no effect at all. (E.g. Bawin and Adey 1976, Blackman 1982). If the hypothesis was correct, other researchers ought to be able to conduct the same experiments and reach the same results, but that has not been the case. As a result, one must conclude that the ICR hypothesis remains unproven."

Rosenberg Rebuttal at 20.

Moreover, Dr. Murray Rosenberg explained that due to physical objections to the ICR hypothesis it is not likely to become established. Rosenberg Rebuttal at 17-20. For example, ions in human cells pass through submicroscopic channels in the cell wall, but for ICR to work, the channels in the cell walls would have to be about 10 feet wide. Rosenberg Rebuttal at 18. Dr. Rosenberg concluded with regard to the theoretical evidence on ICR that:

"[T]he ICR hypothesis must be viewed as merely a speculative attempt to establish a mechanism with very good reasons for believing that this mechanism does not and cannot occur in actual biological tissue."

Rosenberg Rebuttal at 19.

In the absence of such an explanatory mechanism, Protestants cannot claim to have met their burden of proving that the line will cause adverse health impacts sufficient to warrant disapproval of the line. Even Dr. Liboff testified that the ability to explain an "underlying physical interaction" between 60 Hz magnetic fields and human tissue is "of critical importance in not only assessing the potential hazard to the public, but also doing something about it." Liboff Statement at 6. And Dr. Murray Rosenberg concluded with regard to Dr. Liboff's ICR hypothesis: "In my

opinion, the ICR hypothesis has no implications for human health." Rosenberg Rebuttal at 20.

E. Protestants Did Not Prove that EMF From the Line Will Cause Adverse Endocrine Effects

Dr. Liboff claimed that exposure to EMF causes "endocrine changes." Liboff Statement at 5. Dr. Liboff asserted three such endocrine changes: in calcium "efflux," Liboff Statement at 2, in human reproduction and development, Liboff Statement at 4, and in levels of the hormone "melatonin." Liboff Statement at 5.

1. The Calcium "Efflux" Studies Relied Upon by Dr. Liboff Used Microwave Fields, Are Inconsistent, and Have No Implications for Human Health

Dr. Liboff relied on calcium "efflux" research in which the researchers measured the amount of radioactive calcium that is released from slices of chick brain. Liboff Statement at 2, 5, T.S. at 801-03. As discussed above, the calcium efflux studies used modulated microwave fields far different from those that will be associated with the Woodbourne-Heaton line. Dr. Murray Rosenberg, the medical doctor and biophysicist who appeared on behalf of PECO, explained that power frequency fields, such as those from the Woodbourne-Heaton line, "cannot interact with living systems in ways that are similar to microwaves." Rosenberg Rebuttal at 13.

Dr. Richard Bockman addressed Dr. Liboff's claim that exposure to power frequency fields causes adverse calcium effects. Dr. Bockman, who is a medical doctor, was head of the Laboratory for Calcium Metabolism at Memorial Sloan-Kettering Institute for 14 years, and currently spends the majority of his time engaged in clinical and laboratory studies to determine the mechanisms by which the endocrine system regulates calcium. Bockman Rebuttal at 11.

According to Dr. Bockman, due to inconsistent and contradictory results from different laboratories, there is considerable doubt whether the calcium "efflux" effects reported in the "modulated microwave" studies are a real effect of exposure

to those fields. Bockman Rebuttal at 12. *See also* Gelmann Rebuttal at 18, Rosenberg Rebuttal at 20. Dr. Liboff agreed that the results of these studies have been inconsistent, with some studies showing an increase in calcium efflux, others a decrease, and still others no effect at all. T.S. at 764-65. Dr. Liboff did not, however, view the interpretation of such conflicting results as a matter that depended upon scientific analysis of the studies:

"[I]t becomes almost a matter of advocacy as opposed to truth. Because it depends upon what side of the fence you're on. If you're in the camp of those who believe that the original effect is true, then you will normally, very often, claim that the failed attempt at replication is not really replication.

"On the other hand, if you're among those who are trying to argue against an original experiment of some sort, then your experiment, aimed at trying to replicate, quotes, may turn out to be negative. And because of this, this can be used as an argument against the original experiment. . . .

"It's very close to politics."

T.S. at 763.

This cynicism says far more about Dr. Liboff's approach to scientific analysis than it does about the scientific issues involved in this proceeding. Dr. Murray Rosenberg described the approach that should be taken if one is, in fact, interested in the scientific truth:

"In one of the sets of experiments that have been conducted by researchers outside of Dr. Liboff's group -- the calcium efflux experiments -- the researchers have found contradictory results, with one group reporting an increase in calcium efflux, another group reporting a decrease in calcium efflux, and a third group reporting no effect at all. (E.g. Bawin and Adey 1976, Blackman 1982). If the hypothesis was correct, other researchers ought to be able to conduct the same experiments and reach the same results, but that has not been the case."

Rosenberg Rebuttal at 20.

Dr. Bockman explained that calcium has an important role in the endocrine system as a "signal molecule" between the cell and external stimuli. Bockman Rebuttal at 11. According to Dr. Bockman, the important question in assessing the

calcium research is whether changes occur in biologically important calcium. *Id.* Dr. Bockman explained that the calcium "efflux" studies do not measure biologically important calcium and have no implications for human health. Bockman Rebuttal at 12-13. Even Dr. Liboff frankly admitted that he could not make any extrapolation from the calcium "efflux" studies to human health. T.S. at 805.

An extensive body of 60 Hz research, however, looking at key calcium parameters in intact animals and using techniques capable of measuring the flow of individual calcium ions across cell membranes, "indicate that such fields do not affect calcium metabolism in living organisms." Bockman Rebuttal at 12 -13.

Based upon his medical training, his 14 years of experience as head of the Calcium Metabolism Laboratory, and his review of all the relevant literature on calcium metabolism, Dr. Bockman concluded that "there is no indication that 60 Hertz electric and/or magnetic fields modulate cell function or endocrine system function by altering calcium metabolism. *Id.*

2. Dr. Liboff's Opinion That Adverse Effects on Reproduction are a "Possible Area of Concern" Was Based on Pulsed Field Studies and Ignored the Extensive Body of Well-Done 60 Hz Research on Reproduction and Development

Dr. Liboff also asserted that adverse effects on human reproduction are an "area[] of possible concern" from exposure to EMF. Liboff Statement at 4. In reaching this conclusion, Dr. Liboff relied upon one epidemiology study (by Wertheimer and Leeper). Dr. Liboff has no training in epidemiology to assist him in understanding this research. T.S. at 755. Dr. Liboff also relied upon "supporting parallel evidence" from chicken egg and fish egg studies. *Id.* Dr. Liboff has not had training in the medical disciplines relevant to reproduction. T.S. at 755.

Dr. Liboff's claims of adverse human reproductive effects were addressed by Dr. Bockman. Dr. Bockman explained that human reproduction depends upon precise coordination of a sequence of endocrine events. Bockman Rebuttal at 18-19. Dr. Bockman reviewed the research relied upon by Dr. Liboff, as well as a large body

of research on this issue not addressed by Dr. Liboff. Bockman Rebuttal at 18-21.

Dr. Bockman explained that when expert scientific review panels have evaluated the epidemiology study Dr. Liboff relied upon they found it to be subject to "severe criticism on many grounds," and concluded that "the claims of Wertheimer and Leeper . . . do not appear justified." Bockman Rebuttal at 20. More recent and extensive epidemiological work, conducted by researchers at the National Institutes of Health and the American Cancer Society, reported "no increase in the risk" of adverse reproductive effects after exposure to EMF. Bockman Rebuttal at 21.

The "supporting parallel evidence" relied on by Dr. Liboff did not even involve 60 Hz fields like those that will be associated with the Woodbourne-Heaton line -- it used "pulsed fields." T.S. at 826-29. The extensive chick embryo studies that have been conducted using actual 60 Hz fields "found that exposure to power frequency fields did not affect any of the reproduction and development endpoints studied. Bockman Rebuttal at 20.

Dr. Bockman also discussed the extensive animal research that has evaluated whether EMF exposure has adverse reproductive effects. This research has shown no effects on fertility, fecundity, impregnation, fetal weight, fetal malformations, fetal growth, or any of numerous other reproduction and development endpoints studied. Bockman Rebuttal at 19. Dr. Bockman concluded that:

"The issue of EMF effects on reproduction and development has been examined extensively and there is no persuasive scientific evidence that exposure to power frequency fields has any adverse effect on reproduction, development, or related endocrine function."

Bockman Rebuttal at 21.

3. Protestants Did Not Prove That Exposure to Power Frequency Fields Causes Adverse Changes in Melatonin or Human Biological Rhythms

Dr. Liboff also claimed that exposure to EMF can cause changes in the hormone "melatonin." Liboff Statement at 4-5. These putative endocrine changes

were addressed by Dr. Bockman.

Dr. Bockman explained that the melatonin research should be understood as one part of the larger question of whether EMF affects biological rhythms. Bockman Rebuttal at 17. Substantial research has been conducted regarding EMF and major biological rhythms, such as body temperature, eating patterns, sleep/wake cycle, and biologically important hormones. None of these rhythms has been shown to be altered by EMF exposure. *Id.* at 16.

"Melatonin" is a hormone, produced in the pineal gland, that is biologically active in rats and some other animals. Bockman Rebuttal at 17. The EMF melatonin research has primarily involved rats, though a few studies have been done on other species. *Id.* In extrapolating these results to humans, Dr. Liboff assumed that melatonin plays the same role in human physiology as in rat physiology. T.S. at 832. As Dr. Bockman testified, however, that assumption was incorrect: "The pineal gland has no known function in human beings." Bockman Rebuttal at 17.

Dr. Bockman explained that there are no known biologic consequences of the reported changes in melatonin, and that the changes in melatonin cycle are not associated with changes in important biological rhythms. "Consequently, it cannot be said that the rat melatonin stud[ies] provide[] a basis for concluding that power frequency electric or magnetic fields leads to adverse effects on human biologic rhythms." *Id.* at 18.

F. Protestants Did Not Prove that EMF From the Line Will Cause Adverse Immune Effects

Dr. Liboff also discussed a few in vitro studies on lymphocytes, which are a part of the immune system. Liboff Statement at 6. Dr. Liboff did not express an opinion as to whether exposure to EMF adversely effects the immune system, but did claim that this research demonstrates "physiological effects" of exposure to EMF. *Id.*

Dr. Bockman addressed Dr. Liboff's claims regarding immune system effects.

Dr. Bockman studied immunology in Paris with Dr. Bernard Halpern, one of the world's leading immunologists. Bockman Statment at 3. Endocrine function and immune function are closely related, *id.* at 22, and in addition to his endocrinology publications Dr. Bockman has published scientific articles reporting the results of his own research in immunology in such journals as the *Journal of Immunology*, *Clinical Immunology*, and *Immunopathology*. *Id.* at 4.

Dr. Bockman evaluated the body of immune research, including whole animal immune studies which "provide a much more accurate reflection of the functional integrity of the immune system since they involve whole organisms rather than isolated cells deprived of the body's defense mechanisms." *Id.* at 23. Dr. Bockman concluded that these comprehensive animal models indicated no deficit in the immune systems of the animals studied and, based on those studies, that exposure to moderate or even strong electric and magnetic field levels does not adversely affect the host's immune system. Bockman Rebuttal at 25.

G. Protestants Did Not Prove that EMF From The Line Will Cause Cancer

Dr. Liboff also claimed that exposure to EMF is "linked" to cancer. This opinion had three bases: bone healing studies, cellular level research, and epidemiological research. Liboff Statement at 4. As demonstrated in the following sections, Dr. Liboff simply misanalyzed the medical and health implications of this body of research and failed to take into account important research disproving his claims.

1. Dr. Liboff Ignored Molecular Genetics and Cellular Biology Research That Disproves His Cancer Claims

In reaching his conclusion that exposure to EMF is linked to cancer, Dr. Liboff relied upon cellular research. The cellular research was addressed by Dr. Edward Gelmann. Dr. Gelmann is Chief of the Division Medical Oncology at the Vince Lombardi Cancer Center and conducts research on the molecular and cellular

biology of cancer. Gelmann Rebuttal at 1-5, Exh. EGV-1 at 1. Dr. Gelmann explained the molecular and cellular processes that are involved in the process of carcinogenesis:

"The cell is the basic building block of the human body. Cells make up all the systems of the body, including the muscular, skeletal, nervous, and circulatory systems. Within the cell is the nucleus, and within the nucleus are the chromosomes. The chromosomes contain the cell's DNA. DNA encodes the genetic information which provides a blueprint for all inherited characteristics. Genetic information is contained in discrete subunits of the DNA known as genes; for this reason, DNA is called the 'genetic material.'"

"DNA contains the essential information coding for all the cell's structural and functional elements. Change in the DNA molecule, i.e. genetic change, can have serious effects on cell processes and therefore on tissues and organisms. Subtle change in the DNA molecule can be responsible for making a normal cell become a cancer cell. DNA change is associated with all cancers. Cancer cannot occur without permanent changes to the cell's DNA known as 'mutations.'"

Gelmann Rebuttal at 6.

Dr. Gelmann explained that there are standard laboratory tests that are used to evaluate whether an agent affects these molecular and cellular processes. Gelmann Rebuttal at 8-9. Dr. Gelmann then described an extensive body of EMF research from those standard laboratory tests that establishes that:

- Power frequency fields do not cause DNA mutations. Gelmann Rebuttal at 9.
- Power frequency fields do not affect DNA repair processes. *Id.* at 10.
- Power frequency fields do not cause damage to chromosomes. *Id.* at 11.
- Intact animals exposed to power frequency fields do not exhibit abnormalities in functions such as reproduction, growth, or development, that would be affected by genetic change. *Id.* at 14.
- When animals with cancer are exposed to power frequency fields, there is no effect on the development of the tumor. *Id.* at 15.

Dr. Liboff made no mention of any of this research anywhere in his testimony. Nor did he discuss any of the key molecular and cellular processes addressed in this body of research. In short, Dr. Liboff reached his conclusion regarding an EMF/cancer "link" without even mentioning the actual molecular events and cellular events that are involved in the process of carcinogenesis. And he completely ignored the extensive body of research which proves that none of those processes are affected by exposure to power frequency fields.

2. The Cellular and Bone Healing Research Relied Upon by Dr. Liboff Studied Endpoints Unrelated to Carcinogenesis

Dr. Liboff stated that his opinion of an EMF/cancer "link" was based upon his "gradual acceptance" of the epidemiological research. Liboff Statement at 5. Dr. Liboff made it clear, however, that he found the epidemiological research more believable because of the cellular research and the research on bone healing:

"You have the bone therapy, the cell work, and the epi work. And what I have suggested is that since we are talking about weak ELF fields in each case, and since there seems to be evidence in each of these three cases, there very well could be a connection in the three cases.

"If one pursues this concept, then one comes to the conclusion that the epi work is much stronger [than] it appears to be, if you just assume that the epi work exists by itself.

"The fact of the matter . . . is that the epi work is supported by the work in the cells, supported by the work in bone therapy . . . And to me, that's a very strong argument."

T.S. at 895-96.

In fact, however, the cellular research and bone therapy research relied upon by Dr. Liboff does not support a conclusion that EMF is related to cancer. To the contrary, the research relied upon by Dr. Liboff has nothing to do with the processes of carcinogenesis. Dr. Gelmann analyzed each of the cellular level and bone healing studies relied upon by Dr. Liboff, and explained that the processes being studied in each of those studies are not relevant to an examination of carcinogenic potential.

Dr. Gelmann's overall conclusion regarding this cellular research is that:

"[T]here is a body of [EMF] research that examines processes and endpoints unrelated to carcinogenesis. Some of this research has reported that exposure to power frequency fields can cause measurable change in the endpoint studied. . . . [A] careful analysis of the studies demonstrates that, even if the reported results of these studies are valid, they do not indicate that exposure to power frequency fields affects carcinogenesis. The endpoints studied are simply not related to that process."

Gelmann Rebuttal at 21.

3. The Epidemiology Studies on Childhood Cancer Do Not Demonstrate that Exposure to EMF Is Associated with Increased Childhood Cancer

Six epidemiology studies have been published with information relevant to childhood cancer and EMF: Wertheimer & Leeper (1979), Savitz (1987, 1988), Fulton (1980), Tomenius (1986), Myers (1988), and London & Peters (1991). Cole Rebuttal at 12.

Dr. Liboff discussed two of these studies -- Wertheimer and Leeper (1979), and Savitz (1988) -- and concluded that there are "rather obvious correlations" between EMF and childhood cancer. Liboff Statement at 3. Dr. Liboff is not an epidemiologist. T.S. at 863. In fact, he has had no graduate level courses in epidemiology. T.S. at 755.

In stark contrast, Dr. Cole is a medical doctor, a Professor of Epidemiology, and has over 25 years experience designing, conducting, and evaluating epidemiological research. He addressed the two studies relied upon by Dr. Liboff. Wertheimer did not report that exposure to magnetic fields is associated with childhood cancer -- in fact, she did not even collect data on magnetic fields. Instead, she reported higher rates of childhood leukemia in homes near certain types of electric distribution wires. As Dr. Cole explained, the Wertheimer study was the first epidemiology on this issue and, like most exploratory studies, it had limitations. Cole Rebuttal at 12-13.

The Savitz study, on the other hand, is "one of the best done of the published studies on childhood cancer and EMF." Cole Rebuttal at 16. And the Savitz study is "consistent with nullness -- that is, with a lack of effect of exposure to magnetic fields." Cole Rebuttal at 16. Savitz collected data on the "wiring code" and found a few irregular statistically significant associations with childhood cancer. Importantly, Savitz collected data on actual magnetic field levels in the homes and found no association between EMF and childhood cancer. *Id.*

Dr. Cole also reviewed the study by Tomenius (1986). Tomenius reported an inverse trend between measured magnetic fields and cancer, and an inverse trend between distance from electrical installations and childhood cancer. Cole Rebuttal at 15. In short, "increased exposure [to EMF] resulted in lower cancer risk" and the Tomenius study provides no support for the hypothesis that EMF's are related to an increased risk of childhood cancer," and provides some support against that hypothesis. *Id.* Dr. Cole also reviewed the negative studies by Fulton (1980) and Myers (1988). *Id.* at 14.

Finally, Dr. Cole reviewed the recent Peters study. (London and Peters (1991)). The Peters study is the best-done childhood cancer study to date. It contains extensive data on actual measured magnetic fields, and found no association between measured magnetic fields and cancer. *Id.* at 18. Peters also reported a weak association between the wiring code and childhood leukemia. *Id.*

There are two important patterns of results in these studies. First, the childhood cancer studies have consistently shown no increased risk of cancer when actual measured magnetic fields were studied. *Id.* at 19. Second, as the quality of the childhood cancer studies has increased over time, the reported associations with the "wiring code" have become weaker and weaker, "which again suggests that there is no true association between EMF and cancer." *Id.*

In his written surrebuttal testimony, OCA's witness Dr. Rosenbaum disagreed with this last conclusion, claiming that "[t]he Peters study had a higher odds ratio . . . than the Savitz study." Rosenbaum Surrebuttal Statement at 3. Dr. Rosenbaum

also is not an epidemiologist, and admitted that he is not qualified to design or run an epidemiology study. Rosenbaum Rebuttal at 2. He had not carefully studied all of the epidemiology studies on EMF. *Id.* In fact, Dr. Rosenbaum had not even reviewed all the available data from the Savitz study. T.S. at 1396.

Under cross-examination, Dr. Rosenbaum admitted that his conclusion was not based on an "apples and apples" comparison of the data in Peters and Savitz. T.S. at 1421. And he frankly stated that "what I meant was that if you do calculate comparable categories you would probably find that Peters' results were weaker than Savitz's results." T.S. at 1420. When such calculations were actually conducted during cross-examination, it was clear that Peters actually had reported a smaller odds ratios than Savitz. T.S. at 1409, *see also* PECO Cross-Examination Exhibit 5(a).

One epidemiologist, Dr. Cole, testified in this proceeding. He conducted a careful and detailed analysis of all of the available childhood cancer studies. Based upon his 25 years of experience as a cancer epidemiologist, his medical expertise, and his review of the EMF research, Dr. Cole concluded that:

"Looking at the childhood cancer studies as a whole and recognizing the degree of validity of individual studies within that group, I conclude that there is no demonstrated increased risk of childhood cancer when actual electric or magnetic fields were measured. When surrogates such as the wiring code have been used in the childhood studies, the data have shown a pattern of mixed results between weak positive and negative outcomes. This is a pattern of random association in a non-experimental science, not the pattern of cause and effect. Long term time trends of EMF exposure and leukemia in children in this country are not consistent with a cause-effect relationship. Finally, neither theoretical considerations nor animal studies are available to support a cause-effect hypothesis. I conclude that the epidemiologic literature on EMF, when viewed as a whole, provides no persuasive scientific support for the hypothesis that EMF causes cancer in children."

Cole Rebuttal at 20-21.

4. The Epidemiology Studies on Adult Cancer Do Not Demonstrate that Exposure to EMF is Associated with Increased Adult Cancer

Dr. Liboff did not specifically mention any epidemiology studies of adult cancer in his testimony, stating only that his opinion of a human health hazard was based upon "gradual acceptance" of the epidemiology. Liboff Statement at 5.

Dr. Cole discussed more than 40 adult cancer studies. Cole Rebuttal at 23-27. For each study, he reviewed the study design and conduct and considered the strengths of weaknesses of that study design. *Id.* He concluded with regard to the adult cancer studies that:

"The studies involving power frequency electric and/or magnetic fields and cancer show weakly positive to zero or negative associations. The studies that use the most acceptable design consistently have found no association between EMF and cancer. I conclude that this body of studies does not support the hypothesis that EMF is associated with adult cancer, and that the best-designed and conducted studies provide strong support against that hypothesis."

Cole Rebuttal at 28.

5. Dr. Liboff and Dr. Rosenbaum Reviewed Only a Small Portion of the Important Epidemiologic Research

Approximately 50 epidemiology studies have been published which contain data on EMF and cancer. Cole Rebuttal at 10, T.S. at 858. Dr. Cole described the importance of including all of that data in an epidemiologic evaluation:

"Conclusions need to take into account the results of all the relevant studies. It is thus necessary to evaluate not only the strengths and weaknesses of each study on its own merits, but also the strengths and weaknesses of each individual study in the context of the entire body of literature."

"Occasionally, a study is so deficient that that it provides no useful information and can be completely dismissed. More commonly, the analysis of the individual study reveals that it has both strengths and limitations. Some studies are so limited, either in design or in conduct, that they are properly termed "hypothesis-generating" -- that is, they raise a question without providing useful or persuasive information about the answer to that

question. Such studies are given relatively little weight in the overall epidemiologic analysis."

"This is far different from dismissal of the study. An epidemiologic evaluation that did not include analysis of substantially all of the available data would be of questionable utility, and the utility of the evaluation would decrease as larger amounts of data were dismissed or otherwise excluded."

Cole Rebuttal at 9.

Dr. Liboff is not an epidemiologist and did not consider all of the available epidemiologic data in reaching his conclusions. Indeed, he stated that he based his opinions on only 9-10 of the studies, T.S. at 859, of which he had only actually read two or three. T.S. at 660.

Dr. Rosenbaum is not epidemiologist and did not consider all of the available epidemiologic data in reaching his conclusions. He reviewed only approximately 12 of the epidemiology studies in his testimony. Rosenbaum Statement at 3-5. He admitted that he had not actually read some of those studies, such as the Tomenius study. T.S. at 338. And it was clear that he had not reviewed all the data from the Savitz study. T.S. at 1401.

Dr. Cole's qualifications and expertise as an epidemiologist are superb: doctorate degrees in both epidemiology and medicine, 25 years experience as a cancer epidemiologist, more than 130 publications of his own epidemiology research, and international recognition for contributions to the science of epidemiology. Dr. Cole reviewed all of the available epidemiologic data and carefully evaluated the study design, conduct, and results of each study, both individually and within the context of the entire body of research.

Dr. Cole concluded with regard to the entire body of epidemiological research on EMF and cancer that:

"Taken together, the epidemiologic reports fail to demonstrate any strong or consistent pattern of association between EMF and cancer among human beings. Indeed, even among the positive studies, findings are not supported by the internal characteristics of the data. The summation can only be that, to date, there is no demonstrated relationship between EMF and cancer in human beings.

"Since I am of the opinion that EMF's have not been demonstrated to be carcinogenic, I believe that the 230 kV transmission line poses no threat of cancer to persons in its vicinity."

Cole Rebuttal at 28.

Dr. Liboff's opinion that EMF is a "health hazard" was based upon his "gradual acceptance" of the epidemiologic research. Liboff Statement at 5. Yet it is clear that his "acceptance" was uninformed, based upon only a small portion of the research, and incorrect.

V. Protestants Have Not Shown that the Concept of "Prudent Avoidance" Justifies Delay in Energizing the Line

As demonstrated in the previous sections of this brief, Protestants failed to meet their burden of proving that the line will violate the Commission's standards on health or land use. Protestants' witness Mr. Turner, however, also discussed the concept of "prudent avoidance" and recommended that application of prudent avoidance to this line would require delaying energization. Turner Statement at 8. In addition, the OCA's witness Dr. Rosenbaum discussed prudent avoidance and testified that, in his view, PECO should have used more formal evaluation and decision procedures before it made decisions about the line. Rosenbaum Statement at 6-8.

These recommendations should be rejected. As explained below, the design, chosen route, and field levels from the line are consistent with the concept of prudent avoidance. Contrary to Dr. Rosenbaum's assertions, prudent avoidance does not require that any specific steps or timing be followed in reaching such a result. Finally, the recommendations to delay energizing the line are not required by prudent avoidance; to the contrary, they are wholly inconsistent with prudent avoidance.

A. The Line is Consistent With the Concept of Prudent Avoidance

Mr. Silva described the concept of "prudent avoidance":

"Prudent avoidance has been suggested as one possible framework for analyzing exposure to electric and magnetic fields, and for considering actions that might alter exposure to electric and magnetic fields."

"Prudent avoidance. . . is based on the assumption that health effects from exposure to electric and magnetic fields have not been demonstrated. Prudent avoidance is a concept that recognizes that a scientific determination cannot be made that changes in EMF levels will have any effect on health, and thus prudent avoidance advocates only a modest effort in making such changes."

Silva Rebuttal at 15-16.

Mr. Silva testified that an evaluation of prudent avoidance of a transmission line should include the design, chosen route, and field levels of the line. Silva Rebuttal at 16.

1. The Line's Design is Consistent With Prudent Avoidance

The compact delta design that was used for the line resulted in lower field levels than would be associated with other designs. Boeggeman Direct at 12-13. The line design incorporates "phase rolls," which control current imbalance on the line and thus result in lower field levels. Silva Rebuttal at 17. Dr. Rosenberg suggested that one design-related method of implementing prudent avoidance is to increase ground clearances above required levels. Rosenberg Statement at 7. The line incorporates that design feature. Oedemann Direct at 10.

Mr. Silva is an electrical engineer with extensive experience in the design of transmission lines and a leading expert on assessing human exposure to magnetic fields from a variety of sources, including transmission lines. Silva Rebuttal at 1-7. Mr. Silva evaluated the design features of the line and concluded that:

"The design for this 230 kV project is a compact delta (or triangular) configuration. This type of line configuration is known to produce fields that are generally lower than other typical configurations. As discussed in Mr. Boeggeman's testimony in this proceeding, use of other design configurations for the Woodbourne-Heaton line would result in comparable or higher fields than those associated with the compact delta configuration. Also, the phase transpositions (rolls) used to mitigate induction effects on the railroad tracks and signal equipment will result in more balanced (equal) phase currents (little or no net current), thereby producing lower magnetic fields as a function of distance due to almost equal cancellation of the balanced phase currents. These design considerations result in lower field levels at modest effort, and are consistent with the concept of prudent avoidance."

Silva Rebuttal at 16.

No witness in this proceeding challenged that the compact delta design will result in the lowest field levels of the available designs. To the contrary, Dr. Rosenbaum testified that he had carefully checked PECO's calculations, and that they are correct. T.S. at 351. Moreover, Dr. Rosenbaum agreed that if one designs a line that achieves lowered fields at modest costs -- as the Woodbourne-Heaton line does -- that result is consistent with the concept of prudent avoidance. T.S. at 315-16.

2. Use of the Existing Conrail Utility Corridor as the Route for the Line is Consistent with the Concept of Prudent Avoidance

Both Mr. Turner and Dr. Rosenberg suggested that one method of implementing prudent avoidance is to avoid routing through "heavily populated areas." T.S. at 557, Rosenberg Statement at 7.

Mr. Van Dyke analyzed the population and urbanization in a corridor 400 feet on either side of the line and demonstrated that the Woodbourne-Heaton line was not routed through a "heavily populated area": "[T]he Corridor Study Area is not generally categorized as a high density urban area, nor is it expected to reach that categorization even if the CSA becomes fully developed." Van Dyke Rebuttal at 11. Moreover, Mr. Van Dyke explained that the relatively low population density in the Corridor Study Area exists because the land uses and zoning in the corridor were

developed in the immediate context of an existing utility corridor. *Id.* at 12-15. The use of this existing utility corridor as the route for the Woodbourne-Heaton line thus resulted in avoidance of heavily populated areas -- a result that both Mr. Turner and Dr. Rosenbaum recognized as consistent with the concept of prudent avoidance.

Mr. Silva also addressed the prudent avoidance aspects of using the common corridor for the line, testifying that for this line it allowed use of a near-linear route between the substations, avoided the creation of a new utility corridor, and allowed use of the favorable compact delta configuration on the existing transmission line poles. Mr. Silva concluded that: "Taking these factors into consideration, I view the routing of this transmission line as consistent with the concept of prudent avoidance." Silva Rebuttal at 17.

3. The Field Levels Associated With the Line are Consistent With Prudent Avoidance

Mr. Silva also described an approach to prudent avoidance known as the "similarity-based" approach:

"[T]he concept of prudent avoidance incorporates the assumption that we do not know which aspect of exposure, if any, is important in discussions of EMF and health. One approach to prudent avoidance, known as the "similarity-based" approach, recognizes this assumption by suggesting that EMF from transmission lines be similar to the levels from other transmission lines. This approach was used in developing the field standards in New York State and Florida, for example."

"The fields that will be associated with the Woodbourne-Heaton 230 kV project are not materially different from other 230 kV transmission lines already in operation in Pennsylvania and throughout the United States. The fields that will be associated the Woodbourne-Heaton line also are lower than the New York and Florida standards. These feature are consistent with the similarity-based approach to prudent avoidance."

Silva Rebuttal at 18.

It is noteworthy that Mr. Turner testified that, if a transmission line were to

meet generally agreed upon magnetic field standards, it would be consistent with prudent avoidance to route that transmission line through heavily populated areas. T.S. at 640. Mr. Turner thus recognized that meeting the similarity-based approach to prudent avoidance is sufficient, without further action, to be consistent with prudent avoidance.

The fields that will be associated with the Woodbourne-Heaton line are lower than the only existing magnetic field standards, which were adopted in New York and Florida. Silva Rebuttal at 18. It is thus clear that the field levels from the line alone are sufficient to make the line consistent with the concept of prudent avoidance.

B. The Concept of Prudent Avoidance Does Not Require That Specific Decision-Making Procedures Be Followed

Dr. Rosenberg testified that in his view a critical aspect of prudent avoidance is that costs and effects of alternative routes and designs be formally considered before construction decisions are made. Rosenberg Statement at 7.

As Mr. Oedemann testified, PECO did consider alternative routes and designs for the Woodbourne-Heaton line before making its construction decisions. T.S. at 11, 19-20, 31. The chosen route along the existing utility corridor described a near-linear route between the substations, did not require acquisition and creation of new utility right-of-way, allowed use of the existing transmission poles from the Conrail 138 kV line, and was consistent with the Commission's past approvals of the common corridor approach. *See e.g., In re Philadelphia Electric Company*, 57 Pa. PUC 161 (1983). In short, it was "obvious." T.S. at 31. Similarly, the compact delta configuration was chosen without a formal evaluation because it allowed use of the existing Conrail structures and, due to the compactness of the design, could be predicted to result in low field levels. T.S. at 20. Mr. Oedemann testified that both the route and design were considered prior to making construction decisions and that in his professional judgment at the time these choices would have the

advantages of lower cost and lower fields. T.S. at 11, 19-20, 31.

Moreover, the formal calculations requested by the OCA have shown that Mr. Oedemann's professional opinion was correct: the chosen route and design do result in the lowest fields and lowest costs. Oedemann Direct at 13, Boeggeman Direct at 12-13. In Dr. Rosenberg's view, however, this result of achieving lower fields is somehow unacceptable because PECO did not follow a specific procedure involving calculations of costs and effects before it completed its construction decisions. Rosenberg Statement at 7.

This is far too formalistic a view of prudent avoidance. Prudent avoidance suggests only that modest efforts be made to reduce fields; it does not require that a specific procedure be followed. As Mr. Silva explained:

"The concept of prudent avoidance is a general framework that has not been codified. It suggests modest efforts to reduce field exposure, and should be understood to be oriented toward that result, rather than toward any required method of achieving that result. The question of what is "modest" will vary depending upon the specific project. Where, as here, the design and routing of the transmission line result in lower fields at modest cost consistent with prudent avoidance, the concept of prudent avoidance does not require that any specific decisional or temporal process must be followed in achieving that result.

Silva Rebuttal at 18.

The Commission can also find guidance on this issue in the decision of the Maryland Public Service Commission in its May 1, 1990 decision with regard to Potomac Electric Power Company's ("PEPCO") application for approval to construct a 500 kV line in Montgomery and Howard counties in Maryland. ("Brighton-High Ridge Decision." Copy of decision attached.)

The PEPCO proceeding involved a line that had been designed and routed before publication of the concept of prudent avoidance in the May, 1989 Office of Technology Assessment Report. The Maryland Commission was nonetheless asked to determine whether the line was consistent with the concept of prudent avoidance. The Commission concluded that the transmission line was consistent with prudent avoidance:

"The record reveals that the Brighton-High Ridge line will have ground clearances that exceed the NESC requirements; employ larger conductors than is required for the load; have reverse phasing in the area of concern to [landowners]; use steel poles for the 500 kV line; and that the field levels emanating from the line are generally less than the levels from other transmission lines operating throughout the country. Thus, the transmission line will be constructed in a fashion that will mitigate the fields emanating from it. . . . [W]e believe that the extra measures taken by PEPCO to reduce the magnetic/electric fields are consistent with the theory of 'prudent avoidance.'"

Brighton-High Ridge Decision at 17-18 (emphasis added).

The Maryland Commission found the line to be consistent with prudent avoidance because, like the Woodbourne-Heaton line, the line incorporated design features that resulted in lower fields and because, like the Woodbourne-Heaton line, the fields from the line met the "similarity-based" approach to prudent avoidance. As the Commission stated: "[T]he transmission line will be constructed in a fashion that will mitigate the fields emanating from it." The key to prudent avoidance is the result obtained, not the process by which it is obtained. And it is uncontested in this proceeding that PECO did consider alternatives before making construction decisions about the line, that the design and route of the Woodbourne-Heaton line result in lower fields, and that the fields from the line meet the similarities-based approach to prudent avoidance.

C. Delaying Energization of the Woodbourne-Heaton Line Would Be Inconsistent With Prudent Avoidance and is Not Warranted by The Evidence Before the Commission

Mr. Turner, appearing on behalf of the Protestants, claimed that "the prudent avoidance approach would delay energizing of the line." Turner Statement at 8. Dr. Liboff, appearing on behalf of the Protestants, claimed that delay is justified by a "health hazard." T.S. at 918.

Prudent avoidance does not require a delay in energization. As Mr. Silva explained:

"Prudent avoidance is a concept that allows us to act and move forward while research continues. The authors of the OTA Report have consistently stated that prudent avoidance is designed to help guide action given the current state of scientific knowledge. Delaying projects because of the current state of scientific knowledge thus runs contrary to the basic assumptions of prudent avoidance. To my knowledge, no utility regulatory commission that has evaluated the concept of prudent avoidance has concluded that it requires waiting for further research results."

Silva Rebuttal at 19.

The record evidence is quite clear in this proceeding. The design of the line results in the lowest fields of available designs. The fields from the line meet existing magnetic field standards. And Protestants have not met their burden of proving that energizing the Woodbourne-Heaton line will cause adverse health or land use effects sufficient to warrant disapproval of the line. There is no justification for delaying energization of the line or for otherwise altering the Commission's approval of the line.

VI. Conclusion

Protestants have not met their burden of proving that the Woodbourne-Heaton line will cause adverse health or land use impacts sufficient to warrant disapproval of the line. The line is consistent with the concept of prudent avoidance, and Protestants have not provided any justification for delaying the energization of the line. The Commission should adopt the following proposed Findings of Facts and Conclusions of Law and issue an Order reconfirming its approval of PECO's Letter of Notification for the Woodbourne-Heaton line.

"The record reveals that the Brighton-High Ridge line will have ground clearances that exceed the NESC requirements; employ larger conductors than is required for the load; have reverse phasing in the area of concern to [landowners]; use steel poles for the 500 kV line; and that the field levels emanating from the line are generally less than the levels from other transmission lines operating throughout the country. Thus, the transmission line will be constructed in a fashion that will mitigate the fields emanating from it. . . . [W]e believe that the extra measures taken by PEPCO to reduce the magnetic/electric fields are consistent with the theory of 'prudent avoidance.'"

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Proposed Findings of Fact

1. The compact delta design used for the Woodbourne-Heaton 230 kV transmission line will result in the lowest levels of 60 Hz electric and magnetic fields levels that could be achieved on the existing right-of-way using technologically available designs for 230 kV transmission lines. PECO Direct Statement No. 2 at 12-13.
2. The Woodbourne-Heaton 230 kV transmission line meets all applicable provisions of the National Electrical Safety Code. PECO Direct Statement No. 1 at 8-11.
3. It has not been shown that reconductoring and/or energizing the Woodbourne-Heaton 230 kV transmission line will cause decreased property values. PECO Rebuttal Statement No. 5 at 13-15.
4. It has not been shown that reconductoring and/or energizing the Woodbourne-Heaton 230 kV transmission line will cause adverse land use impacts. PECO Rebuttal Statement No. 5 at 11-15.
5. It has not been shown that the electric fields associated with reconductoring and energizing the Woodbourne-Heaton 230 kV transmission line will cause adverse human health effects. PECO Rebuttal Statement 1 at 26, PECO Rebuttal Statement 2 at 28, PECO Rebuttal Statement 3 at 21, PECO Rebuttal Statement 4 at 20, OCA Rebuttal Statement 1 at 10, OCA Rebuttal Statement 2 at 5-6, T.S. at 835.
6. It has not been shown that the magnetic fields associated with reconductoring and energizing the Woodbourne-Heaton 230 kV transmission line will cause adverse human health effects. PECO Rebuttal Statement 1 at 26, PECO Rebuttal Statement 2 at 28, PECO Rebuttal Statement 3 at 21, PECO Rebuttal Statement 4 at 20, OCA Rebuttal Statement 1 at 10, OCA Rebuttal Statement 2 at 5-6.
7. The design of the Woodbourne-Heaton 230 kV transmission line is consistent with the concept of prudent avoidance. PECO Rebuttal Statement No. 6 at 16 , T.S. at 315-16.
8. The use of the common utility corridor with the existing Conrail utility facilities as the route for the Woodbourne-Heaton 230 kV transmission line is consistent with the concept of prudent avoidance. PECO Rebuttal Statement No. 6 at 17.

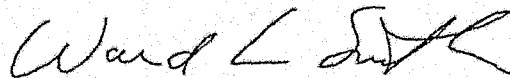
9. The magnetic field levels that will be associated with the Woodbourne-Heaton 230 kV transmission line are within the levels adopted by the State of New York in its magnetic field regulations. PECO Rebuttal Statement No. 6 at 18.
10. The magnetic field levels that will be associated with the Woodbourne-Heaton 230 kV transmission line are within the levels adopted by the State of Florida in its magnetic field regulations. PECO Rebuttal Statement No. 6 at 18.
11. The electric and magnetic field levels that will be associated with the Woodbourne-Heaton 230 kV transmission line are in the same range as electric and magnetic field levels from other 230 kV transmission lines in Pennsylvania and elsewhere in the United States. PECO Rebuttal Statement No. 6 at 18.
12. The electric and magnetic field levels that will be associated with the Woodbourne-Heaton 230 kV transmission line are consistent with the "similarity-based" approach to the concept of prudent avoidance. PECO Rebuttal Statement No. 6 at 18.

Proposed Conclusions of Law

1. Philadelphia Electric Company's Letter of Notification relative to reconstructing and rebuilding of the existing 138 kV line to operate as a Woodbourne-Heaton 230 kV Line in Montgomery and Bucks Counties was approved by Commission Order on February 9, 1990. February 1, 1990 Commission Order at 4.
2. Protestants and the Office of Consumer Advocate have been granted a full hearing on all questions related to whether the Woodbourne-Heaton 230 kV transmission line meets the Commission's regulations for approval of transmission lines. 52 Pa. Code § 57.72 -76.
3. The Woodbourne-Heaton 230 kV transmission line meets all applicable Commission safety regulations. 52 Pa. Code § 57.72 -76 .
4. The Woodbourne-Heaton 230 kV transmission line will not create an unreasonable risk of danger to the health and safety of the public. 52 Pa. Code § 57.76 (a)(1).

5. The Woodbourne-Heaton 230 kV transmission line will have minimum environmental impact, considering the electric power needs of the public, the state of available technology and the available alternatives. 52 Pa. Code § 57.76 (a)(4).
6. All provisions of the Commission's regulations related to approval of a transmission line having been met, the Commission's February 9, 1990 approval of PECO's Letter of Notification relative to reconstructing and rebuilding of the existing 138 kV line to operate as a Woodbourne-Heaton 230 kV line in Montgomery and Bucks Counties is hereby confirmed.
7. The Commission's approval of PECO's Letter of Notification grants PECO the authority to energize, operate, and maintain the Woodbourne-Heaton 230 kV transmission line within the scope of the Commission's regulations.

Respectfully submitted,



Counsel for Philadelphia Electric Company

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April 21, 1992

STATE OF MARYLAND

COMMISSIONERS

FRANK O. HEINTZ

Chairman

WILLIAM A. BADGER
LILLO K. SCHIFTER
CLAUDE M. LIGON
LINDA M. THOMAS



BRYAN G. MOORHOUSE

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Executive Secretary

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Executive Director

PUBLIC SERVICE COMMISSION

231 E. BALTIMORE STREET
BALTIMORE, MARYLAND 21202-3486

(301) 333-6000

TTY FOR DEAF: 333-6661

May 1, 1990

RECEIVED

MAY 2 1990

RATE COUNSEL

In the matter of the application *
of Potomac Electric Power Company *
for a certificate of public con- *
venience and necessity for the *
construction of a 500 KV overhead *
transmission line from the *
Brighton Substation in Montgomery *
County, to the vicinity of Balti- *
more Gas and Electric Company's *
High Ridge Substation in Howard *
County, Maryland. *

Case No. 7004

* * * * *

TO ALL PARTIES OF RECORD:

Enclosed is a certified copy of Order No. 68784 issued today
by the Commission in the above case.

Also enclosed is an Admission of Service form, which we ask
that you complete, sign and return to our office.

Very truly yours,

Ronald E. Hawkins
Executive Secretary

REH/sgb
Enclosures

STATE OF MARYLAND
PUBLIC SERVICE COMMISSION

ORDER NO. 68784

IN THE MATTER OF THE APPLICATION
OF POTOMAC ELECTRIC POWER COMPANY
FOR A CERTIFICATE OF PUBLIC CON-
VENIENCE AND NECESSITY FOR THE
CONSTRUCTION OF A 500 KV OVER-
HEAD TRANSMISSION LINE FROM THE
BRIGHTON SUBSTATION IN MONTGOMERY
COUNTY, TO THE VICINITY OF BALTI-
MORE GAS AND ELECTRIC COMPANY'S
HIGH RIDGE SUBSTATION IN HOWARD
COUNTY, MARYLAND.

BEFORE THE
PUBLIC SERVICE COMMISSION
OF MARYLAND

CASE NO. 7004

I. INTRODUCTION

The matter of the application of Potomac Electric Power Company ("PEPCO" or "Company") for a certificate of public convenience and necessity for the construction of a 500 kV overhead transmission line from the Brighton Substation in Montgomery County to the vicinity of Baltimore Gas and Electric Company's High Ridge Substation in Howard County, Maryland, is once again before the Commission. The procedural history of this case is quite extensive and is set forth in the Proposed Order; therefore, it will not be recounted here.

The instant proceeding was initiated when on February 4, 1988, the Brinkwood Community Association, Inc. ("BCA"), a party to the original proceeding, filed with the Commission a Request For Rehearing to Receive New Evidence. The BCA petition averred that since the conclusion of the hearings in Case No. 7004, new scientific and medical evidence concerning the safety and health effects of (primarily) magnetic fields associated with high voltage transmission lines has come to light. On

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February 22, 1988, PEPCO filed a response to BCA's petition and indicated if Case No. 7004 were reopened, the record to be developed would show there was no new evidence which would warrant any modification of the Certificate of Public Convenience and Necessity. Nevertheless, PEPCO stated that it supported BCA's request to reopen Case No. 7004 and to provide the parties with an opportunity to present additional evidence concerning possible electromagnetic effects resulting from the operation of the Brighton-High Ridge line.

By Order No. 67998, the Commission reopened Case No. 7004,

for the purpose of receiving and considering evidence . . . on the limited issue of the safety and health effects, if any, associated with the electromagnetic field resulting from the operation of the certificated 500 kV line to be located between the Brighton and High Ridge substations. No other issue previously decided by Order No. 64227, or any other issue -- whether or not capable of having been raised during the prior hearings in Case No. 7004 -- except for the limited issue described above, shall be raised during the reopened proceeding. Re Potomac Electric Power Company, 79 Md. P.S.C. 80, 82 (1988).¹

The matter was delegated to the Hearing Examiner Division and a prehearing conference in the reopened case was held on July 8, 1988. The following parties, who participated in the initial proceeding, entered their respective appearances: PEPCO, the Commission Staff ("Staff"), the Office of People's

¹ Order No. 64277 was issued by the Commission on March 5, 1980, wherein the Commission adopted the findings of the Hearing Examiner. See, Potomac Electric Power Company, 71 Md. P.S.C. 68 (1980).

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Counsel ("OPC"), the Department of Natural Resources ("DNR"), Howard County ("HC"), and Baltimore Gas and Electric Company ("BG&E"). In addition, Maple Lawn Farms, Inc. ("MLF") and 10 property owners appearing pro se were granted leave to intervene in the reopened case. The BCA chose not to retain counsel in this matter and, thus, did not intervene as a party. However, various property owners in the Brinkwood community were among those who were granted leave to intervene pro se.

Hearings on the limited issue specified by the Commission were held on March 27 through March 31, 1989. Initial Briefs were filed on April 26 with Reply Briefs on May 12, 1989.

PEPCO presented the testimony of eight expert witnesses. Testifying were: William F. Trapp, Manager of PEPCO's System Planning Department; J. Michael Silva, a transmission line engineer and president of ENERTECH Consultants; Edwin L. Carstensen, Professor of Engineering and Professor of Biophysics at the University of Rochester; Dr. H. Dwight Mercer, a veterinarian and comparative toxicologist and Dean of the College of Veterinary Medicine of Mississippi State University; Dr. Mark Israel, a pediatric oncologist and cancer researcher and Chief of the Molecular Genetics Section of the Pediatric Branch in the Division of Cancer Treatment at the National Cancer Institute (National Institutes of Health); Dr. Margaret A. Tucker, a physician and cancer epidemiologist, and Chief of the Family Studies Section of the Environmental Epidemiology Branch at the National Cancer Institute; Dr. Roswell K. Boutwell, an Emeritus Professor of Oncology at the University of Wisconsin, a

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cancer researcher at the McArdle Laboratory for Cancer Research, and a member of the National Cancer Advisory Board (which oversees the National Cancer Institute); and Dr. Richard Bockman, Associate Professor of Medicine and Associate Professor of Biochemistry at the Cornell University Medical College.

Testifying on behalf of DNR/Staff was Thomas E. Magette, Manager of Nuclear Programs for the Maryland Power Plant and Environmental Review ("PPER") Division of DNR. In addition, Dr. J. Patrick Reilly, an electrical engineer with the Johns Hopkins University Applied Physics Laboratory and president of Metatec Company, and Dr. William H. Bailey, a research scientist with Environmental Research Information, Inc. and a visiting research scientist at the Cornell University Medical College, also testified for DNR/Staff.

The Office of People's Counsel sponsored the testimony of Dr. Charles Polk, Professor of Electrical Engineering at the University of Rhode Island and president of the Bioelectromagnetics Society.

Howard County presented the testimony of Dr. Jerry L. Phillips, a biochemist at the Cancer Therapy and Research Foundation of South Texas and an Adjunct Professor of Medicine in the Division of Oncology at the University of Texas Health Science Center.

In addition to the expert witnesses, several property owners and residents of the area through which the transmission line would traverse made statements for the record.

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A complete, accurate and exhaustive summary of all the witnesses' testimony and the evidence presented is provided in the Proposed Order and will not be repeated here.

It should be noted, however, that during the course of the reopened proceeding, testimony and evidence was presented that addressed: (1) electric transmission lines in general and the Brighton-High Ridge line in particular; (2) the properties of electric fields and magnetic fields; and (3) laboratory studies and epidemiological studies which have been conducted to investigate possible associations between electric and/or magnetic fields and adverse health effects.

At the conclusion of the evidentiary hearing, the Hearing Examiner ruled that the expert witnesses in this case agree that a causal relationship has not been established between exposure to electric and/or magnetic fields and adverse health effects. She also rejected suggestions to expand the right-of-way of the line, redesign the line configuration, or set a magnetic field limit within homes along the transmission lines' routes, for such action appears to be arbitrary and perhaps counterproductive.²

The Hearing Examiner adopted DNR/Staff's recommendation that PEPCO be allowed to proceed with construction of the

² In her Proposed Order the Hearing Examiner notes that it is inappropriate to set standards for magnetic fields or rights-of-way when there is no scientific basis to support said standards. Further, in support of her ruling, she cites the testimony of OPC witness, Dr. Polk, that given the possibility of "window effects," establishing standards that are intended to decrease fields may in fact cause an adverse effect in another window.

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Brighton-High Ridge line with the Commission monitoring new scientific evidence on the issue of health effects from exposure to power lines.

On January 23, 1990, the Commission received correspondence from Maple Lawn Farms, Inc. requesting the Commission not to grant PEPCO the right to build the 500 kV line. On February 1, 1990, OPC filed a Memorandum of Appeal and on February 2, 1990, Mr. and Mrs. Roscoe C. Born and Mr. and Mrs. Robert M. Murch ("Born/Murch") also filed a Memorandum of Appeal. Reply Memorandums were filed by PEPCO, Howard County and Staff/DNR.

On March 2, 1990, Born/Murch filed a Petition for Redress and on March 9, 1990, DNR/Staff filed a Response to Appellants' Petition for Redress.

It is in regard to the above-noted appeals of the Hearing Examiner's decision that we are now called upon to review and render a decision.

II. Discussion

A. Evidence

On appeal Born/Murch (Intervenors pro se) and Howard County challenge the Hearing Examiner's ruling on the admissibility of hearsay evidence and the sufficiency of the record evidence. To place these arguments in proper perspective, it should be noted that on December 20, 1988, Born/Murch filed with the Commission a statement which was accompanied with three documents. The three documents attached were: Biological

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Effects of Power Line Fields, the Final Report of the Scientific Advisory Panel of the New York State Power Lines Project, July 1, 1987; Health Effects of Transmission Lines, Oversight Hearing before the Subcommittee on Water and Power Resources of the House Committee on Interior and Insular Affairs, 100th Congress (October 6, 1987); and Biological Effects from Electric and Magnetic Fields, Air Ions and Ion Currents Associated with High Voltage Transmission Lines, project resumes by researchers at a Contractors Review symposium sponsored by the United States Department of Energy and the Electric Power Research Institute in November 1987. Born/Murch requested that these documents be made part of the record.³

By an order issued March 20, 1989, the Hearing Examiner admitted into evidence the report of the Scientific Advisory Panel of the New York State Power Lines Project; however, she ruled that the other reports would not be received into evidence.⁴

³ On February 4, 1988, the Brinkwood Community Association filed a Request for Rehearing to Receive New Evidence. Attached to the request were the three documents Born/Murch wishes to have become part of the record evidence. By Order No. 67998 we declined to take judicial notice of the set of documents. Re Potomac Electric Power Co. 79 Md. PSC 80 (1988).

⁴ The Hearing Examiner admitted into evidence the NYSPLP report. However, she rejected the inclusion of the other two reports for reasons fully explained in her 12-page written ruling, with which the Commission concurs.

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It is Born/Murch's position that the record in this proceeding is incomplete and that the Commission has failed to comply with the dictates of The PSC Law.⁵ Specifically, they argue that the Staff's and Commission's failure to obtain the direct testimony of the scientists cited in the proffered research reports, and to consult with these scientists in its decision making, resulted in a grossly incomplete record. It is their opinion that the Commission ". . . should have constructed a comprehensive list of scientists and investigators working in this field, then consulted them in hearings or by deposition to obtain their reports of their findings. These, then, could have been subjected to impartial scrutiny by medical, scientific, or technical advisers" (Born/Murch Memorandum on Appeal at 11) In the same vein as the above-noted argument, Born/Murch contend that the Commission's refusal to take judicial notice of the research documents led to an incomplete record. In an attempt to clarify its request for judicial notice, Born/Murch assert that:

BCA does not request that the Commission, at this time, take judicial notice that the statements of these scientists and investigators are correct -- only that these are the views and findings of these scientists and investigators, who could be expected to so testify if called as witnesses in a rehearing of this case.

They believe that the Commission's refusal to receive the statements or the testimony of these particular scientists constituted a dereliction of duty.

⁵ Article 78, Maryland Annotated Code (Cum. Supp. 1988).

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Echoing the same argument as Born/Murch, Howard County⁶ in its Reply Memorandum asserts that, ". . . the Commission has less than the best available evidence before it and that it would have been preferable for the Commission to hear from the experts conducting research in the area." (Howard County Reply Memorandum at 6) Further, the County believes that the Hearing Examiner's decision to preclude the inclusion of the two documents within the record evidence was "inappropriate and needlessly stringent." (Id. at 4)

In reply, PEPCO contends that the Proposed Order of Hearing Examiner is based on a complete evidentiary record. PEPCO points out that 12 expert witnesses provided extensive testimony documenting the full range of anticipated field levels for the Brighton-High Ridge Line.

On the issue of whether electric and/or magnetic fields cause or promote cancer, PEPCO notes that the record contains the testimony of one of the world's leading cancer researchers who was appointed to the National Cancer Advisory Board by the President. The record also contains the testimony of a cancer epidemiologist and a pediatric oncologist both from the National Cancer Institute. Regarding field levels and related exposure issues, the record contains the testimony of one of the nation's leading experts on electric and magnetic field exposure assessment. A nationally recognized expert addressed the

⁶While Howard County did not appeal the Proposed Order, it did file a Reply Memorandum which agreed with the arguments raised by People's Counsel and Born/Murch.

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research on immunology and endocrinology. (PEPCO Reply Memo at 12)

While Born/Murch refer to studies of Savitz, Adey, Goodman and Tomenius in claiming that the record is incomplete, PEPCO counters that the Hearing Examiner considered every facet of the Savitz study in her Proposed Order. PEPCO maintains that the Hearing Examiner appropriately found that the studies of Adey and Goodman do not provide a basis for a finding of adverse health effects. In addition, PEPCO states that there is abundant evidence, including Born/Murch's own exhibit, to show that Tomenius reported a drop in cancer risk as magnetic field levels increased. (Id.)

Finally, PEPCO points out that DNR/Staff did a thorough independent assessment of the research. PEPCO concludes that there is no basis to claim that the record is anything but complete. (Id. at 13)

DNR/Staff categorically deny that there is any validity to the unsupported accusations of the Borns and Murches concerning the evidence in the record. DNR/Staff argue that the record clearly demonstrates that all available information on health effects and electromagnetic fields has been exhaustively considered.

In deciding these issues, we have carefully considered all of the testimony, evidence and arguments advanced by the parties. Our review of the record evidence reveals that the Hearing Examiner received testimony and reports from expert witnesses that addressed: (1) electric transmission lines in

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general and the Brighton-High Ridge line in particular; (2) the properties of electric fields and magnetic fields; and (3) laboratory studies and epidemiological studies which have been conducted to investigate possible associations between electric and/or magnetic fields and adverse health effects. The review of laboratory and epidemiological studies concerning the topic addressed by the various witnesses consisted of a vast number of studies conducted in this field. During the course of these proceedings, these studies were reviewed, critiqued, analyzed and challenged. The Hearing Examiner in her Proposed Order painstakingly addressed the studies and provided sound reasonings for her acceptance or rejection of the conclusions of certain studies. The Hearing Examiner not only reviewed the studies conducted by various researchers and scientists in the field, but also considered reports produced by witnesses participating in this case.

We believe that the testimony, documents, and reports produced in this case provided a sound basis for the Hearing Examiner's findings which we adopt as our own. The argument advanced by Born/Murch that the best evidence was not available overlooks the fact that the record evidence included testimony of expert witnesses who have experience in the areas of engineering, physics, genetics, oncology, epidemiology, teratology, endocrinology and immunology; and that these witnesses were in fact made available for cross-examination. The Commission finds that the parties presented extensive evidence to address the

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issue presented herein; therefore, we conclude that Born/Murch's argument that the record is incomplete is without merit.

The Commission also rejects Born/Murch's argument, supported by Howard County, that the Hearing Examiner erred in refusing to admit hearsay evidence in an administrative proceeding. We have reviewed the Hearing Examiner's Ruling on Evidentiary Matters issued March 20, 1989 and believe that reasoning to be sound and therefore adopt it as our own.

While the Commission is not bound by the technical rules of evidence or procedure of courts of law or equity, it must observe the basic rules of fairness as to the parties appearing before it. American Radio-Telephone Service, Inc. v. Public Service Commission, 33 Md. App. 423, 434, 365 A.2d 314 (1976). In adversary proceedings before the Commission, parties have the right of cross-examination. (Id., see also Art. 78, §82(b)) In reviewing the rights of parties before administrative agencies, Maryland courts have examined this issue and have held,

"Perhaps the most often repeated rule of administrative law is that administrative agencies 'must observe the basic rule of fairness as to parties appearing before them.' Ottenheimer Pub. v. Employment Security Admin., 275 Md. 514, 520, 340 A.2d 701 (1974); Dickinson-Tidewater v. Supervisor, 273 Md. 245, 253, 329 A.2d 18 (1974); Rogers v. Radio Shack, 271 Md. 126, 129, 314 A.2d 113 (1974); Fairchild Hiller v. Supervisor, 267 Md. 519, 524, 298 A.2d 148 (1973). Under this fairness requirement, the right of cross-examination must be reasonably available. Hyson v. Montgomery County, 242 Md. 55, 67, 217 A.2d 578 (1965). The Court of Appeals in Hyson explained: 'The authorities seem to be in accord that when an administrative board or agency is required to hold a public hearing and to decide disputed adjudicative facts based upon evidence produced and

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a record made, that a reasonable right of cross-examination must be allowed the parties . . . The rationale of the cases and authorities is that reasonable cross-examination, which is required for a full and true disclosure of the facts, having due regard to the circumstances of each particular case, the nature of the proceedings, and the character of the rights which may be affected by it must be permitted" Tron v. Prince George's County, 69 Md. App. 256, 266-267, 517 A.2d 113 (1986).

The matter sub judice is an adversary proceeding in that the Certificate of Public Convenience and Necessity for the construction of a 500 kV transmission line has been challenged by several parties. The issue presented to the Hearing Examiner, and now the Commission, is whether this transmission line will produce adverse health effects and thus the certificate that has been granted should be changed. The parties participating in this case have presented opposing or conflicting evidence that advanced their respective positions. Thus, there are disputed adjudicative facts that must be resolved by the Commission. To admit into the record the documents proffered by Born/Murch would in essence deny PEPCO and other parties the right to cross-examine any expert witness sponsoring or relying upon the documents and would place the Company and other parties at a disadvantage. Moreover, we do not believe that the parties to this proceeding have been prejudiced by this denial, for considerable testimony and evidence from well recognized experts in their respective fields has been presented that advance differing opinions concerning the possibility of adverse health effects of transmission lines, and the evidence has been thoroughly reviewed.

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We also reject the judicial notice argument advanced by Born/Murch and Howard County. As indicated in Article 78, §83(d), the ". . . Commission may take notice of judicially cognizable facts and also of general, technical, or scientific facts within its specialized knowledge." We concur with the Hearing Examiner that "[t]he proffered documents are being offered for the truth or correctness of the theories and conclusions contained therein. These theories and conclusions, while based on certain facts, are not self evident or notorious and formal proof is clearly necessary to aid the fact-finding process; they must therefore be proven and not simply 'noticed.'" (Hearing Examiner's Ruling on Evidentiary Matters, March 20, 1989, page 7) Therefore, we will again deny the request to take judicial notice of the proffered documents.

B. Prudent Avoidance

On appeal, the Office of People's Counsel maintains that though scientific evidence is inconclusive on the question whether exposure to magnetic fields produces adverse health effects, the record evidence in this proceeding reveals that there is sufficient evidence that there is "a potential human health hazard associated with long-term exposure to magnetic fields to warrant the imposition of conditions to reduce the magnetic fields produced by the proposed 500 kV transmission line." (OPC Memorandum on Appeal at 5) Given the above, OPC asserts that the Hearing Examiner erred in rejecting its proposals to reduce risk of exposure from the magnetic field.

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OPC recommends that the Commission direct PEPCO to investigate the feasibility of design changes to the Brighton-High Ridge line to reduce the magnetic field strength to 10 milligauss or less at the edge of the right-of-way or in the alternative, require PEPCO to widen the right-of-way so that the field strength is 10 milligauss or less at the edge or consider rerouting the line through a less developed residential area. (Id. at 6) In support of its position, OPC notes that epidemiological and laboratory studies conducted by its witness, Dr. Polk, and Howard County witness, Dr. Phillips, conclude that electromagnetic fields pose a potential health risk. Since there is a potential harm to the public as a result of the operation of the 500 kV transmission line, OPC urges the Commission to adopt a policy of "prudent avoidance." According to OPC, "prudent avoidance" is defined as "the striking of a reasonable balance between avoiding potential harm and the attendant costs and risks." (Id. at 9) Thus, it is OPC's opinion that in order to accomplish the goal of adopting a policy of "prudent avoidance" the Commission must adopt the conditions proffered by it.

PEPCO in reply disagrees with People's Counsel's proposals. PEPCO points out that People's Counsel has not identified any errors in the Hearing Examiner's analysis of the scientific research nor has People's Counsel identified any health effects that would be caused by the Brighton-High Ridge line. Further, PEPCO maintains that People's Counsel's view that absent "scientific certainty" the Commission is obligated to take regulatory action reflects a fundamental misconception of

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scientific research and the record evidence in the case. (PEPCO Reply at 13-14)

According to PEPCO, the only basis in the record for People's Counsel's proposed 10 mG standard is a conversation that Dr. Polk once had with a scientist in Sweden. The evidence does not show a 10 mG right-of-way standard exists in Sweden or anywhere else. PEPCO asserts that there is no basis for concluding that a 10 mG standard would prevent health effects or have any positive effect at all on human health. PEPCO concludes that People's Counsel's proposed 10 mG standard is nothing more than an arbitrary field level that has no scientific basis. (Id. at 15-16)

With respect to the Colorado decision cited by People's Counsel, PEPCO believes it is consistent with the Proposed Order of the Hearing Examiner. According to PEPCO, both rulings found no basis to conclude that power line fields cause adverse health effects and in neither case were field level standards found to be warranted or appropriate. In addition, both rulings found no basis to change the proposed transmission line design or operation. (Id. at 17)

PEPCO also points out that the Brighton-High Ridge line has higher ground clearances than the National Electrical Safety Code ("NESC") requirements, larger conductors than required for the electricity load, and a reverse phasing arrangement in the Born/Murch area where it is necessary to reconstruct the existing 230 kV lines to place a fifth circuit in the existing right-of-way. Finally, the field levels from the line are generally less

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than the levels from other transmission lines operating throughout the country. (Id.)

DNR/Staff agree with PEPCO that there is nothing in the record to support People's Counsel's proposed 10 mG edge-of-right-of-way standard. DNR/Staff indicate that there is nothing unique which would distinguish the proposed Brighton-High Ridge 500 kV line from any other 500 kV line in the State. (DNR/Staff Reply at 10)

According to DNR/Staff the evidence does not support the conclusion that electromagnetic fields, whether from this transmission line or any other source, cause health effects on humans, adverse or otherwise. Further, the evidence at this time does not support the conclusion that electromagnetic fields have a "significant" potential as a harmful environmental agent. (Id. at 14)

The Commission has reviewed the record evidence and the arguments advanced by the parties and agrees with the findings and reasoning of the Hearing Examiner.

The record reveals that the Brighton-High Ridge line will have ground clearances that exceed the NESC requirements; employ larger conductors than is required for the load; have reverse phasing in the area of concern to Born/Murch; use steel poles for the 500 kV line; and that the field levels emanating from the line are generally less than the levels from other transmission lines operating throughout the country. Thus, the proposed 500 kV transmission line will be constructed in a fashion that will mitigate the fields emanating from it. Since

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the current scientific data shows that there is no causal relationship between electric and/or magnetic fields and adverse health, we believe that the extra measures undertaken by PEPCO to reduce the magnetic/electric fields are consistent with the theory of "prudent avoidance."⁷

Further, we reject OPC's recommendation that the Commission direct PEPCO to investigate the feasibility of design changes to the Brighton-High Ridge line to reduce the magnetic field strength to 10 miligauss or less at the edge of the right-of-way or in the alternative, require PEPCO to widen the right-of-way so that the field strength is 10 milligauss or less at the edge or consider rerouting the line through a less developed residential area. We are of the opinion that the record evidence reveals that there is no scientific basis for the imposition of these conditions; therefore, we do not deem it to be an appropriate measure to be adopted at this time.

IT IS THEREFORE, this 1st day of May, in the year Nineteen Hundred and Ninety, by the Public Service Commission of Maryland,

⁷Our finding in this case is similar and consistent with the Colorado Commission decision in In the Matter of Public Service Company of Colorado to Have Upgrades in Douglas County, Docket No. 89-A-028E, December 29, 1989, wherein the Colorado Commission found no basis to conclude that power line fields cause adverse health effects or that the proposed transmission line design or operation should be changed.

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ORDERED: That the Proposed Order of the Hearing Examiner issued on December 21, 1989 in this proceeding is hereby affirmed.

Frank O. Heintz

W. R. R. R. R.

L. L. L. L. L.

Clarence J. J.

Linda M. Thomas

Commissioners

State of Maryland
Office of Public Service Commission } ss.

The preceding copy has been compared with the original
ORDER NO. 68784, CASE NO. 7004 - IN THE MATTER OF THE APPLICATION OF
POTOMAC ELECTRIC POWER COMPANY FOR A CERTIFICATE OF PUBLIC CONVENIENCE
AND NECESSITY FOR THE CONSTRUCTION OF A 500 KV OVERHEAD TRANSMISSION
LINE FROM THE BRIGHTON SUBSTATION IN MONTGOMERY COUNTY, TO THE VICINITY
OF BALTIMORE GAS AND ELECTRIC COMPANY'S HIGH RIDGE SUBSTATION IN HOWARD
COUNTY, MARYLAND,

*on file in this office and I do HEREBY CERTIFY the same to be a correct
transcript therefrom and of the whole thereof.*

*Witness, my hand and the Seal of Office of the
Public Service Commission, at the city of
Baltimore, this 1st day of
May, one thousand nine hundred
and ninety.*

Ronald E. Hawkins
Secretary.

LPW

ORIGINAL

6/11/1

SUGARMAN & ASSOCIATES

ATTORNEYS AT LAW

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SUSANNE I. GIENDL*

KEVIN M. STACK

LEGAL ASSISTANT

*NOT ADMITTED TO PRACTICE
IN PENNSYLVANIA

April 21, 1992

John G. Alford, Secretary
PA Public Utility Commission
Room G-18, North Office Building
Harrisburg, PA 17120

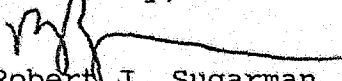
Re: Letter of Notification
of Philadelphia Electric Company
Re: Proposed 230 KV Woodbourne to
Heaton Transmission Line,
Docket No. A-110550, F. 055

Dear Secretary Alford:

Please find enclosed for filing an original and nine (9)
copies of the Protestants' Main Brief in the above-captioned
proceeding.

Copies have been served upon all parties of record as shown on
the attached Certificate of Service.

Sincerely,

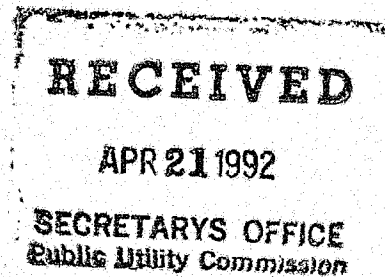
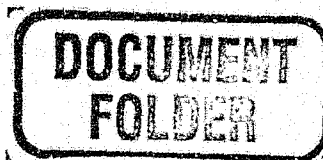


Robert J. Sugarman
Counsel for protestants

Enclosures

cc: All parties of record

Md7



Re: Letter of Notification
of Philadelphia Electric
Company Re: Proposed 230 KV
Woodbourne to Heaton
Transmission Line,
Docket No. A-110550, F. 055

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of
the foregoing document, Protestants' Main Brief, upon parties of
record in this proceeding in accordance with the requirements of 52
Pa. Code 1.54 in the manner and upon the persons listed below:

Dated this 21st day of April, 1992.

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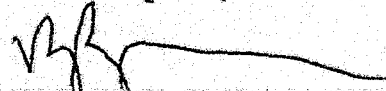
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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

IN RE: LETTER OF NOTIFICATION	:	DOCKET NO. A-110S50-F055
OF PHILADELPHIA ELECTRIC	:	
COMPANY UNDER 52 PA	:	
CODE § 57.72(d) RE: PROPOSED	:	
230 KV WOODBOURNE	:	
TRANSMISSION LINE	:	

MAIN BRIEF OF PROTESTANTS

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DATED: April 21, 1992

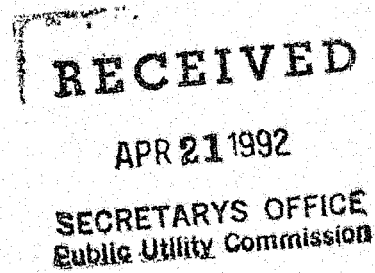
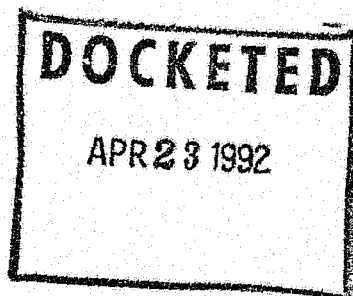
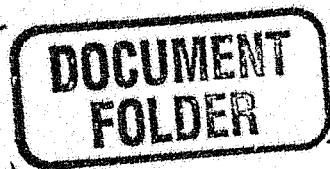


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MAIN BRIEF

SUMMARY OF ARGUMENT

The Commission denied the petitioners an opportunity to be heard prior to the institution of this line next to their properties. The Commonwealth Court stated that the petitioners had had a right to be heard, and that the Commission should have allowed them to present their case.

Because the Commonwealth Court's order was framed in terms of "effects," the Commission interpreted the order narrowly as a first step, and limited the hearings to the issue of effects. Following on the Commission, the ALJ limited the testimony to "effects".

In ruling on evidentiary matters, the ALJ has already determined that effects on patterns of landuse, including the use of the land by the protestants, is relevant to the issue of effect. These evidentiary rulings are not subject to reversal at this stage.

Accordingly, PECO has not carried its burden of proof with respect to the issues at Section 57.72(d)(4) specifically, as regards safety, PECO has not proved that the line will be safe.

Specifically, the safety considerations covered in 57.72(d)(4), by incorporation of 72(c)(6) is requisite.

To the extent that PECO did offer any proof in this regard, it only offered proof that there was a relative decrease in risks due to the Delta configuration of the lines. However, it did not address this in a straightforward way, since the considerations were imposed only after the line was originally designed.

In any event, in addition, there was no consideration of location as effected by safety considerations, and it was admitted that no such consideration was given. The Office of the Prosecutory Staff has, in another proceeding (Duquesne Light), argued that the doctrine of prudent avoidance entails siting as well as design.

Accordingly, the company's evidence is inadequate as a matter of law. In addition, however, the overwhelming evidence presented by the protestants of the adverse effects on them due to the lack of safety is clearly un rebutted and un rebutable on the record, and established that the letter of notification should not have been approved, at least without further hearings in order to balance the need against the adverse effects. Therefore, the Commission should presently hold these hearing, or reject the letter of notification altogether.

ARGUMENT

I. PECOS EXPERT WITNESSES CONCEDES THAT ELECTROMAGNETIC FIELDS DO HAVE BIOLOGICAL AND HEALTH EFFECTS

The evidence presented at the hearings by the company was woefully inadequate. None of the other parties even presented any

evidence. In the company's evidence, the witnesses admitted that their expertise, each of them, was limited and that their assignment was narrowly limited. Thus, certain areas were altogether unsupported by testimony, either indirect or rebuttal.

As to those witnesses who did testify, they conceded that electromagnetic fields do have health effects and biological effects. Moreover, the epidemiologist had to concede that qualified studies indicated such effects.

No PECO expert medical witness denied that studies in different areas of science and medicine demonstrated biological effects of EMFs that either are or could be linked to adverse health effects. The company witnesses often qualified positive results or downplayed them, or criticized the studies, but continually acknowledged their familiarity with positive results in a number of studies in a number of areas (PECO Rebuttal Testimony No. 1, pp. 10, 12, 13, 14, 15, 17, 18, 22, 23, 24, 25; No. 2, pp. 16, 17, 18, 25, 26, 27; No. 3, pp. 17 - 18, 18 - 20, 21 - 22; No. 4, p. 20; N.T. pp. 1020, 1022, 1217, 1223, 1224, 1240, 1472).

One witness, Dr. Cole stated that the evidence was inconclusive or evenly divided between positive results and negative results (N.T. 1097, 1523).

These PECO expert witnesses all confined their testimony to their areas of specialization and stated that their opinions as to adverse health effects were limited to those areas. None would survey the entire range of EMF research and say that nothing had been shown, or could be shown in the future. Nor were they willing

to comment on or offer explanations of EMF effects demonstrated in fields other than their own (N.T. 1083, 1084, 1122, 1142, 1169, 1171, 1181 - 1182, 1184 - 1185, 1185 - 1186, 1189, 1193, 1194, 1225).

PECOs experts witnesses in the scientific area often showed a disregard for studies conducted in other fields, refusing to give significant weight to their results. Epidemiologic studies often surfaced in this regard (N.T. 1042, 1045, 1048, 1051, 1052, 1056, 1179). The experts exhibited an obstinacy with regard to results from other fields of studies whose implications they could not reconcile with their preconceived scientific beliefs (N.T. 1219, 1222, 1225, 1227). The general trend was to play down information as to EMF effects if it clashed with theories regarded as certain within one's own field (N.T. 1052, 1056, 1092, 1093, 1124, 1169, 1179, 1189).

II. PECO ACKNOWLEDGED POSSIBLE EFFECTS IN ADVOCATING PRUDENT AVOIDANCE

Though PECO argues that there will be no adverse effects on the protestants, the company has in fact advocated prudent avoidance at least in theory. Some protestants indicated that they had been advised by PECO representatives to practice prudent avoidance (N.T. 110, 246 - 246). PECO itself has issued a publication which advises that consumers consider the concept of prudent avoidance (Protestants' Exhibit 1, back page). PECO witness Charles J. Boeggeman helped to prepare this document. While he admitted that PECO wanted to make the public aware of the possible risk, he suggested that PECO never advised people to

practice prudent avoidance but only to consider the concept (N.T. 68 - 69).

The PECO EMF document entitled, "ABCs of EMF" asserts that the company takes EMFs into consideration in evaluating line designs (Protestants' Exhibit 1 back page). Mr. Oedemann testified for PECO that the company seeks to lower EMFs to make line safe but tried to say that EMF is not really a safety issue (N.T. 35 - 36). He additionally stated that PECO practices prudent avoidance to minimize EMF and any possible health effects (N.T. 29). He also said that if PECO had an unconstrained right-of-way, it would keep the Line as far as possible from the edge of right-of-way "to keep EMF levels at the edge of the right-of-way as low as we [PECO] can" (N.T. 31).

While Company witnesses Boeggman and Oedemann spoke of prudent avoidance as being an approach suited to a situation wherein there is great uncertainty and question about risk as research continues, other PECO witnesses in scientific testimony said that no additional research was desirable (N.T. 975, 1147 - 1148). One PECO scientific witnesses, Dr. Cole, said that the evidence at present is just about equally divided (N.T. 1523).

III. THE PROTESTANTS HAVE MET THE TEST OF
THE COMMONWEALTH COURT AND THE COMMISSION,
AND THE ALJ, WITH RESPECT TO DEMONSTRATING
EFFECT

The protestants' evidence, on the other hand, clearly indicated that there is definite scientific evidence of adverse biological effects of EMF on health.

In these circumstances, the concrete illustrations of the

adverse effect of the EMF on peoples lives and property is compelling and unrebutted.

All of the protestants testified that the proposed Line is in close proximity to their property lines, houses, local childrens' play areas, and in some cases their places of business. Some protestants testified that the Line is as close as 50 to 80 feet to their property lines (N.T. 97 - 100, 130, 258, 269, 437 - 438, 466, 481 - 482, 487 - 488).

Protestants testified as to their intense recreational use of their backyards and neighborhood play ares. Most of the witnesses have children, often young. Many have decks, picnic tables, patios, outdoor games, pools, worksheds, etc...which are used extensively by family members and friends.

Many protestants expressed a well informed fear of the possible health risks of EMFs. Some protestants have done in depth research on the subject while others have learned about it through popular media (N.T. 103; 112; 138, 147, 155, 166 - 170, 201 - 203, 215 - 216, 222 - 223, 242 - 243, 260, 440 - 441, 470 - 471, 483 - 484, 494). A lot of protestants' fears are heightened by histories of cancer in the family or existing debilities of family members (N.t. 167, 184, 201 - 203, 253, 260, 441, 489 - 490). One citizen even testified that as a child she lived near power lines. Of the 9 closest homes to the lines, there were 4 cases of cancer including her. She developed uterine cancer which required years of extensive treatment (N.T. 265).

A majority of the protestants who appeared testified that if

the Line is energized, they will move. They will move, in many cases, regardless of whether or not they are able to sell their homes (N.T. 103 - 104, 129, 204 - 206, 234, 245, 267, 279 - 280, 472 - 473). Some protestants testified that they had already begun to try to sell their homes with little success (N.T. 133, 204 - 206, 235, 245, 253 - 254, 439, 469, 478 - 479, 483 - 484).

Protestants also testified how they would change the use of their land, especially with regard to the use their children currently make of the outdoors (N.T. 145, 162 - 163, 184 - 188, 189, 222 - 223, 277, 485 - 486, 489 - 490).

The majority of protestants currently practice prudent avoidance with respect to EMFs from household appliances. They do in fact act to the best of their abilities with respect to the serious fear that they have of EMFs (N.T. 138 - 139, 148, 162, 203 - 204, 234, 445 - 447, 471, 473, 476, 483 - 484, 489). Many explained their understanding of prudent avoidance ruled out the possibility of practicing prudent avoidance with a transmission line abutting their homes (103 - 104, 278, 138).

IV. THE PROTESTANTS HAVE PROVED THAT THEY
ARE ENTITLED TO CONSIDERATION AS TO
THE SITING OF THE LINE

It is only be intense thought reversal that the advocates of this line, including the Commissions' Prosecutory Staff, are able to formulate a set of words which disassociates the effects on the protestants from safety considerations. The only way that they can avoid the obvious consequences of their action is to attempt to recategorize the effects from safety into property values.

However, it is far too late in the day for effects on peoples health, which cause them to lose the benefit of their property, to be categorized as loss of property value.

Moreover, and most importantly, it is a total logical fallacy to contend that because the commission does not set monetary damages, loss of value of property due to safety considerations is not a relevant concern. Put another way, since every safety question can be avoided by people simply abandoning their properties abutting a line, the argument that adverse effects on property are barred would preclude consideration of any safety effects of a line, contrary to the explicit language of section 57.72. Therefore, conversely, since unsafe conditions always entail adverse effects on property, it is clear that in order to consider safety, as the regulations require, adverse effects on property must be considered as a means of quantifying and concretizing such adverse safety considerations.

B. The lack of precise knowledge of the mechanism and character of the adverse effects is not a basis for ignoring them.

Safety is inherently a probabalistic issue. An unsafe railroad crossing does not guarantee that accidents will occur or, if they occur, the precise nature of the accidents. For example, one cannot know whether the absence of a safety light will induce individuals to fail to see a train, or to carelessly assume that they can "beat it," etc.... However, as indicated, the Commission's siting regulations and its statutes do not require precise proof of the character of the unsafe condition in order to characterize a

condition as unsafe.

For this reason, obviously, the utilities themselves have counseled consideration of prudent avoidance. In itself, the consideration of prudent avoidance establishes the validity of the effect argument.

As protestants asked many witnesses, and never got an answer, the question becomes, how does a homeowner with children, or grandchildren, "consider" prudent avoidance as related to this line in his backyard?

Mr. Turner was unrebutted in his conclusion that it would deter future buyers of the property, and thereby limit the opportunity of families who "vote with their feet." The homeowners themselves were unrebutted in their testimony that they would change their pattern of life. Those that can afford to will move; those who cannot afford to will curtail their activities.

In short, the protestants are clearly affected by the line through its lack of adequate safety, and the Commission must therefore consider this factor in redetermining the letter of notification. Since the Commonwealth Court ruled that the petitioners are entitled to be heard, hearings on this subject are necessary.

V. THE LAW REQUIRES THAT EFFECTS
SUCH AS THOSE INVOLVED IN THIS CASE
BE CONSIDERED.

Given the Commission's order, it is necessary for the ALJ to set a further course in these proceedings. Therefore, it is necessary for the ALJ to determine whether the petitioners are

entitled to further consideration of the letter of notification.

It is implicit in the Commonwealth's ruling in *Small vs. Pennsylvania PUC*, No. 761 CD 1991 (Copy attached), that the petitioners were not given their minimum due process in the first round in this proceeding. Otherwise, the Commonwealth Court would have had no jurisdiction to order a remand.

Beyond that, it is clear that under the Commission's own precedent and rulings of the Commonwealth Court concerning the Commission's actions, petitioners were entitled to notice and an opportunity to be heard, as affected persons. E.g., Allegheny Ludlum Steel vs. PUC, 459 A.2d 1218 (1983), affirming 447 A.2d 675 (1982). Indeed, the Courts have held, as they did in this very case, that an order cannot stand where constitutional rights have been violated (Westinghouse Electric vs. PUC, 404 A.2d 712 (1979)).

Therefore, because of the adverse effect on the petitioners through the incontestable effects of EMF on the human biological system, the petitioners are entitled to an opportunity to be heard on the siting issue as a whole.

These considerations are enhanced by Article 1, Section 27 of the Pennsylvania Constitution. That provision entitles the people, as a matter of constitutional right, to clean air, and the benefits of the natural environment. EMF is an intrusion on that. Within the framework for implementation of Article 1 Section 27, compliance with regulations is one of the critical tests. Through the failure to give petitioners notice of these proceedings, there was a clear lack of compliance with the regulations, as interpreted

by the Commonwealth Court in Small vs. PUC. Therefore, one of the basic test of Article 1 Section 27 having been failed, hearing at this time is constitutionally required.

VI. THE CONSIDERATION OF ADVERSE EFFECTS
ON PETITIONERS USE OF THEIR PROPERTY
IS NOT A DETERMINATION OF DAMAGES

Petitioners do not contest that the Commission does not determine eminent domain damages. However, there is no justification in precedent or in logic for equating that rule with a failure to consider adverse effects on landuse. Indeed, the regulations expressly provide that the Commission will consider effects of the project on "landuse" (52 Pa. Code Section 57.75(e)(3)(i)). Indeed, effects on landuse are the very first consideration as to the impact and efforts to minimize the impact of the line. It is hard to imagine a case involving residential use in which effects on "landuse" will not be expressed in terms of diminution of useability, diminution of ability to move to escape a safety problem, and the like.

As testified by Mr. Turner, without essential contradiction, moreover, because of the accumulative effect of individual landuse decisions by individual property owners, an unsafe line in a populated area can have a significant effect on the overall character of the landuse. This also may be expressed in terms of value, or it may not be expressed in terms of value. From a strictly damages point of view, the anticipated conversion of the corridor of this line from residential to commercial may in fact add to the dollar value of these properties, as commercial land

often has higher dollar value than residential. However, such an increase, if it were to occur, would still be an effect on landuse. Moreover, although it may create additional dollars ultimately for some persons, it may not be and an effect on landuse which will be beneficial to the community as a whole.

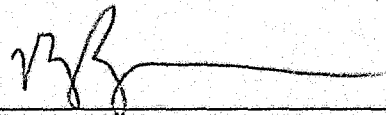
All effects on landuse may be expressed in, or may have an effect, on dollars. The rule against considering damages does not barr these considerations. Thus for example in the PECO 500 KV line case, in 1978, the Commission heard and considered numerous effects on landuse. In Philadelphia Suburban Water Company Tower, a 1975 decision, the PUC considered effects on landuse. In the PP&L application in Hilltown Township Bucks County, in 1971 and 1972, the Commission considered effects on landuse, which would obviously effect dollar values.

In its prehearing memoranda, the PECO and the Prosecutory Staff suggest that the rule on land monetary damages precludes consideration of effects on landuse. While PECO makes such an argument, it is hard to understand how the Prosecutory Staff of the Commission can so far depart from the Commission's precedent rulings as to make such a novel argument. The role of the Prosecutory Staff in EMF cases has been questioned by the Commission in its order of April 10, 1992, reversing itself regarding the participation of OTS in the Duquesne Powerline case. In these circumstances, it is hard to know who the Prosecutory Staff is speaking for, but it must be clear that the Prosecutory Staff is not speaking for the Commission.

In this regard, it is noteworthy that the Prosecutory Staff has been responsible for "educating" the Commissioners on EMF. In the literature and references produced by the Prosecutory Staff after orders by this ALJ and the Commission itself, it has emerged that the Prosecutory Staff has failed to involve a single scientist who has opined that EMF effects human health in its Commission education. Thus, the Prosecutory Staff has elected to limit its knowledge, and that of the Commission, with the effect that its arguments regarding landuse must be discounted because of its bias.

To the contrary, the health effects on hundreds of people for an unnecessary powerline is a matter of considerable concern under the Constitution, the Statute, and the Commission's regulations. Unless and until there is proof of the necessity of the line, and the location as well, the Commission cannot grant an effective letter approval. Moreover, if the Commission is to consider ultimately such an approval, it must condition such an approval on an effort to minimize safety impacts, which would include purchasing all of the adjoining properties along the line in order to enable individuals to avoid adverse effects on their health.

Respectfully submitted,



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SUMMARY OF TESTIMONY

PECO WITNESS RONALD J. OEDEMANN

Ronald Oedemann testified that he is a Senior Engineer in the Transmission Branch of the Engineering and Design Division of the Transmission and Distribution Services Department of PECO. His business address is 2301 Market Street, Philadelphia, PA 19101 (PECO Direct Statement, No. 1, "PECO DS1", 1).

Mr. Oedemann testified that he is the Lead Project Engineer for the Woodbourne-Heaton 230 KV Line (PECO DS 1,3). The design for the Line involves the utilization of a 60 foot easement in an existing Conrail right-of-way and 208 existing transmission line structures (PECO DS1,4). In locating the Line in the Conrail right-of-way, PECO employed the "common corridor" approach (PECO DS1,5).

The configuration of the proposed line is the compact delta formation in which the three phase conductors are arranged in a triangle. Such a formation is appropriate for structures 300 feet as are the old Conrail structures (PECO DS1,5). Mr. Oedemann testified that even after the implementation of new support guys, anchors, anchor poles and foundation caps, use of the existing structures would save \$2.5 million. The estimated total cost of the project was given by Mr. Oedemann as \$19.8 million (PECO DS1, 6-7).

Mr. Oedemann testified that the line design would place the Line in accordance with the National Electric Safety Code (NESC) requirements which call for the safeguarding of workers and the public during installation, operation, and maintenance of the line (PECo DS1,8). Mr. Oedemann provides a number of NESC Code Requirements and shows how the Woodbourne-Heaton line would satisfy each one; none of the NESC requirements listed relates to the issue of electric and magnetic Fields, (PECo DS1, 10).

Three alternative line designs are horizontal, vertical and longer span delta. Each of these designs assume a span length between structures of 600 feet. The vertical design would require 103 foot high poles; longer span delta would require 82 foot high poles; the horizontal configuration would require 88 foot high poles. Mr. Oedemann testified that use any of these three alternate designs would require the costly replacement of the existing catenary structures and additional right-of-way (PECo DS1, 11-12).

In Oral cross exam Mr. Oedemann testified that he did not know how much loading was on the Conrail Line from 1981 to 1986; the voltage was 132,000 volts (N.T. 10). The PECO line is to be positioned in the center of the 60 foot easement along its entire 12.8 mile length (N.T. 11).

Upon reviewing his response to the Office of Consumer Advocate's (OCA) Interrogatories Set I, No. 8, Mr. Oedemann testified that the cost information and field calculations in his prefiled testimony were conducted some time after the initial

design was completed. That information was prepared in July of 1991. Mr. Oedemann stated that in July 1991, construction of the Line was approximately 90% complete (N.T. 12-13).

Mr. Oedemann testified further that he did not think that it was necessary to mention alternative designs in PECO's letter of notification (N.T. 19). The selection of the compact or tight delta configuration was driven by the fact that the Conrail right-of-way and structures, the tight delta configuration is not the preferred method of PECO (N.T. 27).

At the time of choosing the Line design, Mr. Oedemann testified, no formal calculations were made of EMFs, but he knew through experience that the compact delta would result in lower fields. He did not discuss the issue with anyone. He has had experience taking EMFs into account in designing lines (N.T. 20-21).

Mr. Oedemann testified that PECO began looking at the EMF issue over the last 4 or 5 years and taking it into account in line designs (N.T. 24). Now PECO endeavors to build lines that result in lower fields at a modest increase in cost, in order to "make the line as safe as we possibly can for our neighbors" (N.T. 23). He testified that PECO practices prudent avoidance to minimize EMF and any possible health effects (N.T. 29). If PECO had had an unconstrained right-of-way, in which to build the Woodbourne-Heaton Line, it would keep the Line as far as possible from the edge of the right-of way "to keep EMF levels at the edge of the right-of-way as low as we can" (N.T. 31). The route

selected was selected as obviously the best route as it was almost a straight line; Oedemann did not formally investigate other routes because the area "is so built up that buying a new route would be unheard of" (N.T. 32).

Mr. Oedemann testified that no requirements in the NESC codes relate to EMF considerations. While testifying that PECO seeks lower EMF's to make lines safe, he stated that he did not list EMF reduction in his prefiled testimony as having been considered because to him "EMF is not really a safety issue to keep the public from getting hurt by the Line" (N.T. 35; 36). He testified that PECO cares about EMF because of the inconclusive evidence related to health risks but that it is not a safety issue (N.T. 36). Mr. Oedemann did not recalling seeing "ABCs of EMFs", published by PECO (N.T. 41). That pamphlet asks citizens to "consider what one researcher has called Prudent Avoidance. Prudent avoidance is simply common sense reduction of your exposure to electric and magnetic fields", and then givess examples of reducing exposure to EMFs from household appliances and electrical devices (Protestants' Exhibit 1, back page).

Mr. Oedemann also testified that in the design generally, the height of a line is adjusted to accout for the topography being crossed. PECO compensates for deviation in another line where a railroad iss in a cut; the line is raised so that the conductors will be the same elevation above ground where the line runs along railroad tracks (N.T. 41-42).

PECO WITNESS CHARLES J. BOEGGEMAN

Charles J. Boeggeman testified that he is an Electrical Engineer in the Consulting Services Branch of the Engineering and Design Division of the Transmisssion and Distribution Services Department of PECO. His business address is 2301 Market Street, Philadelphia, PA (PECo Direct Statement No. 2 [PECo DS No. 2], 1).

Mr. Boeggeman testified that EMF issues have been his responsibility for 2 1/2 years. He has attended conferences, participated in committees and task forces, and has testified before congress (PECo DS No. 2, 2-3).

Mr. Boeggeman testified that electric and magnetic fields exist whenever electricity is present. Electric fields are created by voltage and measured in Kv/m; magnetic fields are created by the flow of electrical current and measured in milligauss. Fields decrease away from the electrical source (PECo DS No. 2, 4-6).

To calculate the EMfs for the Line, Mr. Boeggeman testified, he used a computer program called ENVIRO. The highest electric field level, in the middle of the right-of-way it will be 1.2 Kv/m (PECo DS No. 2, 7).

Magnetic field levels will vary according to the current sent through the Line. When the Line is deenergized, the current is 0 amperes; such condition will rarely occur. The second loading situation is the "light" load, or 180 amperes. The third loading situation is the "normal" load of 360 amperes; together, the "light" and "normal" loading situations are expected to occur over

90% of the time the Line is operating. The next loading situation is the "emergency maximum" load of 1,000 amperes. Such a loading situation is not expected to exceed 4 hours per year (PECo DS 2,8).

Mr. Boeggeman testified that the emergency minimum situation of 0 amperess results in no magnetic fields. The "light" loading situation results in a maximum field of approximately 21 milligauss and 13 milligauss in the middle of the right-of-way and the edge of the right-of-way respectively. The "normal" loading situation results in maximum field of 42 milligauss and 25 milligauss at the center and edge respectively. The "heavy" loading situation results in maximum field of 70 milligauss and 42 milligauss at the center and edge respectively. The "emergency maximum" loading situation results in a maximum field of 117 milligauss and 70 milligauss at the center and edge respectively (PECo DS 2, 9). Mr. Boeggeman presented these figures and others in his exhibit attached to PECO DS 2.

Mr. Boeggeman also performed calculations of the electric fields produced by alternative line designs under various loading conditions and compared them to those produced by the compact delta. His results are shown in his exhibit attached to PECO DS 2 (PECo DS 2, 10).

As for comparing the magnetic fields produced by the compact delta design and the alternative designs, Mr.Boeggeman testified that he only prepared comparisons for the "heavy" load of 600 amperes. He stated that the vertical design results in lower magnetic fields on the right-of-way, at higher fields beyond the

edge. The horizontal and longer-span delta designs result in higher fields both on and off the right-of-way. While Mr. Boeggeman asserted that "other loading conditions would result in similar results", such results or relevant calculations are not included in his attached exhibit, not are they alluded to in his prefiled testimony (PECo DS 2, 11-12).

In cross exam, Mr. Boeggeman testified that there will be a load on the Woodbourne-Heaton Line all day barring out of service time (N.T. 48). In calculating electric and magnetic fields, Boeggeman did not factor in the currents of the existing Conrail rail lines nor did he factor in parallel pipelines either (N.T. 49). In making his calculations, he relied on a 12 foot phase spacing. He testified that he had used 14 foot phase spacing in the calculations done in response to OCA Interrogatory Set I, No. 2 because Mr. Oedemann's exhibit shows a variation in phase spacing of 12 to 15 or 16 feet. Since 90% of the Line has 12 foot spacing he later decided to use that number in calculations. Wider spacing exists at rolls on deadend turns; there is 14 foot spacing at rolls and 16 foot spacing at deadends. EMFs increase with wider phase spacing (N.T. 51-52).

Mr. Boeggeman testified that the calculations of the magnetic fields were done by him in approximately July, 1991 in preparation of his present testimony (N.T. 50).

On further cross exam, Mr. Boeggeman testified that another alternative design that has a different EMF results in split phase - similar to double circuit vertical. Subject to phase spacing,

this design could achieve lower levels of EMF than the tight delta. Mr. Boeggeman testified that the "fact that...[he is] aware of the split phase went through...[his] mind," but he thought that compact delta presented less fields though he stated that he did not "formally" evaluate the split phase design for this Line. He did not recommend split phase because, "we could not use the existing structures to do that" (N.T. 58-59).

Mr. Boeggeman went on to testify that he did not try to quantify - evaluate or describe - the risk of health effects associated with the selected or alternative designs; no one at PECO did. The company does not have a procedure for evaluating and describing quantitatively the EMF risk associated with different line decisions (N.T. 59-60). Mr. Boeggeman stated, "we have not calculated risk nor have we hired anyone because there is no known risk. There is no "established risk" (N.T. 61). However, testified Mr. Boeggeman, since the New York power study was released in 1987, PECO has been proactively addressing the EMF issue (N.T. 64). Also, he testified before a Congressional Committee in 1990 that PECO has experienced some delays in projects due in part to customers' concerns surrounding EMFs (N.T. 66). Mr. Boeggeman testified further that he helped prepare PECO's "ABCs of EMFs" pamphlet (N.T. 60).

The pamphlet, on its back page, states:

PECO is investigating new engineering methods. For example, when we design and build new power lines, we evaluate construction practices designed to reduce EMFs (Protestants' Exhibit 1, back page).

The pamphlet which Boeggeman testified that he helped prepare further states:

I understand milligauss as a unit of measure. Now what? Consider what one research has called Prudent Avoidance. Prudent Avoidance is simply common sense reduction of your exposure to electric and magnetic fields. Some cases in point: Don't stand close to your microwave oven, your dishwasher or your television set while they're on. Move radios, answering machines, electric clocks and other appliances so they're not right next to you. Consider using your electric blanket to preheat your bed to a comfortable temperature, and then turn it off when you climb in for the night. At work, keep your video display terminal at least 18 inches from you (Protestnts' Exhibit 1, back page).

Mr. Boeggeman testified that the passage about prudent avoidance was taken from the Office of Technology Assessment (OTA) report. PECO did not make any independent judgment to exercise prudent avoidance. It pointed out reports so the public can make up its mind absent any verification of the risks (N.T. 67-68). When asked whether PECO concurred with or dissented from the OTA recommendation, Boeggeman testified that, "We don't say it. We say consider what one researcher says... So that they can make their own decisions. It is something that is out there. We felt the responsibility to let them know what was out there" (N.T. 68-69).

Further testifying on the subject of EMFs, Mr. Boeggeman testified that he did state in testimony to Congress that it is PECO's policy to treat EMF as a societal issue (N.T. 74). In explaining that statement, Mr. Boeggeman stated:

It means that society as a whole are exposed to both electric and magnetic fields. We live

with this daily in our lives. And by virtue of that exposure, it is a societal issue (N.T. 74-75).

According to Mr. Boeggeman, prudent avoidance was practiced with respect to the Woodbourne-Heaton Line. He testified that the design chosen for the Line "just fell in our laps" as being optimum for reducing EMFs; "We didn't have to do anything extra to reduce the fields" (N.T. 75). Mr. Boeggeman testified that to change the towers and come in with "a ridiculous - not ridiculous - outlandish design" to reduce EMF levels further is not prudent (N.T. 76). Whatever consideration PECO gave to alternatives other than building on the narrow Conrail corridor is a systems issue (N.T. 76). Mr. Boeggeman averred that he does not agree that prudent avoidance cannot be practiced without considering a range of alternative methods of achieving desired and/or needed power (N.T. 78-79).

Mr. Boeggeman also testified that the loading scenarios for the Line - which he used to calculate EMF levels - were "estimated" by PECO Systems Planning Personnel (N.T. 71). He is not familiar enough with the network system to know whether systems planners could elect to increase the average load; if the load were increased, magnetic field levels would be increased (N.T. 72-73).

Protestants' Witness Edward Koerper

Mr. Koerper of 300 Casey Circle, Huntingdon Valley, Upper Southampton Township, testified that the proposed Line is 143 feet

from his residence. It is a distance of 63 feet from the edge of the Conrail right-of-way to his home. The power Line pole is 80 feet from his property line. The right-of-way abuts his backyard for its entire length of 200 feet. (N.T. 97-100).

Mr. Koerper testified that he is married and have two young girls, ages three and four. The children have toys and swings in the backyard and play there often. There is also a patio used for family meals in the summertime (N.T. 99-100).

Both the PUC and PECO, Koerper testified, have told him and his family to practice prudent avoidance. He first met with PeCo representatives in August 1990. His family was told of the possible EMF risk and were then, and later, advised to practice prudent avoidance (N.T. 110).

Mr. Koerper testified that he has done a lot of reading and research on prudent avoidance and EMF. He was not reassured by the California PUC study which indicated that there were without doubt biological effects of EMF (N.T. 103;112).

With respect to the possibility of the Line being energized, Mr. Koerper testified that his family situation now is one of turmoil. If the Line were energized, the environment of the property would change and he knows his family could not practice prudent avoidance. He could not shield his family from EMF; therefore he thinks that he would have to move (N.T. 103-104). But such a move presents real problems because he could not morally sanction selling his house to another family knowing what he knows about the EMF risk (N.T. 109). To practice prudent avoidance at

that juncture would mean moving and giving up his house at the price of giving up the \$175,000-\$200,000 he owns in his home (N.T. 129).

PROTESTANTS' WITNESS MARGARET E. LAWLER

Mrs. Lawler of 1533 Grace Circle, Feasterville, Lower Southampton, testified that she lives 1 1/2 miles north up the Line from Mr. Koerper. Her property is adjacent to the PECO Line; it is 70 feet from the powerline pole to the side edge of her property, and another 20 feet to her house. Her side yard is between the house and the Line (N.T. 130).

Mrs. Lawler testified that she has children ages 21, 17, and 13. Her 17 year old daughter sunbathes and plays with friends in the yard, and her 13 year old daughter makes general use of it. There is a porch for summer meals, and the family dog is always outdoors (N.T. 131). Her children and other neighborhood children play a variety of street sports in front of the house in the cul-de-sac. The powerline is approximately 90 feet from the pavement of the cul-de-sac (N.T. 132).

Mrs. Lawler testified that she is aware of the concept of prudent avoidance and has stopped using electric blankets, keeps back from appliances, and keeps family back from television and VCR (N.T. 141). Based on her reading of literature and information obtained through PAUSE, she believes that with respect to EMF risk prudence avoidance is applicable strategy for her family (N.T. 138-139).

If the Line were energized, prudent avoidance would require staying indoors, spending little time outside or in the area, and staying away from the house itself (N.T. 138). Her family will move if Line is energized and, because of the threat, the house is already up for sale. Mrs. Lawler testified that there have been no buyers in 3 1/2 months and that people lose interest in the house when they learn about the Line (N.T. 133).

On redirect examination, Mrs. Lawler testified that she did not know how to define a safe line in her yard from one side to the other delineating safe from non-safe areas.

Protestants' Witness George L. Henry

Mr. Henry of 508 Militia Hill Road, Southampton, testified that he lives 2 miles east of Koerper. The Line is behind his house, 105 feet from the property line and another 60 feet from his home (N.T. 143).

Mr. Henry testified that he has a daughter, age 5. The backyard has a swimming pool, swing set, and workshop/garage in the works. His family spends a lot of time in the backyard, especially in the summer when the pool and swings see a lot of use (N.T. 144). His daughter also spends a lot of time at her friend's house two doors away where the backyard is 36 feet, 6 inches from the line (N.T. 145).

On cross examination, Mr. Henry testified that he is very scared of EMFs based on television specials he has seen (N.T. 147).

He also said that in terms of prudent avoidance he stays away from the microwave oven, plans to replace fluorescent light, and stays back from television (N.T. 148).

If the Line were energized, he would not let his daughter play at her friend's anymore; he would have his yard tested for EMF. He does not know what he would do if EMF effect were found. All of his money is tied up in the house, and, he testified, "This is like my dream house. With everything in this house and in the backyard, I don't know what I would do" (N.T. 145-146).

PROTESTANTS' WITNESS KAREN DALRYMPLE

Mrs. Dalrymple of 583 Valley View Road, Langhorne, Middletown Township, testified that she lives towards the eastern end of the Line; it is approximately 250-300 feet from the back of her home to the Line. It is 150 feet from her property line to the proposed transmission Line (N.T. 150-151).

Mrs. Dalrymple testified that her backyard is 206 feet wide and has a swimming pool, and a clubhouse where her son and his friends like to play and sleep out. The pool is near the property line. Besides her 15 year old son, Mrs. Dalrymple lives with her husband and the family dog. The family also has a hammock and enclosed porch in the backyard, and uses the land for croquet and volleyball (N.T. 152-153).

After having read all of the EMF literature she has available, she testified that "you can't help but be afraid". She is a nurse

and takes care of cancer patients; her greatest fear is dying of cancer (N.T. 155).

Mrs. Dalrymple stated that she knew that her neighbor had her house up for sale for 3 months and couldn't sell. Mrs. Dalrymple wants to move, though she's lived in house for 19 years; her husband does not want to start over, and disagreement has led to conflict (N.T. 154).

On cross examination and redirect, Mrs. Dalrymple testified that though her house was separated from the Line by woods, the Line can be seen from her house. She is not assuaged by the fact that the Conrail property is between her property and the Line, nor does the PECO literature tell her what distance from the Line makes her family okay (N.T. 157-158).

PROTESTANTS' WITNESS PATRICIA KELLY HALL

Mrs. Hall of 641 Valley View Road, Langhorne, testified that she lives towards the eastern end of the Woodbourne-Heaton Line, several miles from Koerper and Lawler. Her side yard is closest to the Line (N.T. 159-160).

Mrs. Hall testified that she is married and has two daughters, ages 16 and 13, and a boy age 12. Her children play outdoors a lot and in front of Mrs. Dalrymple's house (N.T. 160).

She is aware of the EMF issue and practices prudent avoidance. Mrs. Hall testified that she leaves the room when the microwave is on, won't use electric blankets, and has moved clocks

(N.T. 162).

If the Line were energized she would not let her children play down the street or at the Dalrymple's any longer. She would no longer want to swim or visit there either, though Mrs. Dalrymple is her best friend. She would want to have her home measured for EMF before deciding what further to do (N.T. 162-163).

PROTESTANTS' WITNESS BARBARA GLATHORN

Mrs. Glathorn of 467 Militia Hill Road, Upper Southampton, testified that she lives 2 miles east of Koerper and has been there for 19 years. It is 400 feet from the end of her property to the Woodbourne-Heaton Line (N.T. 165).

Mrs. Glathorn testified that her husband and 17 year old daughter have used their land for barbecuing, volleyball, sunbathing, croquet, and badminton (N.T. 165-166).

Mrs. Glathorn further testified that she has read a lot on EMF and seen television specials on the subject. Her readings have made her concerned enough to want to move. She has serious health concerns owing to history of cancer in her family. She also testified that she is aware that a school has been closed owing to EMF concerns. The school was in Fresno, California (N.T. 166-170).

On cross examination, Mrs. Glathorn testified that there is one row of houses between hers and the line, but only one house actually in between the Line and her home. Media reports are the basis of her EMF knowledge; she will have EMF measurement taken if

the Line is energized. She testified that she does not think that the intervening house makes her neighborhood safe (N.T. 172-174).

PROTESTANTS' WITNESS ROBERT H. MATIRKO

Mr. Matirko of 1390 Clover Lane, Feasterville, Southampton Township, testified that he lives 2 1/2 miles east of Koerper, and that the corner of his property is 37 feet from the Line itself. The Line runs along the back of his yard which is 195 feet long (N.T. 179-180).

Mr. Matirko testified that he has a heavily used patio, a hammock and a swing in the yard. Family functions involving up to 20 or 30 people are held in the backyard (N.T. 181).

With respect to EMF risks, Mr. Matirko testified that he is primarily concerned about his wife's health; she has a low immune system and gets allergy shots regularly. If the Line were energized, he would curtail the majority of use of the backyard (N.T. 184-188).

On cross examination Mr. Matirko testified that the Line is 166 feet to his home. He's lived there for 11 years (N.T. 186).

PROTESTANTS' WITNESS DANTE BONTEMPO

Mr. Bontempo of 1381 Clover Lane, Feasterville, Lower Southampton, testified that he lives 3 miles east of Koerper, across the street from Matirko. His home is parallel to the Line

with the front of his house facing the Line. It is 300 feet from the Line to his property N.T. 188).

Mr. Bontempo testified further that he uses the outdoor area in the cul-de-sac, approximately 30 feet from the center pole of the line. He has six grandchildren who play there on weekends at soccer, horseshoes, and stickball. If the Line is energized he does not think that they'll play there anymore (N.T. 189).

Mr. Bontempo also testified that he retired recently with plans to sell his home in a year or year and a half in order to have needed extra income. If the powerline is energized he will not get the needed money due to depreciation (N.T. 189). Unable to create the retirement fund he needs, he would have to change his standard of living. He stated that:

I would not be able to do the things that I thought I would be able to do in my retirement life: travel, have money for luxury items (N.T. 192).

On cross examination Mr. Bontempo said that he has lived in his house for 18 years. The cul-de-sac playground is located right next to the Conrail right-of-way. His grandchildren who play there visit almost every weekend. In an effort to practice prudent avoidance, he testified on redirect, Mr. Bontempo has gotten rid of his electric clock and thrown out his microwave oven (N.T. 194-197).

PROTESTANTS' WITNESS LYNN COHEN

Mrs. Cohen of 1509 Grace Circle, Feasterville, next door

neighbor of Mrs. Lawler, testified that it is 177 feet from the edge of her house to the powerline with one house in between. It is 147 feet from her property to the Line; her side yard is the closest part of property to Line (N.T. 199).

Mrs. Cohen testified that she has a 9 year old daughter and a 4 year old diabetic son. Her son plays a lot in the backyard and in the cul-de-sac which is 55 feet from the line pole. Kids there play baseball, basketball, and ride their bikes. Her daughter plays outside as well (N.T. 200).

All of the studies Mrs. Cohen has read link EMF with health risks. She testified that she has read a study which suggests that EMF has adverse effects on insulin production. If the line is energized, she does not think that the neighborhood will be safe (N.T. 201-203).

By way of practicing prudent avoidance, Mrs. Cohen has adjusted television, stopped using microwave, kept children back from television, kept lights out, and gotten rid of appliances like electric can openers. Mrs. Cohen testified of her and her husband that:

We take all the precautions we possible can to raise our children as healthy children. We just feel it is unfair that something is being put alongside my home that potentially can harm the children and it is really outside my control (N.T. 203-204).

Mrs. Cohen testified that the house is on the market and that it is written on the highlight sheet that lines are being installed. If the Line is energized, the family will leave their house and rent another whether or not theirs is sold (N.T. 204-

PROTESTANTS' WITNESS WILLIAM COHEN

Mr. Cohen of 1509 Grace Circle, husband of Lynn Cohen, testified that Mr. Oedemann from PECO came out to the house and gave estimates on magnetic fields. Mr. Boeggeman said that 360 amperes would be off peak current, 600 would be peak, and 1000 amperes would be maybe 4 hours per year. Cohen testified that Oedemann's numbers are different: 1,200 amperes would be peak and 1,800 would be maybe 4 hours per year.. PECO estimated 3 milligauss at 600 amperes, 5 milligauss at 1,200 amperes, and 8 milligauss at 1,800 amperes--these were in-house projections (N.T. 212-213).

Mr. Cohen stated that the scientists--epidemiologists, physicists-- that he has spoken to have made him fearful. He corroborated his wife's testimony that they will move into a rental house if the line is energized. He also testified that he was hospitalized with ulcers two months prior to testimony never having suffered from them before (N.T. 215-216).

PROTESTANTS' WITNESS CAROL DEMPSEY

Mrs. Dempsey of 705 Buck Road, Feasterville, testified that she lives 2 1/4 miles east of Koerper. Her property line is 105 feet from the powerline; it is 150 feet from the Line to the house

itself. There is no house between her and the Line; she sees it from her front window; the poles are on the same side of the tracks as her. Her house is elevated and so is actually more even with poles. Her children's bedrooms face the Line (N.T. 219-221).

Mrs. Dempsey testified that she has children ages 21, 19, and 14. Her family uses the backyard a lot; they have a terrace; she gardens 8 or 9 hours each week; there is also a patio (N.T. 219-221).

It was further testified by Mrs. Dempsey that with regard to EMF and prudent avoidance, she has read studies and newspaper articles. EMFs and their effects are a great concern to her. Not being in a position to sell the house financially, if the line were energized the family will spend as much time as possible away from its home. Her 14 year old daughter would not be able to play in the yard (N.T. 222-223).

On cross examination Mrs. Dempsey testified that before deciding to spend time away from the house she would have a magnetic field measurement taken, but she would not regard a low reading as safe (N.T. 226).

PROTESTANTS' WITNESS FRANK ENGLISH

Mr. English, of 239 West Bristol Road., Feasterville, Southampton Township, testified that it is 101 feet from the Line pole to the corner of his house. It is 90 feet from the powerline to his property line. The Line runs at an angle and his house is

set at an angle to the Line. It is closest to the northwest corner of his home, in the rear. There is a deck which runs the full length of the back of his house (N.T. 228-230).

Mr. English testified that at the time that he learned about the line construction he had been reading about EMF and became very concerned (N.T. 231). He helped put together the first citizens' meeting about the potential line. The more he learned about EMF the more he felt he did not want to be associated with it. It made him very "upset" and "angry" because the field is invisible and you can't control it (N.T. 233-234).

Mr. English testified that he and his wife have lived in their home for 12 years and bought it with the understanding that they did not want to move again. They have spent a lot of money on their home. But the fact is that if there is a possibility of exposure to cancer or biological cell change, he doesn't want to be there; if the Line is energized he will abandon the property (N.T. 234).

It was further testified by Mr. English that he and his wife consciously try to practice prudent avoidance. They are careful with microwaves, have changed around televisions and radios, and have eliminated certain electrical items (N.T. 234).

The English's have put the house on the market and potential buyers have explicitly indicated that they are not interested because of the powerline and the proposed energization (N.T. 235).

PROTESTANTS' WITNESS DOROTHY ENGLISH

Mrs. English of 239 West Bristol Road, Feasterville, corroborated her husband Frank English's testimony.

Mrs. English testified that when the Line issue arose, she began to make calls about EMF and got many papers and articles. She was bothered by how old some of the research was and how long the EMF issues had been around. If EMF can affect cells, she doesn't want to be near it. She understood from PECO that milligauss levels would be 100 at the edge of the right-of-way, and 30 at the edge of her home. Her research tells her that 2 1/2 -5 milligauss would be safe. It is her understanding that EMFs accelerate rate of cell division and even cause alteration to the structure of cells (N.T. 242-243).

Mrs. English further testified that there are enough questions about EMF that "it is not reasonable to ask people to be subjected...and essentially be human guinea pigs until the research is settled" (N.T. 243). For her and her husband's part, they have practiced prudent avoidance by measuring appliances, rearranging rooms, and reducing appliance use (N.T. 243-244).

If the Line is energized the Englishes will leave. They have reduced the price of their house \$60-\$70,000 in an attempt to sell, but people say the Line is too close (N.T. 245).

Mrs. English testified that she is a co-founder of PAUSE. PECO and non-PECO people came to talk to citizens about EMF's and Mr. Stan Johnson of PECO downplayed EMF danger and cited the statistical insignificance of two additional child cancer victims out of 10,000 which made Mrs. English very angry (N.T. 246-247).

She also testified that Mr. Johnson said EMF was a social issue, that society had to decide what to do about it. Mrs. English testified:

Well, if the onus is on society to decide what to do about it why don't we have a say in whether this line is put up or not? None of us were notified. The township didn't recall being notified (N.T. 247).

On cross exam Mrs. English testified that she tested outside home for EMF and level was 0 milligauss. Indoors has been tested and the levels tend to be significantly below 1 milligauss (N.T. 248).

Of the English's indoor appliances, only the refrigerator is on 24 hours per day, seven days per week, and its emissions don't compare to the proposed Line according to what PECO said, Mrs. English testified (N.T. 249).

PROTESTANTS' WITNESS WILLIAM J. HARLEY

Mr. Harley of 1660 Bonnie Brae Drive, Huntingdon Valley, Upper Southampton township, testified that the rear of his home is 206 feet from the proposed Line. At the rear of his home is the dining room and the office where he sometimes spends 10 hours per day working. The Line is 60 feet from his property line. The rear of the house, 270 feet, runs parallel to the Line (N.T. 250-251).

Mr. Harley also testified that he has two grown children who live with him, as well as his wife. The backyard is used for

picnics, friends, son's lab, deck, basketball (N.T. 252).

Mr. Harley stated that he has read up on EMFs and seen programs on television. He is scared about his family's exposure to EMFs given the history of cancer in his family and his wife's family.

Mr. Harley testified that he only moved in 15 months ago. Now he cannot sell his house. A realtor told him that he would only get 25 percent of what he paid because of the proposed Line. After adding in other expenses, he calculates that he just cannot afford to move. The alternative to taking a loss on the sale of his home is to walk away, but he feels that he is locked in. The property seemed to him to be where he wanted to retire (N.T. 253-254).

PROTESTANTS' WITNESS VIRGINIA LYNN MONARCH

Mrs. Monarch of 17 Wychwood Lane, Langhorne, testified that the Line goes along back of her property line, about 50 feet back. It is about 170 feet from her home to the Line (N.T. 258).

Mrs. Monarch has a husband, a six year old daughter and an eleven year old son. Her bedroom and her son's are at the rear of the house. The children play in the yard; there is a swing set, sandbox, picnic table, clothesline, and basketball court (N.T. 259).

Mrs. Monarch testified that she has read about EMF risks in regard to leukemia, cancer, melatonin. Her son already has attention deficit syndrome and she fears he is going to get much

worse because of EMF (N.T. 260).

She testified that if the Line were energized she would move.

She further stated:

• We moved to this house and we thought it was our final house, you know, that we would live there forever. So it is a major disruption of our plans. Our children are very well settled in their schools and all that. I don't know how to balance it, but financially it would be devastating (N.T. 261).

On cross exam she testified that her property line abuts the Conrail property. Her family has had its house for 4 years; the Line was defunct when she moved in (N.T. 262-263).

PROTESTANTS' WITNESS ALIX SHIRLEY MAIER

Alix Shirley Maier, of 1331 Clover Lane, Feasterville, testified that she lives on the same block as Bontempo and Matirko. She lives across from the transmission Line, facing it (N.T. 263).

Mrs. Maier testified that she has a daughter, 11 1/2, and a son, aged 9. She and her children walk around the neighborhood a lot, and the kids play in the fenced in backyard. Her children are home a great deal because the Maiers home school them. The children also play in their neighbors' backyards (N.T. 265-266).

Mrs. Maier further testified that when she was younger she lived near power lines. Out of the 9 closest houses to the lines, there were 4 cases of cancer including her. Mrs. Maier had uterine cancer which required years of extensive treatment (N.T. 265).

If the line were energized, Mrs. Maier testified that she would not want her family to remain in the house. She said that,

financially, her family could not afford to move, but she would find someplace to go (N.T. 267).

PROTESTANTS' WITNESS ROBERT SMALL

Robert Small, of 15 Wychwood Lane, Langhorne, testified that he lives two doors from Mrs. Monarch. The back of his property is 200 feet long and runs parallel to the train tracks. It is 45-50 feet from his property line to the center of the Conrail right-of-way (N.T. 269-270). Depending on which corner of the house chosen, the power Line is 110 or 130 feet from his home (N.T. 275).

Mr. Small testified that he has a son, aged 5, and a daughter, aged 2. The back area of the Small's backyard has a jungle gym; there is a deck which runs along the back of his house. Mr. Small's daughter's bedroom is in the rear of the house. His children spend a lot of time playing in the backyard (N.T. 275-276).

If the Line were energized, Mr. Small stated:

I am going to be in a situation where I can't run the statistical probability of even an hour a day being too much exposure for them [his children]. I don't want to be talking to them 15 years down the road and saying the reason why you have a health problem is because I underestimated the dosage. I should have only allowed you to play 45 minutes in the backyard, not an hour and 15 minutes... So basically it has turned my backyard into a wasteland (N.T. 277).

As to prudent avoidance, Mr. Small testified:

They're [PECo] going to put something that's going to blast my property 24 hours a day, 365

days a year. That is being put to me. There is no way I can exercise prudent avoidance on something that is being put to me in such a constant fixed fashion (N.T. 278).

If the line were energized, Mr. Small will have to move his children out of the risk environment; he will move. The move will cause him to lose \$30-\$50,000 just in out of pocket expenses alone. He estimates that between \$25-\$40,000 of improvements have been done over the years that he will have to walk away from (N.T. 279-280).

PROTESTANTS' WITNESS JOSEPH BIANCHIMANO

Joseph Bianchimano, of 91 Bridgestone Drive, Langhorne, testified that it is 50 feet from his property line to the PECO transmission Line. It is 75 feet from the Line to his house (N.T. 437-438).

Mr. Bianchimano testified that he has a wife, and children aged six, and 12 months. His children play out in the street along which the Line runs adjacent; all the neighborhood kids play there. He testified, as president of the homeowners association, that there had been plans to build a playground at an open area on the block (N.T. 438; 447-448).

Mr. Bianchimano testified that he has read EMF literature and feels he cannot take a chance with his children given the cancer risk. Having read Swedish studies, EPA reports, NPR announcements, and about seminars in Washington, D.C., he believes that the preponderant evidence indicates an EMF risk to health. As a

"reasonable parent", he cannot subject his children to the risk (N.T. 440-441). His wife's family has a history of cancer, and she herself had a cancer operation in May 1991.

It was further testified by Mr. Bianchimano that his family tries to practice prudent avoidance. Family members stand away from the microwave and television; his son was moved out of the room under the attic which has an electric heating unit; they use no electric blankets and have moved clocks. He testified that there is nothing he can do to avoid EMF risk from line owing to its closeness; he cannot avoid a transmission line over which he has no control (N.T. 445-447).

Mr. Bianchimano testified that if the Line were energized, he would not use the play area outside for children because of his EMF concerns. If the line were energized, in fact, the homeowners association would not build a playground as planned. If Mr. Bianchimano were to stay despite energization, he would drive his children to a safe place to play. But that is a moot point because he will leave his home if energization takes place (N.T. 450-452).

Mr. Bianchimano is a real estate agent. He testified that he has been unable to sell his house (N.T. 439). As a realtor, he has a moral problem selling property near lines or substations. He would communicate concern about the Line and energization thereof to any prospective buyer of his home. People have questions as to why three houses on his block are for sale; one neighbor just left with 3 children and turned his house over to the bank (N.T. 442-444). He knows from the Multiple Listing Service--and in his

capacity as president of the homeowners association-- that the other houses on his block were not for sale prior to the date of notice of PECO's intent to energize the Woodbourne-Heaton Line (N.T. 455).

Mr. Bianchimano testified that he would remain in his home were it not for the Line. His child is in a special education program in the Council Rock School District, he'd have to move to another district (N.T. 459). As for the house, he paid \$300,000 for it and has done an estimated \$35,000 in improvements, including \$12,000 in landscaping alone. His family has plans and desires to further improve the house (N.T. 457; 460). Mr. Bianchimano stated:

This is my dream house. This what I have worked 40 years for. This is what I have always wanted. And now that I have it, it's dashed away by a powerline that I have absolutely no control over.

PROTESTANTS' WITNESS JOHN FOX

John Fox, of 17 Wychewood Lane, Langhorne, testified that one corner of his property line is 60-70 feet from the Woodbourne-Heaton Line. His property is approximately .8 acres. His home is approximately 170 to 190 feet from the Line (N.T. 466-467).

Mr. Fox testified that he has a wife, a 10 year old son, and a six year old girl. The childrens' rooms are closest to the powerline. His children play throughout the neighborhood, including the wooded area of the yard that runs by the Line (N.T. 468-469).

Mr. Fox averred that he is nervous and upset about the health

risk produced by the line. He has learned about the increased incidence of cancer, leukemia in children, brain cancer, and other risks linked to EMFs. He has learned of the definite connection between EMFs and human cell operation (N. T. 470-471).

EMF reports have changed the way Mr. Fox's family approaches electricity in their home. Clocks have been moved, microwave use has been reduced, and a terminal shield is used by Mr. Fox when he works at his computer (N.T. 471;473).

If the Line were energized, Mr. Fox testified that he would move. A man who was interested in buying his house decided not to because of EMF risk (N.T. 469). He paid \$210,000 for his house and has added an estimated \$30,000 more in investments. If he could not sell the house in a couple of years, Mr. Fox would have to consider abandoning it (N.T. 472-473).

PROTESTANTS' WITNESS JOSEPH KELLY

Joseph Kelly, of 3904 Warfield Drive, Huntingdon Valley, testified that his business address is 206 Holland Road, Holland. His business, real estate sales and management, employs 6 people full-time. It is 500 feet from the Line. His business has been at its present location for 7 years. (N.T. 474-475).

The intention to energize the Line, Mr. Kelly testified, has led to an awareness of EMF health issues; employees now stay 3 to 4 feet back from computer terminals. He is concerned about his health and his employees have voiced health concerns as well (N.T.

476-477).

If the Line were energized, he would strongly consider relocating his business though it is presently in a prime business location and he is known to be there (N.T. 476).

In selling houses, Mr. Kelly testified, he would feel obligated to tell buyers about the Line. He is aware that other properties abutting the Line have been on the market for 6 to 9 months, and one has even been on the market for a year and a half (N.T. 478-479).

On cross exam, Mr. Kelly testified that he knows of other houses away from the Line that have been on the market 6 to 9 months but that 1 1/2 years is rare (N.T. 480). Mr. Kelly spends 10 to 12 hours per day in the office; his employees are there between 5 and 6 hours per day (N.T. 481).

PROTESTANTS' WITNESS MICHAEL LAWLER

Mr. Lawler, of 1513 Grace Circle, Feasterville, testified that the power Line is 70 feet from his property line. It is 90 feet from his house to the power Line (N.T. 481-482).

Mr. Lawler further testified that he has a wife, and children ages 21, 17, and 13. His children play ball in the yard parallel to Line and in the cul-de-sac out front with the rest of the neighborhood children (N.T. 482; 484-485).

Mr. Lawler testified that he and his wife have been very scared about EMFs since learning about them television and

magazine articles. By way of prudent avoidance of EMFs, they have stopped using electric blankets, they have forbidden the children to use the microwave, and he and his wife stand back from the microwave and the electric stove (N.T. 483-484).

The Lawler's house had been for sale for three months at the time of the hearings; they put it on sale because of fear of EMFs. The Lawler's paid \$80,000 for the house and have put in an additional \$4,000 in improvements. No one has made an offer on the house (N.T. 483-484).

If the Line were to be energized, Mr. Lawler testified, he would not let his kids play in the yard or the cul-de-sac anymore. He will also be "scared to death" if energization occurs, and financially hurt. He will have to drive his children to another location to play. His wife is very upset about having to move as she loves the house and neighborhood (N.T. 485-486).

PROTESTANTS' WITNESS ELAINE KUPCINSKI

Mrs. Kupcinski, of 1508 Grace Circle, Feasterville, testified that it is 70 feet from her property line to the proposed power Line. It is 90 feet from the Line to her home (N.T. 487-488).

Mrs. Kupcinski testified that she is married with three daughters aged 12 and 14. Her kids play in the backyard, parallel to the Line, and in the cul-de-sac across the street like the Lawler children (N.T. 488-489).

She further testified that she has read EMF literature through

PAUSE and seen it in the media (N.T. 494). Her kids are scared of EMFs and say they don't want to stay; they don't want cancer, leukemia, or tumors (N.T. 493).

Mrs. Kupcinski has practiced prudent avoidance. She has moved the family's clock and leaves the room when the microwave or dishwasher are in use (N.T. 489).

If the Line were energized, testified Mrs. Kupcinski, she would no longer allow her children to play in the yard and cul-de-sac. In fact, she would move, as she feels that she would be "writing" her "childrens' death warrant" if she stayed. Both her and her husband's families have cancer histories (N.T. 489-490).

Mrs. Kupcinski testified that the family has a \$60,000 mortgage and has put in \$1,000 worth of improvements. She would move whether or not the house could be sold. The house has not yet been put up for sale as she recognizes the problem of several houses on the block being for sale concurrently and has held off accordingly (N.T. 491). She sees no options to avoid the EMF risk but to move (N.T. 496).

OCA WITNESS DAVID M. ROSENBAUM

David M. Rosenbaum testified that he is President of Risk Analysis Corporation, Suite 202, 6723 Whittier Avenue, McLean, VA 22101. Mr. Rosenbaum has over 20 years of experience in analyzing the effects and risks of exposure to ionizing and nonionizing radiation and other risks (OCA Direct 2, 1). Mr. Rosenbaum

testified that he is qualified to judge the policy implications of a body of biological, epidemiological, engineering and physics literature (OCA Direct 2, 2).

Mr. Rosenbaum testified that several epidemiologic studies have reported an association between what may be surrogates for longterm average magnetic field strength and certain types of cancer. Some studies show no relation; different studies show different things. Wertheimer and Leeper found increased cancer death rate among children living near powerlines; adult leukemia calculations yielded the same results. Barregard et al found no increase in mortality or cancer among men exposed to strong magnetic fields at work. Tomenius saw only three tenths the expected number of cases of leukemia in those more highly exposed to fields, and noted an increase in tumors and benign childhood tumors among those nearer to lines and higher fields (OCA Direct 2, 3). Gordon et al showed a relative risk for people 100 to 150 meters from lines that is more than four times the relative risk for people within 100 meters. Savitz et al reported modest effects as a function of magnetic field strength in homes, and found evidence that wire coding is associated with childhood cancer. Rodwall et al studied individuals within 200 meters of a 220 Kv line and found no childhood cancer cases and a lesser incidence for all ages than was expected. Several others found no associations (OCA Direct 2, 4-5). Mr. Rosenbaum characterized the data as confused (OCA Direct 2, 5).

Mr. Rosenbaum testified that knowledge of the effects of

nonionizing radiation--which characterize transmission fields--is very incomplete. He testified that prudent policy in the face of such uncertainty would be: research, public information, the involvement of the public in decision-making before critical decisions are made, and consideration of costs and effects of possible mitigative measures by companies considering line projects before construction is decided upon--this was not done in the PECO case where calculations were performed after the Line was virtually completed (OCA Direct 2, 6-7).

Mr. Rosenbaum testified that mitigative measures may include avoiding heavily populated areas, avoiding parks, schools and public facilities, widening right-of-ways, using higher ground clearances, and designing lines to reduce fields (OCA Direct 2, 7). He said that reductions of 50-75% over current field reduction practice should be possible at reasonable cost (OCA Direct 2, 8). Using current safety codes may mean using codes which ignored field strength (OCA Direct 2, 8).

Mr. Rosenbaum testified that the notion of "Too Costly," should be worked out in public consultations (OCA Direct 2, 8).

In oral testimony, Mr. Rosenbaum testified that he got his information that 50-75% reduction in average magnetic field strengths can be achieved at reasonable cost from Pennsylvania Power and Light though it did not refer to this particular Line (N.T. 314). For a particular right-of-way, if one designs a line that has lower fields than other design alternatives at reasonable cost, then--understanding that prudent avoidance means a number of

things--that would be consistent with the idea of prudent avoidance (N.T. 315-316).

There are different kinds of epidemiology studies. Mr. Rosenbaum testified that a case control study involves focusing on people with the relevant disease. In a cohort study you focus on a group which does something thought to be possibly risky. A retrospective study is not a different category but a different kind of axis (N.T. 317-322). Mr. Rosenbaum testified as to the strengths and weaknesses of different kinds of studies (N.T. 322-323).

Mr. Rosenbaum began to review specifics of studies by Wertheimer and Leeper, Barregard, Tomenius, Savitz, Rodwall, McDowell, Fulton, Coleman, Myers, and Severson. He testified as to the confused state of much of the literature; he discussed different methods of field measurements in the studies, the differing significance levels, and the difficulty in assessing some results (N.T. 328-347).

Mr. Rosenbaum testified that his understanding is that it is generally possible, though not under every circumstance, to lower fields by 50-75% on new lines at reasonable cost (N.T. 348). He meant that these reductions were to apply to new lines, truly "new" lines (N.T. 352). The word "new" so understood does not apply to a new line on an old right-of-way (N.T. 354). He did not recall seeing references to alternative locations for the Line in PECO's answers to interrogatories (N.T. 350).

Mr. Rosenbaum testified that building a line where there are

no homes, or removing the populations, could be two ways to avoid building a line through heavily populated areas (N.T. 356).

Mr. Rosenbaum testified that if a study does not come up with a correlation, that does not mean that there is none; latency, in this regard, is a factor (N.T. 360-361). To develop a position on EMF, it is necessary to study both epidemiological and biological evidence. There is enough evidence to show that people--the state, PECO--ought to consider prudent avoidance measures as a matter of public policy (N.T. 362-363). He thinks that the evidence is strong that EMFs at frequencies under consideration in this case can interact with human cells, and there is enough evidence in the biological field that EMF concerns should be taken seriously (N.T. 367-368).

In further written testimony, Mr. Rosenbaum dealt in part with the prefiled testimony of PECO witness Dr. Philip Cole. He testified that "irregular," in "irregular statistically significant associations" or "irregular associations," on page 16 of Dr. Cole's testimony, suggests a weakness of Dr. Savitz's results that wouldn't be suggested without the modifier. "Irregular" has no technical meaning in this context and it is unclear (OCA Surrebuttal Rosenbaum, 1).

The most important thing about the studies of Wertheimer, Savitz, and Peters is that each found associations between wire code configuration and childhood leukemia. It is not necessarily the case that a more carefully done study should get stronger results (OCA Surrebuttal Rosenbaum, 2).

In addressing the prefiled testimony of PECO witness James Michael Silva, Mr. Rosenbaum testified that the real issue germane to prudent avoidance is the question of what is good public policy. As he stated in earlier testimony, the public should be involved in the decision-making process before the critical decisions are made. Companies should at least consider the costs and effects of possible mitigative measures before construction decisions are made. Such an approach was not used by PECO. All calculations on alternative designs were done only after the line was virtually finished, and then only after a request from OCA (OCA Surrebuttal Rosenbaum, 5).

Mr. Rosenbaum returned to give more oral testimony. He testified that epidemiology is often relied upon in public policy decisions (N.T. 1372). There is no indication from the epidemiological work of Wertheimer and Leeper, Savitz, and Peters that the EMF association will go away in future studies. It is possible to have a situation in which you act imprudently and no harm gets done, he granted, but such thinking does not make for good public policy (N.T. 1374; 1377).

After much technical questioning and answering relating to odds ratios in the Savitz and Peters studies and the calculation thereof, it was established by Mr. Rosenbaum that when the odds ratios are compared head to head--very high compared to very low or underground--and we use the extremes that Savitz employed, the relevant numbers decrease from Savitz to Peters (N.T. 1410). Since Savitz and Peters chose to report their results at a statistical

significance level of 95%, the observed associations between wiring code and leukemia, though present, were deemed statistically insignificant (N.T. 1412-1413). But, Mr. Rosenbaum testified

There is nothing holy about any particular level of statistical significance that is chosen. If something turns out to be significant at the 95% level that in and of itself does not prove the association, nor does it prove that--nor is there a dramatic...[difference] if it is slightly below 95%
...the actual confidence level that it is at is important in judging the worth of the result, but it is important to take, as I think the company [PECo] witnesses have said already in this case, it is important to look at all the data and try to get a sense of what it all means (N.T. 1415).

Mr. Rosenbaum testified that you cannot take 3 studies, which represent at most 2 comparisons between first and second and second and third, and make a long range general trend out of them, particularly when there is question as to the comparability of the categories. You cannot make the deduction that if more and better studies are done that the associations will go away. The striking thing is that all three studies report positive associations; there is just as much reason to think that continued studies will report positive associations as there is to think that such studies will show weaker and weaker positive associations (N.T. 1422-1423).

OCA WITNESS DAVID E. JANES

David E. Janes testified that he is Vice President of Risk Analysis Corporation of McLean, VA. He has over 30 years of experience in analyzing the effects and risks of exposure to

ionizing and nonionizing radiation (OCA Direct Testimony 1, 1).

Mr. Janes testified that exposure to EMFs "produces demonstrable, measurable effects in humans, animals, and experimental cellular systems" (DCA Direct 1, 2). A field is called "weak" if the density it induces in tissue is too small affect the function of critical tissues. Normal current densities associated with the eletrical activity of the brain and heart have lower limits of .1 and 1 microampere per centimeter squared. This corresponds to unperturbed, 60 hertz, electric fields of 8.3 and 46 per meter respectively. The 60 hertz magnetic fields have been calculted to be 5,300 and 44,000 milligauss (respectively) in the brain and heart.

For the proposed line, PECO has calculated the maximum right-of-way fields to be 1.9 to 2.3 Kv/m and fields at the edge of the right-of-way to be 1.2 to 1.3 kv/m. If the Line carried a normal load of 360 amperes, PECO has calculated that it would produce magnetic fields of 42 milligauss and 25 milligauss at the center and edge of the right-of-way respectiviely (OCA Direct 1,3).

Larger unperturbed fields must be used in lab studies of small animals to obtain the current densities equivalent to those induced in humans. The interaction of power frequency magnetic fields with humans and animals causes currents inside the body. Exposure to weak EMFs affect biological systems. Studies show positive and negative results as well as neutral ones (OCA Direct 1, 6).

Mr. Janes testified that weak fields disrupt circadian rythms, biological rythms which repeat at approximately 24 hour

intervals (OCA Direct 1, 7). There are effects on melatonin and neurotransmitters; there is a wide variety of effects in cellular systems (OCA Direct 1, 8).

Mr. Janes offered the following conclusions in his written testimony: 1) weak EMFs affect biological systems; 2) biophysical and biological mechanisms that give rise to observed effects cannot be rejected, and concerns are legitimate (OCA Direct 1, 10).

In oral testimony, Mr. Janes testified that while it is true that non-transmission sources are more common than lines and produces power frequency fields, and could play an enlarged role as a public health problem, one must appreciate that there may be a dose response where effects are related to intensity. One has to answer in terms of what actual exposure is in a given field (N.T. 378-379).

While many of the sources Mr. Janes used were not peer reviewed literature, none of them failed to meet his personal professional standards of quality (N.T. 397). Mr. Janes does not discard a publication simply because it is not in a peer review journal, nor does he accept one simply because it is. He undertakes some independent evaluation to determine whether or not he should rely on a report or study (N.T. 399). The set of articles he used addressing melatonin research and Goodman's work were drawn by Mr. Janes from peer reviewed literature and the factor of peer review was one criterion for selecting quality material. He did conduct an independent expert evaluation of each study cited (N.T. 404). He would not accept a biological effect as proven solely on

the basis that that conclusion was contained in peer reviewed literature, though that factor would be considered (N.T. 405). An independent evaluation of the relevant research is what should be done (N.T. 406).

Mr. Janes testified that circadian rhythms occur in other areas besides endocrine systems. Some circadian rhythms affected by EMF include melatonin, rates of respiration, oxygen and carbon dioxide production, and some neurotransmitters (N.T. 412-413).

Mr. Janes testified that he is aware of no scientific work which disproved the validity of the model proposed to determine the interaction mechanisms which involves changes in cell membranes which affect cell function (N.T. 424-425). Another model is the resonance model; there is no consensus as yet as to the validity of that model (N.T. 424-427).

In his written surrebuttal testimony, Mr. Janes' reaction to the testimony of PECO witness Dr. Edward Gellman was to assert that more research is needed to resolve the present uncertainties about the role which melatonin plays in carcinogenesis (OCA Surrebuttal Janes, I).

In additional oral testimony, Mr. Janes testified that he had not had a chance to see the Demers study which was published in the American Journal of Epidemiology in 1999 to an incidence of cancer in males categorized by exposure to EMFs. It is recent research like Demers, Vilsons, and others that suggest a need for additional research (N.T. 1427; 1428; 1430).

Mr. Janes testified that the Electrical Power Research

Institute currently funds research on biological effects of power frequency fields (N.T. 1449). He is not aware of any direct studies of EMFs on pineals and cancer all in the same study. He has called for that gap in reach to be closed (N.T. 1458).

PROTESTANTS' WITNESS RONALD C. TURNER

Mr. Ronald C. Turner, of Ronald C. Turner & Associates, architects and planners, P.O. Box 68, New Hope, PA, is a professional land use planner.

In his written testimony, Mr. Turner testified that over the last 40 years, the six townships crossed by the Woodbourne-Heaton Line have shifted from rural and low tensity communities to flourishing suburbs with intense land uses. In 1950 the townships had a population of 31,285; by 1990 that figure had grown to 161,310. Some of the land usess adjacent to the Line include Eastern Montgomery County Vocational Technical School, Willow Grove Day Care, Mason's Mill Park, Southampton Industrial Park, Playwicki County Park, Lanhorne Country Club, Buehl Airfield, and residential developments (Protestants' Direct 1, 1).

Mr. Turner stated that

the land use patterns around the Line have intensified at an extraordinary rate over the past four decades and are expected to continue into the future. This continued urbanization of the large townships is a significant factor in deciding whether or not the Woodbourne-Heaton Line should be energized (Protestants' Direct 1, 1).

Mr. Turner also testified that

Research on electromagnetic radiation and its effects...is extensive and still quite active and does legitimize the concerns of local governments which are entrusted with protecting the public's health, safety, & welfare (Protestants' Direct 1, 2).

Mr. Turner testified that standards for the strength of EMFs from lines exist in New York, Florida, Britain, Japan, Poland, and the ex-Soviet Union (Protestants' Direct 1, 2-3). Uncertainty and fear with respect to EMF risks constitute a variable now significant in the planning and regulating of utility lines and public facilities. Mr. Turner expects that the regulatory stance of communities will shift the burden of proof to operators of facilities which emit EMFs and put all such land uses as conditional use subject to review. He also anticipates that standards will be created limiting off-site impacts beyond right-of-ways. He offers highways and accompanying sound walls as an example (Protestants' Direct 1, 3-5).

Mr. Turner testified that fear of EMFs provides motivation for families to leave their homes. Disinvestment leads to changes in land use patterns generally associated with higher density housing, conversions, and ultimately as last resorts for persons of moderate to low income (Protestants' Direct 1, 5-6). Mr. Turner stated that as long as there is uncertainty and disagreement about EMF issue, there is a "high probability" that one result will be, "changes in land use, which are contrary to local policy and zoning... in the areas immediately adjacent to transmission lines" (Protestants' Direct 1, 6).

Prudent avoidance may not justify costly and major rerouting of extant facilities, but may indeed justify the modest cost of regulating proposed facilities so as to avoid potentially greater costs down the road, Mr. Turner said. He continued, "that is, encourage the placement of EMF facilities away from areas where people live and work" (Protestants' Direct 1, 7).

As reasons why prudent avoidance is appropriate in the Woodbourne-Heaton case, Mr. Turner stated: first, the community context of the Line has changed radically in the last 40 years; second, public concerns and fears have mounted to the point that damage to values and community life would be avoided by not energizing the line; third, changes to Line of the size noted within a right-of-way designed for a rail line is unsound without additional evidence; fourth, the issue of whether planners would have selected a 60 foot right-of-way given the new EMF information; fifth, the question as to whether the line is absolutely essential for the region's power system; sixth, the issue of alternatives to using the narrow right-of-way; the question as to whether it might be prudent to avoid energizing the Line until there is greater evidence with regard to health effects (Protestants' Direct 1, 7-8).

In oral testimony, Mr. Turner testified that analyses of zoning issues and land use patterns were both essential parts of his professional opinions and viewpoints as set forth in his written testimony (N.T. 520).

Mr. Turner further testified that because it is a significant

criterion of prudent avoidance that lines avoid populated areas, he and his associates examined the history of communities contiguous to the Line to see whether or not they were urbanized and were continuing to be urbanized (N.T. 537). Hatboro Borough has increased its population by 50% over 40 years and, despite being fairly well developed, continues to be urbanized. Though the Line is immediately south of Hatboro, the Borough is one of those areas which Turner and Associates studied as part of the corridor analysis pertaining to land use (N.T. 550-551).

Mr. Turner testified that the function of the urbanization factor is to establish whether or not one is dealing with a continued urbanization area, and whether the population will continue to come in (N.T. 552).

Lower Moreland has grown over 400% in the last 40 years. Though Lower Moreland extends up to 2 miles from the Line, it was included in the corridor analysis as part of the comprehensive approach to the issue of land use. Accordingly, he included data on the population growth for the entirety of townships such as Lower Moreland (N.T. 553-555).

It was testified by Mr. Turner that one reason for the prudent avoidance approach is related to the effect on property values as reflected in quality of life; his position is that energizing the Line will affect property values and cause disinvestment, where disinvestment is understood to refer to people leaving their homes under financial duress (N.T. 556-561).

Mr. Turner testified that interviewing Protestants confirmed

for him the issue of fear of EMFs. The conclusion as to fear of EMFs was based on interviews, literature, and experiences in Phoenixville, PA and Upper Providence Township, PA where there was considerable concern about the off-site impacts of EMFs (N.T. 564).

Mr. Turner's assignment was to examine the effects of the Line on the profession of land use planning and the communities to be affected; that job involved derivatively PAUSE statements as to property values (N.T. 567).

Mr. Turner has in fact been contacted by a township to prepare an ordinance dealing with the issue of off-site impacts of transmission lines and radio towers (N.T. 614). Off site impacts have been coming into play in the planning profession more and more over the last 20-25 years. With current emphasis, publicity, and research into health impacts of EMF, we will see an attempt to regulate off site impacts (N.T. 620). It is Mr. Turner's opinion that the health effects will be incorporated in the nuisance ordinances or performance ordinances in communities (N.T. 621). Mr. Turner later testified that by "nuisance," in his testimony, he means not the legal definition but an action by a party that affects one's use of one's own property (N.T. 700).

Mr. Turner testified that as a planner he deals with impacts of land use; the use of land is a determiner of its value. He is constantly dealing with the appropriate disposition of land uses with public and private clients (N.T. 679). He regularly deals with the impacts of land use on adjacent land use and community-wide land use (N.T. 680). Professional planners are aware of values

and how they shift according to land use in the area; within the land use classification system is a system of community values and worth. Mr. Turner himself has written land development ordinances (N.T. 680-681). He has also written and evaluated zoning ordinances which involves taking into account the effects of different zoning classifications and existing uses in zoning and land values. Such work also involve seeking mitigating devices and dealing with differences in land uses in order to avoid impacts on value and decreased quality of life (N.T. 682).

The building and energizing of the Line, testified Mr. Turner, is something that persons living adjacent to it consider an onerous land use, an interference and nuisance that they cannot mitigate. Disinvestment is a pattern of economic behavior based on trying to optimize one's lifestyle; in cases where there are onerous land uses and nuisances, people will attempt to move (N.T. 683).

Mr. Turner testified that the use of literature, interviews with realtors, appraisers, and citizens, are normal research techniques and a normal source of data in determining whether there will be a disinvestment which will result in further changes in land use (N.T. 686).

Uses which have a significant external impact should not be located in an area where that impact will be felt by a significant number of people and/or other kinds of land uses. Distance is one of the coefficients or parameters used with regard to onerous uses as opposed to more normal uses. Planning literature deals with buffers and separations and other means to isolate onerous uses

from more normal patterns of land use within a community (N.T. 725).

PROTESTANTS' WITNESS ABRAHAM R. LIBOFF

Abraham R. Liboff testified that he is professor of physics and also director of the medical physics doctoral program at Oakland University in Rochester, Michigan. Dr. Liboff has been involved in biophysics and medical physics research since 1968, focusing in three areas: the physical properties of biological materials, the experimental effects of electric and magnetic stimulation on living systems, and the mechanisms underlying the interaction of weak magnetic fields and living systems. Dr. Liboff organized the first conference ever held to specifically examine the evidence for bioelectromagnetic interactions. He is currently a reviewer for the key journal in the area of bioelectromagnetism, Bioelectromagnetics, and an Associate Editor for the Journal of Bioelectricity (Protestants' Direct 2, 1).

It was known back in the 1960's that weak electrical currents can influence repair mechanisms in hard and soft tissues. Electromagnetic procedures have become "recognized clinical techniques for treating certain types of bone problems" (Protestants' Direct 2,1). Cells must have a specialized mechanism to detect weak electrical signals, but a physical explanation has yet to be found (Protestants' Direct 2, 3). A weak electric or magnetic field is one so small that there is no good physical reason to suppose any sort of physical interaction with living

systems; magnetic fields associated with power lines fit into this weak category (Protestants' Direct 2, 3).

Dr. Liboff's research 11 years ago found that cells exposed to weak extremely low frequency (ELF) show changes - they consistently exhibit an increase in DNA synthesis. Marron et al showed that protein synthesis can be affected; Bawin et al found that calcium efflux from brain tissue can be enhanced upwards of 100 other reports of this nature have been published in scientific journals (Protestants' Direct 2,2).

In Dr. Liboff's opinion, the "basic unlikelihood of these phenomena" goes a great distance towards explaining why the epidemiological work of people like Nancy Wertheimer and the Savitz study were vigorously attacked. Every such study, and Dr. Liboff avers that "there is a preponderance of positive studies," has been severely criticized in ways suggesting that if the likelihood of interaction were more reasonable, the results of such studies would be more reasonable. He testified that

There has resulted a sort of hysterical, non-scientific evaluation of this epidemiological data, in which critics spend a lot of energy searching out minute disparities between study A and study B, giving uncritical emphasis to a very few earlier negative studies, arguing interminably about "cause and effect", (a non sequitor in that epidemiology never establishes causal relationships) and searching for confounding factors or hidden variables to explain away these unpleasant correlations--all because it's not easy to show weak magnetic fields can interact with tissue. Healthy scepticism is of course an important requisite for doing good science, but it is equally important not to let preconceived notions blur your observations (Protestants' Direct 2,3).

Dr. Liboff went on to testify that were it not for the political sensitivity of the epidemiologists' EMF findings, the basic correlations would have been accepted years ago. As an analogy, Dr. Liboff referred to data dealing with tobacco smoking and lung cancer which was long resisted (Protestants' Direct 2,3).

Dr. Liboff further testified that the epidemiological results linking human cancer to line exposures becomes much stronger when placed in the context of a larger body of work sharing the common characteristic of ELF EMF: induced biologic change. Three lines of independent evidence are connected: bone repair studies, altered cell responses, and epidemiological cancer studies. Each area involves a different type of biological response to weak low-frequency magnetic fields. If one appreciates the strength of experimental evidence in the first two categories, one should then be willing to accept at face value the epidemiological work in the third category (Protestants' Direct 2,4).

A variety of physiological processes are sensitive to weak ELF magnetic fields and one of these "pathways" apparently leads to human cancer. There are also concerns regarding human reproduction -- the work done by Wertheimer is an example. Work done by Wilson indicates that there are endocrine changes connected to the pineal gland following EMF exposure (Protestants' Direct 2,4). Graham and Cohen have reported evidence of changes in heartbeat in a group of men exposed to 60 Mhz magnetic fields. Reiter has studied magnetic field induced changes in melatonin and linked them to some sleep disorders, for example. Dr. Liboff's extensive research and his

awareness of research done by others has led him to believe that magnetic fields present a hazard to human health. This opinion is based upon the gradual acceptance of epidemiological data, with each new report strengthening prior ones (Protestants' Direct 2,5).

Dr. Liboff testified that he has put forward a hypothesis as to the mechanism that would explain at least the physical part of the ELF interaction related to EMFs. The concept is called Ion Cyclotron Resonance (ICR). The hypothesis holds that the effects observed as a result of exposure to 60 Mz magnetic fields are functionally dependent upon local dc magnetic fields. He testified that "specific combinations of ac and dc magnetic fields can act to put different biological ions such as calcium, potassium and magnesium into resonant states and thereby influence their transport into and out of the cell" (Protestants' Direct 2,5). Dr. Liboff and his team have carried out dozens of experiments designed around the ICR hypothesis and most of them have been successful and confirmatory of ICR. They have obtained a number of patents involving both the basic ICR concept and a number of medical applications (Protestants' Direct 2,5).

Another area he notes in connection with ICR involves Dr. Liboff's work on exposing human lymphocytes to calcium-tuned magnetic fields which resulted in "profound changes in calcium uptake"; this approach has been carried on and expanded by others. Also, he has begun in the last year a new series of experiments to examine the effects of weak ELF resonance exposures on human cancer cell lines, notably human lymphoma. Others in this area confirmed

results of "high rates of proliferation in ELF magnetic fields" (Protestants' Direct 2,6). Dr. Liboff testified that he is now reasonably certain that human cancer cell, at least in vitro, show "significant progression following exposure to weak 60 Mz magnetic fields at specific geomagnetic resonance values" (Protestants' Direct 2,6).

In cross exam in oral testimony, Dr. Liboff testified that the issue of replication of precedent experiments is contentious and that politics will enter into how scientists argue about whether an experiment was replication or not (N.T. 760-763).

Within the bioelectromagnetics community, a number of conclusions drawn in experiments are often analyzed by a sort of casuistry which takes away from the basic evidence showing that there is an effect. The fault-finding of many scientists with respect to the specific nature of different results showing different effects has sometimes clouded the concept that says when you apply a field and you see an effect--be it plus or minus--then there is something happening. That something is happening, that there is an effect, is the critical point (N.T. 765-766).

Dr. Liboff testified that there are experiments using sinusoidal field applications and others which employ pulsed field application (N.T. 772). What is most important in the experiments is the total energy absorbed; it doesn't matter as much in these cases at very high frequencies what the shape of the signal is. In the ELF area, there is still not a good feeling as to what it is that is the mediator or interactor in observed effects. Thus it

would be "premature" to rule out the possibility that the sine and pulsed waves bear a common denominator that might be comparable. It would also be premature to assume that they have the same properties in terms of interaction with biological material (N.T. 774-775).

Dr. Liboff testified that with the concept of ICR, he has put forth a hypothesis about the mechanism by which EMF will cause biological effects (N.T. 780). He does not really agree that no one has identified such a mechanism (N.T. 782). Others around the world are building upon the concept of ICR; the attempt presently is to build a theory out of the hypothesis (N.T. 783). His hypothesis has engendered debate and some peer-reviewed articles have maintained that it is mechanically impossible (N.T. 785).

There was, for instance, a group that tried to replicate Liboff's experiment and failed. But in that case, one of the lead scientists called him with questions that indicated that he had a lack of understanding as to how to provide fields. Those researchers did not contact him again, nor has he seen a report or heard about one (N.T. 786-787). He knows of other researchers who have failed to get his diatom experiment results; one study has not yet been published; another such study has questions surrounding how it was run with respect to whether or not the same conditions applied and what was done in the lab (N.T. 788-789).

The Berkeley research group conducted ICR research and also found large swings in calcium efflux. When Dr. Walleczek was at Berkeley, his group added another variable to the ICR experiments

called mitogenic stimulation. The group added con-A mitogens. Drs. Liboff and Walleczek have resolved the issue by agreeing on the likelihood that Liboff used a greater density of cells in his work such that they could have been self-stimulating by virtue of contact, which would have been equivalent to adding an external mitogen. Mitogen makes cells in culture reproduce. The basic concept involved in mitogen use is that it couple to what is called a "receptor" on a cell which may act to move calcium into the cell in such a way as to trigger the mechanism of mitogenesis (N.T. 791-794). Calcium pulse is apparently present in all sorts of different cells in culture accompanying cell division (N.T.795).

To Dr. Liboff's knowledge, no attempts have been made to repeat his results with respect to embryonic chick research. Dr. Liboff has conducted experiments on yeast to test ICR theory, but has not yet published. He does have abstracts on his work with human lymphoma cells (N.T. 796-798). Dr. Liboff agreed that it would be difficult to make extrapolations from calcium efflux studies to humans (N.T. 805).

Dr. Liboff conducted experimental research regarding DNA synthesis which was reproduced by Takahashi. Liboff's report in this area has been cited hundreds of times and is considered accepted fact (N.T. 805-806). He used 90% sinusoidal fields; Takahashi used pulsed fields (N.T. 807).

Dr. Liboff does not think that his testimony as to his own research can fairly be called subjective. When we first hypothesized ICR, he offered explanations of why and where it was

problematic. He has always given a pathway to readers as to possible flaws and problems. It is not wholly accurate to say that anything not totally objective has to be considered non-scientific (N.T. 813-814).

In his prefiled testimony, Dr. Liboff referred to Dr. Wilson on melatonin research; Dr. Liboff testified that Wilson's work is relevant to the possibility that one pathway affected by EMF may result in breast cancer. He got this information from talking to Drs. Wilson and Tenforde. Wilson has published this work in a number of peer-reviewed areas. Dr. Reiter in Texas has seen similar effects at cyclotron resonance frequencies; he was also published in a peer review article (N.T. 828-830).

Dr. Liboff testified that he relies on Dr. Reiter on page 5 of his written testimony, to say that he asserted some sleep disorders are caused by electromagnetic environment (N.T. 831). Research work by Vollrath found that under conditions of changed local magnetic fields, melatonin output in rats could be changed considerably. Community consensus is that the Vollrath-Sen-Wilson-Reiter work is in essence correct (N.T. 834). In addition, as referenced on page 2, paragraph 3 of Dr. Liboff's written testimony, Marron showed effects on cell cycles. The results have not been reproduced, but the study was done by an excellent team that stayed with the experiments for a good number of years, published in peer reviewed literature, and the results and work are basically universally accepted (N.T. 834-835).

Dr. Liboff sees data from some studies that doesn't show ELF

magnetic field hazard. He also sees the data coming from work on bone repair, and from epidemiologists studying cancer. He looks at the whole story and the common denominator is ELF magnetic signals. He's gotten different results from the sources which in a way strengthens the results. He believes that more research should be conducted on EMF (N.T. 845-846).

Dr. Liboff testified at some length about the political and governmental pressure he met, suspects, and has been told about with respect to going public with information about the biological effects and possible adverse health effects of magnetic fields (N.T. 846-850).

Dr. Liboff testified that the primary effort at further research should come from agencies like the National Science Foundation and the National Institute of Health; the latter should do the bulk of the research funding (N.T. 856).

Dr. Liboff testified about the part of his written testimony on page 6 as to people claiming that epidemiology studies are wrong because the nature of their results don't make sense in a larger sense (N.T. 861). Various members of the power community have looked to experts outside epidemiology to analyze results and say that they are preposterous and cannot have been done correctly. Such behavior and presumption Dr. Liboff terms "non-scientific evaluation" (N.T. 863-864). Dr. Adair, for instance, and others prefer not to treat epidemiology as a legitimate field. They then go on to presume to have such knowledge about epidemiology that they are able to make generalizing statements about its results and

say those results must be wrong because they know better. Dr. Liboff characterizes this attitude as non-scientific and not reasonable (N.T. 863-866). Dr. Liboff himself was sceptical when he approached the subject in 1980, his point being that one must have an open mind to work past prejudgements in order to be scientific (N.T. 867). He agrees that, in itself, the search for confounders is a good thing (N.T. 869).

Dr. Liboff testified that the Woodbourne-Heaton Line will create 60 Hz sinusoidal AC fields and that when such fields are in combination with local DC fields, one can almost predict that there will be biological effects for certain values of the earth's magnetic field (N.T. 879). Dr. Liboff agrees with PAUSE that the Line should not be energized (N.T. 877).

In further oral testimony, Dr. Liboff explained that bioelectromagnetism is a classification of an area of science made up of inputs from various scientific disciplines; the discipline has in fact molded together many disciplines with mutual reliance on one another (N.T. 882; 884; 885). He testified that it is by looking at the entire picture of bone cell repair, a host of cell work which studies ELF magnetic fields, and the epidemiological results-- opposed to simply extrapolating--that one can conclude that there is a hazard condition with respect to EMFs (N.T. 894). One need not know the pathway before reaching a conclusion as to cause and effect; e.g., it is not known how aspirin relieves headaches (N.T. 896-897).

In ELF Fields, The Question of Cancer, Dr. Liboff had a

chapter where he argued that one could look to the ICR hypothesis as a potential explanation for increased leukemia incidence in the vicinity of powerlines as reported by epidemiologists (N.T. 906). Dr. Liboff also has a patent on the suggestion that the flow or passage of ions across membranes is determined by ICR conditions and that by turning to specific ions there is the possibility of controlling flow (N.T. 907-908). There have been many confirmations of the cyclotron resonance work in experiments since the hypothesis was introduced. The work in Phoenix with his patent has been on the whole a positive confirmation; the owners of the Phoenix company have reported no expected problem in going forward with FDA approval (N.T. 913-914).

Dr. Liboff testified that he has looked at the calculations on magnetic field levels at the edge of the Conrail right-of-way and concludes that even under a moderate load the field is suprisingly high. He's been in situations like this one before but never seen edge levels so high. He is accustomed to seeing 10 milligauss and below at the edge of the right-of-ways. Dr. Liboff stated, "I find myself more than a little disturbed about the level of the magnetic field that would result in people's homes and yard" (N.T. 918-919).

PECO WITNESS RICHARD S. BOCKMAN

In written testimony, Dr. Richard Bockman, of New York City, NY, testified that he is a medical doctor, a researcher and a teacher in the field of endocrinology and immunology (PECO Rebuttal

Testimony 1, 1).

Dr. Bockman testified that, at present, there is no data to support the concept that people can perceive EMFs from transmission lines when no external physical cue is present (PECO RT 1,8). EMF studies have noted effects in animals exposed to fields, but the animals habituate to the fields with an accompanying return to normalcy of hormonal activity (PECO RT 1, 9). When field strength is increased, test animals show a variety of responses. Dr. Bockman testified that field strengths above an animal's perception threshold have resulted in "subtle changes in blood or brain levels of neurotransmitter substances or of enzymes regulating neurotransmitter levels." These changes probably can be explained by the fact that the animals are showing a "normal recognition response to a newly perceived external stimulus" (PECO RT 1, 10).

Dr. Bockman further testified that many of the calcium efflux studies have used fields much different from the 60 Hz transmission line fields. The results are inconsistent as they report conflicting changes in calcium efflux. It is his opinion that 60Hz fields do not affect calcium metabolism in living organisms (PECO RT 1, 12). He also gave his opinion that EMFs do not cause changes in biologically important calcium in whole animals (PECO RT 1, 13).

In concluding his discussion of the neuroendocrine system, Dr. Bockman testified that "exposure to EMF can cause subtle, transient biological changes in the neuroendocrine system." He characterized these changes as "consistent with a normal perception or

recognition response" and added that the changes "do not indicate that exposure to EMF is harmful" (PECO RT 1, 14).

Dr. Bockman testified that the hormones associated with the endocrine gland are not elevated in the blood with prolonged exposure to significant EMFs and animals are not stressed by these fields. Early studies showed that there were effects while later research failed to corroborate the finding. Corticosterone levels have shown a transient increase on first exposure. Dr. Bockman testified that the animals quickly habituate to the field (PECO RT 1, 15).

Dr. Bockman testified that none of the major biologic rhythms have been shown to be altered by exposure to EMFs. The 1988 Vasquez research reported that the circadian rhythm of certain neurotransmitters was altered after exposure to EMSs. Dr. Bockman explained his concerns with that research and opined that the Vasquez results do not indicate a harmful effect on biological rhythms (PECO RT 1, 16).

Melatonin, produced by the pineal gland, is one of several neurologic hormones that has a distinct rhythm tied to the daylight/darkness cycle. Dr. Bockman testified that studies involving extended exposure have shown decreases in melatonin levels; the levels returned to normal when the exposure ended. Dr. Bockman opined that no deleterious health effects were observed and, though he did not say what kind of study, he suggested that "no study has demonstrated any such biological effect of magnetic field exposure" (PECO RT 1, 17).

The melatonin levels are not associated with changes in other major biologic rhythms; also, the level changes are limited to exposure to electric fields. Dr. Bockman concluded this discussion by downplaying the significance of the melatonin studies with respect to adverse effects on biologic rhythms (PECO RT 1, 18).

Dr. Bockman testified as to studies which indicated no effect of EMFs on reproduction and development (PECO RT 1, 19).

Dr. Bockman agrees with the criticisms in secondary literature of the epidemiological studies on reproductive effects which yielded positive results. (PECO RT 1, 20).

Dr. Bockman concluded his testimony in this area by asserting that there is "no persuasive scientific evidence that exposure to power frequency fields has any adverse effects on reproduction, development, or related endocrine function" (PECO RT 1, 21).

Dr. Bockman testified that several excellent studies have examined the levels of cortisone and corticosterone-adrenal gland hormones that regulate immune cell function-and that only one showed a change; the change was transient (PECO RT 1, 22). He concluded that there is no scientific basis for concluding that immune systems are affected through the pathway of altered endocrine function" (PECO RT 1, 23).

Complex in vitro research on EMFs and the immune system showed effects on PHA-induced blastogenesis; cell proliferation was affected as well. The "biologic relevance" of these esoteric studies was characterized by Dr. Bockman as remaining, "unclear" (PECO RT 1, 23). Other in vitro experiments indicated a reduced

ability of a certain mouse cell-line (CTLL-1, which resembles a class of immune cells) to kill the tumor target cells that they would normally kill. The mechanism of this effect is not yet known, nor has it been observed in intact animals exposed to power frequency fields (PECO RT 1, 24).

Dr. Bockman testified that the animal studies indicate that exposure of animals to EMFs similar to those produced by AC power lines produces "no obvious deficit" in immune cell function. Only Odinstov's early study shows adverse effects on the host's immune system (PECO RT 1, 25). Immune cell viability (and) he testified, is not "significantly affected by exposure to EMF and no adverse effects have consistently been demonstrated in intact animals. "He offers as his overall conclusion that there is no basis for concluding that EMFs have adverse effects on endocrine or immune systems (PECO RT 1, 27).

Dr. Bockman, in oral testimony, testified that it is his opinion that in the area of reproduction and development, adequate experiment have been done, so he would not advocate more research. He also would say that no more research needs to be done in the area of calcium efflux studies. Given funds and priorities, Dr. Bockman is not sure that we need to do more research with regard to this stimulus of EMFs in these areas of biology (N.T. 974). He does not think that this area of electric and magnetic is a very high priority or a very interesting area that is going to help elucidate some more interesting questions in biology; he doesn't see a pressing need for more research (N.T. 975).

Dr. Bockman testified that he has reviewed the areas of bone healing with strong EMFs and magnetic resonance imaging. Not everyone believes that magnetic fields help bone healing, and the mechanism by which such fields aid in the bone healing process is not known (N.T. 978-979).

Dr. Bockman further testified that he has not conducted research into the biological effects of power frequency fields such as those associated with transmission lines, nor has he published papers about the subject. He began to look into biological effects of EMFs only about 6 years ago (N.T. 980).

In reviewing the Wilson study discussed on page 17 of his prefiled statement, lines 25-34, Dr. Bockman testified that despite the demonstrated changes in the level of melatonin production and the circadian rhythm with regard to melatonin, he does not see deleterious effects. He characterizes a deleterious effect as an adverse health effect which would mean that an animal were sick in some way (N.T. 995). He does not know what effect a prolonged decrease in melatonin would have on the body (N.T. 995-996).

Dr. Bockman testified that he is aware of continuing research in the areas of melatonin effects on number of systems, including psychological systems (N.T. 997-998).

Dr. Bockman further testified that he and his colleagues are using EMFs to see if they enhance bone density. He is not aware of his hospital using EMFs in any orthopedic capacity (N.T. 1005; 1007).

In the Stevens, Wilson and Anderson work cited by Dr. Bockman,

it is reported that melatonin can inhibit the growth of several cancer cell lines in vitro, but Dr. Bockman knows of only one such line, MCF-7 (N.T. 1020). Those researchers also say that melatonin may affect the availability of hormones required for growth of hormone-dependent breast, ovarian, and prostate cancers; Dr. Bockman calls it a hypothesis (N.T. 1020). The researchers also say that changes in melatonin secretion may affect production of other hormones such as estrogen and prolactin and alter the proliferation of normal, intermediate, or malignant cells; Dr. Bockman calls it a hypothesis (N.T. 1022).

Dr. Bockman did not consider the work of Graham and Cohen in forming his opinions (N.T. 1042). He has not read the work on resonance transport in membranes by Liboff, McCloud and Smith (N.T. 1044-1045). He is not familiar with Liboff's abstract Human Lymphoma In Vitro Proliferation Increases Following K-Plus Cyclotron Resonance Magnetic Exposure (N.T. 1045). Dr. Bockman may have perused abstract of Graham and Cohen on Human cardiac activity in 60Hz magnetic fields (N.T. 1045). But he did not use Graham and Cohen, or Liboff, in reaching his conclusions (N.T. 1048). His opinion as to the validity of the Werthimer-Leeper conclusions is based on criticism of their epidemiological quality and on a comparison of epidemiology animal research and other bases. His opinion is not that of an expert in epidemiology, but one of a scientific evaluation of epidemiological studies (N.T. 1049-1050). Dr. Bockman partly does and partly does not include epidemiology in forming his overall conclusions (N.T. 1051).

Dr. Bockman testified that as a practicing clinician in endocrinology he is influenced by epidemiological studies; yet he did not rely on conclusions relating to epidemiological studies in reaching his conclusions (N.T. 1052, 1056).

PECO WITNESS DR. PHILIP COLE

Dr. Philip Cole testified that he is employed in the Department of Epidemiology at the School of Public Health, University of Alabama, in Birmingham, AL. He is Associate Director for Epidemiology at the Comprehensive Cancer center at the University (PECO Rebuttal Testimony, RT, 2, 1). His research for the past 25 years has focused on the epidemiology of cancer and its methodology (PECO RT 2,3).

Dr. Cole characterized epidemiology as being non-experiential, highly susceptible to error, exacting in that it demands a large number of studies with consistent findings to generate causal inferences, and called it a " powerful approach for establishing causes of disease in man" (PECO RT 2, 5-6).

Dr. Cole discussed "surrogates" in epidemiological studies and suggested that it is often difficult to know if a surrogate is a reliable predictor of actual exposure. Such uncertainty can raise questions as to the accuracy of results obtained by a study (PECO RT 2, 8).

A single epidemiological study is rarely enough to yield a

conclusion as to the relationship of an agent to a disease (PECO RT 2,9). Approximately 50 studies have been published regarding EMFs and cancer, and Dr. Cole has reviewed them all in addition to major secondary resources (PECO RT 2, 10).

Dr. Cole testified that the strength of case control studies is that they offer good control over "confounders," or hidden variables; the weakness is that they are difficult to conduct properly and are thus prone to error (PECO RT 2,11).

Dr. Cole testified at length about the Wertheimer and Leeper study of 1979 which reported a connection between wiring codes as a surrogate for magnetic fields and childhood cancers, including leukemia (PECO RT 2, 12-13). Dr. Cole raised questions as to the results and procedures of the study and concluded that he found the study non-persuasive (PECO RT 2, 13).

Dr. Cole mentioned the 1980 Fulton Study which found no relationship between childhood leukemia and wiring codes as a "negative, but non-persuasive, study" (PECO RT 2, 14).

Dr. Cole testified that the 1988 Myers study did not support the idea of an association between cancer and EMFs, but added that, "the study also does not provide persuasive refutation of the hypothesis" (PECO RT 2, 14).

Dr. Cole further testified that the results of the 1986 Tomenius Study were at odds with those of Wertheimer and Leeper's work. His opinion in this case was that the Tomenius study provides some evidence against the hypothesized association between EMFs and cancer.

Dr. Cole characterized the 1988 Savitz study as the best yet on EMF and childhood cancer. The results show no "significant associations" between cancer and magnetic fields, but did show "a few weak, irregular statistically significant associations between childhood cancer and the wiring code surrogate" (PECO RT 2, 16). Dr. Cole conjectured that these associations could be owing to "Random chance" (PECO RT 2, 16).

Dr. Cole's interpretation of the Savitz results led him to downplay the weak associations found as not "descriptive of a cause-effect relationship" (PECO RT 2, 17). He also took the indication that the Savitz study showed a weaker association between EMFs and cancer than the Wertheimer and Leeper to suggest that "there is no true association between EMF and cancer underlying these statistical reports" (PECO RT 2, 17).

Through his familiarity with the Peters California study not yet published or complete at the time of testimony, Dr. Cole testified that his preliminary opinion is that, though Peters found an association between wiring codes and childhood cancer, the association is weaker than the one reported by the Savitz study. He finds that this study confirms the findings that there is no association between measured magnetic fields and cancer despite results that show at least a consistent weak connection. (PECO RT 2, 18).

Dr. Cole does not give substantial weight to the draft EPA report on cancer and EMFs. It is still being peer reviewed and will be revised (PECO RT 2, 21).

Dr. Cole concluded that the adult residential studies are negative for measured field and magnetic field surrogates, though the Wertheimer and Leeper study showed a strong and consistent relationship between wiring code and adult cancers (PECO RT2, 23).

Dr. testified that with respect to occupational studies, "confounding" is a problem. The failure to control for confounders affects the evaluation of the body of literature as a whole (PECO RT 2, 24).

Dr. Cole testified, with qualifications, that 14 of the 19 occupational case-control studies have reported some positive association between a surrogate of EMF exposure and cancer (PECO RT 2, 25).

Dr. Cole was a member of the advisory panel for the occupational studies by Matonoski. The studies have not appeared in peer-reviewed literature, but both show an increased incidence of male breast cancer. Dr. Cole sees these results as "positive, but non-persuasive" (PECO RT 2, 26).

Of 8 proportionate mortality ratio (PMR) studies, 4 showed positive associations. But again, offering qualifications, Dr. Cole testified that he thought the PMR results were not "helpful" in answering the question of occupational EMF exposure and increased cancer incidence (PECO RT 2, 27).

Dr. Cole testified that only 1 of 10 retrospective followup (RFU) studies has reported positive results. This fact he considers to provide "strong support against the hypothesis that EMF exposure causes cancer (PECO RT 2, 27).

Dr. Cole concluded his written testimony by testifying that it is his opinion that the epidemiologic reports, taken together, fail to demonstrate a strong or consistent pattern of association between EMF and cancer among human beings (PECO RT 2,28).

In oral testimony, Dr. Cole testified that he restricts his testimony to the question of EMFs and cancer. He testified that when he used the word "cause," he used it to mean "to increase the risk in general..."(N.T. 1083;1084). Dr. Cole was not expressing an opinion as to whether or not EMF exposure increases risk of adverse health effects other than cancer. Nor does he distinguish between EMFs as a potential contributing factor to the development of cancer, and EMF as a possible contributing factor to the growth of cancer cells (N.T. 1084).

The consistently weak associations he discerns leads Dr. Cole to an inference as to causation. He testified that it is possible that variations in susceptibility to the development of cancerous conditions amongst population subgroups can interfere with the consistency of study results (N.T. 1090).

Dr. Cole testified that being shown a valid biologically plausible mechanism for EMF interaction with cells would probably not change his mind as to EMF-cancer relationship, but would enter into his overall consideration (N.T. 1092-1093).

Dr. Cole agreed with the statement that the evidence as to the link between EMFs and cancer now available is too weak to allow firm conclusions either way, but says that such is not his position (N.T. 1097). On a scale of -100 to 100, where -100 corresponds to

EMF having been demonstrated not to cause cancer and 100 corresponds to EMFs having been demonstrated to cause cancer, Dr. Cole's position is -70. So he is not 100% convinced that EMFs do not cause cancer (N.T. 1101; 1102). Dr. Cole believes that it is much more likely than not that the line poses no threat of cancer to persons in the vicinity (N.T. 1104; 1105).

Dr. Cole testified that the original Wertheimer study, and the Savitz, and Peters studies all contain information relevant to the link between wiring code and either childhood cancer or leukemia, and that each shows some positive results (N.T. 1112). He neither dismisses these studies nor forms opinions solely on the basis of them; he looks at the totality of epidemiologic studies (N.T. 1113).

Dr. Cole admitted that he does not have information as to what field readings would be at the edge of the right-of-way or the center, under various load conditions (N.T. 1117). But he goes on to testify that the Line is not going to produce enormous fields, but ones similar to those produced by other fields (N.T. 1118).

Dr. Cole testified that nobody holds the view that there is an established cause-effect relationship between EMF exposure and cancer (N.T. 1118). He is now beginning an epidemiologic study relating to EMFs, but has never done one before (N.T. 1122).

Dr. Cole can form an opinion or take a position about the Woodbourne-Heaton Line based on his position that EMFs are not an established cause of cancer. This Line-given Dr. Cole's beliefs about the lack of EMF-cancer link-fits into an overall pattern, he

believes in that this line, like others, is not a cause of cancer (N.T. 1123).

In his return oral testimony, Dr. Cole testified that the Demers study was a case control study with no measurement of magnetic fields (N.T. 1463;1468). He had a problem with the categories of EMF exposure used (N.T. 1469).

Dr. Cole explained that the Demers study shows an absence of dose-response and therefore cannot be taken seriously as demonstrating an EMF-cancer relationship. Only those exposed at an early age for a long period of time exhibited an increased cancer risk, he testified (N.T. 1472). If one accepts the Demers results, it suggest that EMFs act as an initiator carcinogen rather than a promoter as other epidemiological information suggests (N.T. 1472).

Dr. Cole again testified as to ostensible weakening of associations as one moves from the Werthimer results. He said that he has not seen an instance where an association got weaker and weaker over time in epidemiological data and still came to be accepted as valid. Dr. Cole did not deny the associations in the results (N.T. 1479).

The studies of men with breast cancer have been relatively few; research into the relationship between EMFs and male breast cancer has not really begun (N.T. 1490;1491). Dr. Cole testified that his comments about the problematic aspect of Demers' results with respect to the general perception of EMFs as a possible promoter of cancer, are limited to findings referring to male breast cancer (N.T. 1493).

Dr. Cole testified that he holds statistical significance to be a relatively weak approach in the analysis of data (N.T. 1494).

When Dr. Cole speaks of "how much exposure," he is asking how high was a field, how long was exposure, and then getting an estimate from those factors (N.T. 1496). He classified the probability of initiation as a function of degree of cumulative exposure to initiator (N.T. 1498). There is no reason to exclude the potential for the intensity of a short-term exposure as being a relevant variable in determining the initiating ability of various substances that cause cancer. Nor is there reason to exclude as relevant dosage the number of times a subject is exposed or the rapidity of the exposures (N.T. 1511).

While Dr. Cole feels strongly that EMFs have not been and are not likely to be shown to be carcinogenic in humans, he does not claim that it is absolutely beyond the range of research (N.T. 1513).

Dr. Cole testified that, at present, the evidence is just about equally divided between that which is supportive and that which is contradictory. This fact leads him to say that is a pattern for associations that end up fading away (N.T. 1523).

PECO WITNESS EDWARD PAUL GELMANN

Dr. Edward Paul Gelmann testified that he is a medical doctor, researcher, and teacher specializing in medical oncology. He is a Professor at Georgetown University Medical School and is also Chief of its Division of Medical Oncology. Oncology is a sub-specialty

of internal medicine that involves the study and treatment of cancer (PECO Rebuttal Testimony 3, 1).

Dr. Gelmann testified that DNA change is associated with all cancers and that cancer cannot occur without permanent changes in DNA called "mutations" (PECO RT 3, 6). Not all DNA change results in cancer.

Mutational analyses are tests that show whether a permanent change has occurred in the structure of the DNA molecule as a result of exposure to an agent. Citing studies by Frazier et al (1984), Trent (1987), and Reese (1988, 1990), Dr. Gelmann testified that exposure to 60 Hz fields has no effects on mutations (PECO RT 3, 9).

Dr. Gelmann is familiar with Liboff's work on DNA synthesis but is not sure that he really was measuring DNA synthesis. He testified that he does not think that Takahashi's work confirmed Liboff's work because different fields were used. He disagrees with Liboff's conclusion that the observed effects may be mutational (PECO RT 3, 10).

Dr. Gelmann cited studies which show that DNA repair processes are not affected by exposure to power frequency fields (PECO RT 3, 10-11).

Chromosome studies evaluated whether there were breaks or other damage to the chromosome as a result of exposure to an agent. Dr. Gelmann cited studies whose results suggest that power frequency fields are not associated with chromosome damage (PECO RT 3, 11-12).

Dr. Gelmann cited a study on animals that suggested that EMF field exposure did not affect many health endpoints examined; an additional test showed no "significant effects" on the stem cells of bone marrow which are important with regard to the development of leukemia (PECO RT 3, 13).

He cited a recent study which showed no effect on bone marrow cells of mice exposed to high magnetic fields (PECO RT 3, 13). The animal studies Dr. Gelmann testified, give no scientific basis to "conclude" that EMFs cause cancer or other adverse health effects (PECO RT 3,14).

Tumor growth studies are a direct test of the cancerous properties of cells. They test whether cancerous cells will form tumors when transplanted to an animal host. Dr. Gelmann cited three studies which showed no effect or no "significant differences" in tumor incidence (PECO RT 3,15).

The work of Dr. Goodman has reported changes in the uptake of RNA precursors after exposure of cells to EMFs, but Dr. Gelmann does not think these results indicate that exposure will cause cancer or other adverse health effects (PECO RT 3,16).

The work of Byus and Adey shows an effect on the activity of ODC--an enzyme involved in cellular growth--but this does not indicate a carcinogenic effect of EMF exposure, testified Dr. Gelmann. Byus and Adey themselves concluded that "any suggestion of a carcinogenic effect from this research is speculative," though he did not indicate that those researches said that such suggesting were wrong or infeasible (PECO RT 3, 17-18).

Dr. Gelmann continued testifying in this vein, citing studies which showed effects of EMFs on different cells and cellular processes. He did not deny the effects, but in each case asserted that the effects were unrelated to carcinogenesis or did not contribute to the development of cancer (PECO RT 3, 18-20).

Dr. Gelmann testified that studies show a number of effects on biological endpoints but that he thinks these effects are unrelated to cancer and he is not convinced that effects necessarily lead to adverse health (PECO RT 3, 21-22). He concluded his written testimony with his expert opinion that EMFs do not cause, promote, or contribute to the development of cancer and said that he has no scientific basis to think that the Woodbourne-Heaton Line would cause adverse health effects, including cancer (PECO RT 3, 22-23).

In oral testimony Dr. Gelmann testified that his opinions in his written testimony were limited to oncology, and molecular and cellular biology (N.T. 1142). He has published no articles on EMFs and cancer beyond a review of the literature (N.T. 1147-1148). This opinion is based on his literature review (N.T. 1149).

Dr. Gelmann testified that the epidemiologic studies which he read have no bearing on his opinion one way or the other (N.T. 1169). He also stated that in scientific knowledge, one must take all information and assess it for its worth. He was not asked to assess epidemiology and it is beyond the scope of his expertise (N.T. 1171).

Dr. Gelmann testified that if studies showed an association or purported to show an association between exposure to electric and

magnetic fields and childhood leukemia, it would not change his opinion that EMFs have no effect on cancer, based on the studies he has reviewed and his own expertise. If there were epidemiologic studies purporting to show an effect of EMF exposure on cancer incidence among occupational fields of adults, it would not change his testimony (N.T. 1179).

Dr. Gelmann declined to express an opinion about whether effects on melatonin production by the pineal gland have any health effects or may have any health effects (N.T. 1181-1182). Outside of his area of expertise or what he has written in his report, he would not express an opinion as to whether the reduction of production in the pineal gland has any adverse health effects (N.T. 1182). He would not give an opinion as to whether EMF exposure slow heart rates (N.T. 1184-1185). He did not intend to express an opinion as to the effects of EMFs on reproduction. (N.T. 1185-1186). Dr. Gelmann has no conclusions on cyclotron resonance theory (N.T. 1189).

Dr. Gelman testified that he did not agree that melatonin reduction is a cancer promoter (N.T. 1193). He does not know if EMFs affect cell proliferation in connection with bone healing, though he has reason to doubt that phenomena (N.T. 1193; 1194).

PECO WITNESS DR. MURRAY ROSENBERG

Dr. Murray Rosenberg of St. Paul, MN, testified that he is a

biophysicist, a researcher and Professor of Genetics and Cell Biology, and a medical doctor (PECO RT 4, 1).

Dr. Rosenberg testified as to the characteristics and strengths of different energy sources in the electromagnetic spectrum (PECO RT 4, 8-13). He testified that there are "no accepted mechanisms by which power frequency fields can cause biological effects in living systems," as opposed to other regions of the electromagnetic spectrum (PECO RT 4, 13).

Dr. Rosenberg testified as to the difference between pulsed and sinusoidal fields and argued that studies using pulsed fields do not provide information relevant to determining the effects of sinusoidal power frequency fields (PECO RT 4, 16).

Dr. Rosenberg had a number of problems with the ion cyclotron resonance (ICR) hypothesis. He argued that the circular path necessary for a 60Hz cyclotron resonance effect to occur with biological ions would have to be quite large to meet the ICR theory's conditions (PECO RT 4, 18). He also argued that the cyclotron resonance phenomenon can't occur if ions are colliding with other particles, as they do in membrane of human cells (PECO RT 4, 18). Third, he argued that the ICR hypothesis miscalculates the mass of the ion and thus undermines its own theoretical calculations (PECO RT 4, 19).

Researchers who have tried to reproduce the calcium efflux experiments of Liboff have found contradictory results, one has shown an increase in efflux, another has shown a decrease, and a third has shown no change (PECO RT 4, 20). In Dr. Rosenberg's

opinion, the ICR hypothesis has no implications for human health (PECO RT 4, 20).

In oral testimony, Dr. Rosenberg testified that you could get biological effects by turning a sinusoidal wave off and on; transients such as turning a line on off would disrupt a sinusoidal wave (N.T. 1217; 1218).

The ICR hypothesis does not make sense to Dr. Rosenberg from a physical point of view (N.T. 1219). He testified that he was being conclusive about impossibility of ICR hypothesis (N.T. 1222). Some groups have indeed found results in calcium efflux, albeit contradictory ones (N.T. 1223).

Dr. Rosenberg testified that if ICR does in fact work in bone healing, there is no good explanation. He would not comment on whether it actually does work or not (N.T. 1225). When asked whether or not it is the case that if the literature is correct in reporting that EMFs have an effect in orthopedic treatment that the problem is then how to explain the effect, Dr. Rosenberg said he was not qualified to answer (N.T. 1227). Nor does he have an explanation for the effects that Liboff and other have found (N.T. 1235). He is willing to say that exposure to EMFs will not result in adverse health effects in humans (N.T.1238).

PECO WITNESS CARTER VAN DYKE

Mr. Carter Van Dyke of Doylestown, PA testified that he is a land use planner and landscape architect (PECO RT 5, 1). Mr. Van Dyke was asked to evaluate the land use implications associated

with the energization of the Woodbourne-Heaton Line.

Mr. Van Dyke provided a zoning breakdown for the Corridor Study Area (CSA) (PECO RT 5, 9). The CSA is all areas 400 feet on either side of the Trenton Cutoff right-of-way (PECO RT 5, 4). He also gave a land use breakdown for the CSA (PECO RT 5, 10).

Mr. Van Dyke testified that the CSA is not generally categorized as a high density urban area nor is it expected to reach that categorization even if the CSA becomes fully developed. He also noted that the CSA does contain some concentrations of urban residential development (PECO RT 5,11).

Mr. Van Dyke further testified that the compatibility of the line must be understood in the context of the land use policy that "utility services must be provided in coordination with urban growth." 51.8% of existing zoning falls in the compatible categories of Industrial, Commercial, Industrial, Commercial, Institutional, or Open Space (PECO RT 5, 12).

Mr. Van Dyke also opined that the Residential zoning areas of the CSA are compatible with adjacent utility use (PECO RT 5, 12).

He testified that an inventory of existing land uses shows a compatibility with adjacent utility use. This compatibility provides some support for a conclusion that no adverse impacts will result from the adjacent land use (PECO RT 5, 13). Mr. Van Dyke downplayed the effect that fear of EMFs will have on land use (PECO RT 5, 14-15).

Mr. Van Dyke reiterated that the "fundamental basis for sound planning and development" concerns coordinating utility services

with urban growth, though he did not characterize the regional study area or the corridor study area as growing (PECO RT 5, 16).

Mr. Van Dyke testified that his corridor study area relates to use impacts of the Woodbourne-Heaton Line route, while the regional study area relates to looking for the best route (N.T. 1250-1251). He studied the area within a bounding of 2 1/2 miles to the north and south of the line, and the extent of the distance between Heaton and Woodbourne substations (N.T. 1272). 400 feet from either edge of the right-of-way was necessary for the corridor study in order to get a good approximation of the adjacent land uses, Mr. Van Dyke testified (N.T. 1276).

Mr. Van Dyke testified that he took into account the public fear of EMFs in concluding that there was no effect on the market valuation of homes. To do this accounting he reviewed Ronald Turner's testimony, but he did not interview the protestants nor is he familiar with the PECO exhibits which recommend consideration of prudent avoidance (N.T. 1284).

Mr. Van Dyke agreed that perceived fear is one particular value, amongst many, that goes into people's choices of where to live (N.T. 1288). Public opinion and factors that the public take into account are relevant in establishing market value (N.T. 1290).

While basic land use policy dictates that utility services must be provided in coordination with urban growth, it also involves providing utility corridors in the least intrusive way (N.T. 1299-1300).

Mr. Van Dyke testified that the utility infrastructure is a

necessary component of normal planned urban growth (N.T. 1301). But since the corridor study Area in Mr. Van Dyke's estimation shows a very limited growth potential, he concurred that the principal that you must provide utility infrastructure with urban growth has a "very limited application as far as this corridor is concerned" (N.T. 1301; 1303).

PECO WITNESS JAMES MICHAEL SILVA

Mr. James Michael Silva testified that he is a research engineer at ENERTECH Consultants, Campbell, CA (PECO Rebuttal Testimony 6, 1).

ENERTECH does work in exposure assessment and the development of electric and magnetic field measurement instrumentation and computer software (PECO RT 6, 2). Exposure assessment means evaluation of people's exposure to electric or magnetic fields through measurement, modeling calculations, or other techniques. ENERTECH developed portable measuring instrumentation called EMDEX and its software, DATACALC. The company also developed EXPOCALC software to measure fields from Lines (PECO RT 6, 4 -5).

Mr. Silva was asked to take EMF measurements in South Eastern Pennsylvania. He did this with EMDEX II, portable EMDEX, in September, 1991. Exhibit JMS-3 shows field levels of 1-12 milligauss in Langhorne stores; 1-30 milligauss in a mall; 4-60 + milligauss in an amusement park (PECO RT 6, 13, and JMS-3).

In Philadelphia, JMS-4 shows, fields were less than 1 milligauss to tens of milligauss, with some locations much higher

(PECO RT 6, 14, and JMS).

Mr. Silva testified that prudent avoidance advocates only a modest effort in making changes to avoid high fields (PECO RT 6, 15-16). Mr. Silva stated that understanding field measurement is necessary to contextualize prudent avoidance; line rating should also be considered. A transmission facility should also be checked to see if it meets existing field standards that are "similarity based." He found the Woodbourne-Heaton features to be consistent with the prudent avoidance concept (PECO RT 6,16).

The "similarity-based" approach to prudent avoidance suggest that EMFs from lines be similar to levels in other lines (PECO RT 6, 18).

Mr. Silva testified that prudent avoidance allows us to act and move forward while research continues. Delaying projects because of the current state of scientific knowledge runs contrary to the basic assumptions of prudent avoidance as he understands it (PECO RT 6,19).

In oral testimony, with reference to the concept of similarity-basing, Mr. Silva testified that a 230KV line compared to a 230KV line is similar; it's a matter of lines and voltage classification and not a health-based standard (N.T. 1311). Some of the lines that are similar to the proposed Line were designed and placed in service as much as a half a century ago (N.T. 1312).

Mr. Silva's measured walk with EMDEX II in Langhorne was not along the proposed line route (N.T.1312).

Mr. Silva testified that the concept of prudent avoidance as

applied by the Office of Technology Assessment does not have a temporal component as to when prudent avoidance comes into play; prudent avoidance could be applied before or after a design is selected (N.T. 1313; 1314).

When asked how prudent avoidance could alter field levels if implemented after design and construction, Mr. Silva responded

...if I can give an analogy from the OTA report itself, they suggest that prudent avoidance, the OTA report itself, they suggest that prudent avoidance might be buying an appliance if it was available that had very low field levels. Put the prudent part of prudent avoidance, the OTA report goes on to explain, would not indicated using that appliance until your old one wore out. So even if there is a field-free appliance on the market and you may want to buy it, they suggest waiting until your other one wore out before you would buy it (N.T. 1319-1320).

Mr. Silva testified that the average life of a power line must be 30 or 40 years (N.T. 1320).

Mr. Silva further testified that he would agree with PECO's literature that prudent avoidance is common sense reduction of exposure to EMFs (N.T. 1326). The concept of prudent avoidance is expending modest efforts in having lower exposure or lower field levels (N.T. 1332). If an individual makes no efforts, it is consistent with this understanding of prudent avoidance (N.T. 1336).

Mr. Silva testified,

To me, the idea of buying a low field appliance but then not using it until your other one wears out provides a context for understanding how far overboard you should go on appliances and all these things until we have more information (N.T. 1344).

He characterized the OTA report by analogy:

If you can buy an electric blanket that has zero field, go ahead and buy it, but we would not recommend that you do that until your old one wore out... That means that lower is better but to me it provides a qualitative factor that lower may be better but maybe not a whole lot, we're not sure, so why don't you wait for four or five years until your old one wears out (N.T. 1345).

When asked why OTA doesn't say buy a higher field blanket, Mr. Silva testified, "I don't know why they didn't put in there. I don't know if you can go out and make a higher field blanket" (N.T. 1345).

COMMONWEALTH OF PENNSYLVANIA



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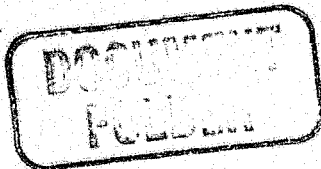
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April 20, 1992

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John G. Alford, Secretary
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Room G-18, North Office Bldg.
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SECRETARY'S BUREAU
Information Control Division



Re: Letter of Notification
of Philadelphia Electric
Company Re: Proposed 230 KV
Woodbourne to Heaton
Transmission Line,
Docket No. A-110550, F. 055

Dear Secretary Alford:

Enclosed please find for filing an original and nine (9) copies of the Office of Consumer Advocate's Main Brief in the above-captioned proceeding.

Copies have been served upon all parties of record as shown on the attached Certificate of Service.

Sincerely,

Tanya J. McCloskey
Assistant Consumer Advocate

Enclosures
cc: All parties of record

CERTIFICATE OF SERVICE

Re: Letter of Notification
of Philadelphia Electric
Company Re: Proposed 230 KV
Woodbourne to Heaton
Transmission Line,
Docket No. A-110550, F. 055

I hereby certify that I have this day served a true copy of the foregoing document, Office of Consumer Advocate's Main Brief, upon parties of record in this proceeding in accordance with the requirements of 52 Pa. Code § 1.54 (relating to service by a participant), in the manner and upon the persons listed below:

Dated this 20th day of April, 1992.

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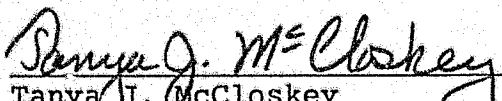
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ORIGINAL

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

FAO

LETTER OF NOTIFICATION
OF PHILADELPHIA ELECTRIC
COMPANY RE: PROPOSED 230 KV
WOODBOURNE TO HEATON
TRANSMISSION LINE

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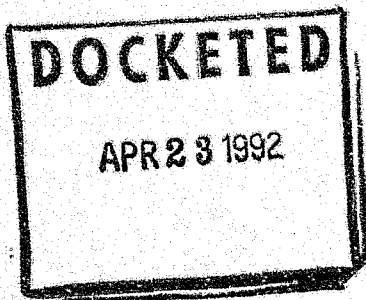
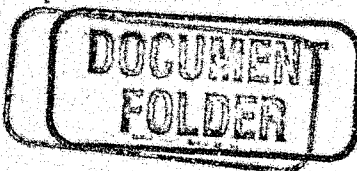
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MAIN BRIEF OF
THE OFFICE OF CONSUMER ADVOCATE

SECRETARY'S BUREAU
Information Control Division



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DATED: April 20, 1992

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I. INTRODUCTION

On November 21, 1989, Philadelphia Electric Company ("PECO") submitted a Letter of Notification in lieu of a siting application to the Pennsylvania Public Utility Commission ("PUC" or "Commission") pursuant to 52 Pa. Code § 57.72(d)(1) proposing the rebuilding and reconductoring of an abandoned railroad 138 kV transmission line. The transmission line was to be located along a Conrail rail line known as the Trenton Cut-off Branch freight line. PECO had purchased an easement from Conrail along the rail line.

PECO was proposing to build a 230 kV transmission line along the railroad right of way to connect the Woodbourne and Heaton substations. The transmission line, referred to as the "Woodbourne-Heaton line," was to be 12.8 miles long and was to follow the railroad right of way.

In submitting the proposal to the Commission, PECO utilized the Letter of Notification procedure pursuant to 52 Pa. Code § 57.72(d)(1) in lieu of the siting application procedure. PECO stated that it believed this procedure was appropriate because PECO did not believe that the transmission line would "substantially alter" the existing right of way within the meaning of 52 Pa. Code § 57.71(d)(1)(iv) and (v). See, PECO Letter of Notification, p. 2. As such, PECO served copies of the Letter Notification in accordance with 52 Pa. Code § 57.72(d)(3), upon the governmental parties entitled to notice.

On February 9, 1990, the Commission entered an Order approving the Letter of Notification by PECO. PECO then began the reconstruction and reconductoring work on the line. On September 10, 1990, certain property owners (hereinafter "the Protestants") filed an Emergency Petition of Non-Noticed Property Owners to Intervene, For Reopening and To Suspend Approval ("Emergency Petition") of PECO's Letter Notification for the Woodbourne-Heaton transmission line. That Emergency Petition asserts that seventy-four individuals own properties and enjoy property rights which are affected by the construction of the Woodbourne-Heaton line. An additional Petitioner is a Pennsylvania non-profit corporation, Parents Against an Unsafe Environment ("PAUSE") whose members are the individual property owners.

The Emergency Petition asserted that the applicant, in its Letter Notification under 52 Pa. Code 57.72(d)(4), characterized the proposed line as a reconstruction, but in fact, that the right of way in question had never been occupied by the applicant and had not been used for at least ten years by anyone. The Emergency Petition also asserts that the property interests to be occupied by the line include the fee simple title to a vertical portion of the right of way proposed to be used, and ownership of adjacent air space intended to be occupied by electromagnetic waves. Emergency Petition at 2.

The Petition further asserts that PECO knew or should have known of the impact upon ownership of adjacent air space,

but that it falsely informed the Commission that no ownership of property would be affected by the project. Id. at 2. As a result, the Petition asserts, no adjacent property owner had notice of the proposed project, nor of the Commission Order approving it, and it was only learned of by personal observation of construction activities. Id. at 2-3. Petitioners stated that they would have presented, and that they then wished to present, issues pertaining to the lack of justification on the part of the Company for the nature, extent and location of the proposed facility, lack of necessity for the line, less dangerous alternatives, risks of exposure to electromagnetic fields ("EMF"), and violations of local zoning ordinances.

The Petition sought a Commission order that would admit them as parties, order the proceeding reopened and suspend the action taken on February 2, 1990 pending further disposition. Emergency Petition at 6.

PECO answered the Emergency Petition and denied all allegations therein. Answer at 1-4. PECO also asserted, among other things, that it was in compliance with all Commission regulations, that if there was a taking of property rights as alleged, it was a matter for the courts and that construction of the line had to continue or else the public's electric service would be in serious jeopardy. Answer at 5-6.

The Office of Consumer Advocate ("OCA") noticed its intervention on January 3, 1991. Simultaneously, the OCA filed

a Statement in Support of the Emergency Petition ("Statement in Support") in which it supported the ordering of a full hearing upon the matter so that the affected adjoining property owners would have an opportunity to be heard. The OCA took no position on the merits of PECO's request, nor upon the merits of the Petitioners' objections to the Letter Notification. The OCA noted that the Commission's reliance upon the fact that no protest had been received was in error, as those who would have protested timely had received neither actual notice, nor notice by publication as would have occurred pursuant to 52 Pa. Code §57.75. Statement in Support, at 3. The OCA also noted that a factual assertion within the Letter Notification under 52 Pa. Code § 57.72(d) i.e., that the proposed project would not substantially alter the existing right of way, was challenged by the Petitioners, thus further justifying a full hearing. Statement in Support at 4.

On January 10, 1991, PECO filed a Reply to the OCA Notice of Intervention and Statement in Support. Therein, it stated that there was no legal basis for reopening the proceeding, that it followed the Commission regulations at 52 Pa. Code § 57.71, and that the Commission had already "adequately considered" all elements of safety in approving the Letter Notification. Reply of PECO at 1-4.

The Commission then, by Order of March 6, 1991, denied the Emergency Petition, ". . . because the Petitioners have failed to prove sufficient grounds for reopening the record in

this case." Commission Order of March 8, 1991, at 12. The Commission then found it unnecessary to decide the Petition to Intervene, and went on to deny the Petitioners' request for a stay of construction of the line. The Commission asserted that the standard for granting of a stay, under Virginia Petroleum Jobbers Association v. Federal Power Commission, 259 F.2d 921 (D.C. 1958), is as follows:

1. The petitioner makes a strong showing that he is likely to prevail on the merits;
2. The petitioner has shown that without the requested relief, irreparable harm will occur;
3. The issuance of a stay will not harm other interested parties in the proceeding;
4. The issuance of a stay will not adversely affect the public interest.

The Commission deemed the first criteria inapplicable, ". . . since it may be presumed that this Commission correctly decided the case, and that if appealed, the Commission would succeed on the merits." Commission Order of March 8, 1991 at 12. The Commission also determined that the Petitioners have not shown that they will suffer irreparable harm if construction of the line is not halted. Id. at 13. As to the third and fourth prong, the Commission stated that it ". . . had already found public need for the reconstruction of the old Conrail electric line. Thus, it would be inconceivable that halting construction would not adversely affect PECO or the public interest." Id. at 14. Commissioner (now Chairman) Rolka dissented from the Opinion, to the extent that the Petitioners

had adequately raised new and novel issues warranting reconsideration of the Order approving the line, but agreeing as to the decision upon the request for stay. Dissenting Opinion of Commissioner David W. Rolka at 1.

Commissioner Rolka also noted the Petitioners' challenge of the reasonableness of the notice provisions in the transmission line siting regulations, and the fact that if EMF were to be proved a valid safety concern, ". . . our regulations may be unreasonable in not providing sufficient notice requirements to potential harmed persons. However, this determination cannot be made without also examining the EMF issue on the record." Id. at 2. He also noted the third new and novel argument raised by both Petitioners and OCA concerning the Company's assertion that the proposed project "will not substantially alter the existing ROW." Id. at 2-3. Commissioner Rolka also noted that several of the 29 local officials who were given notice of the proposed line had written to the Commission, stating that at the time they received the notice from the Company, they had no reason to believe that the residents could not protect their own interest in the proceeding. Id. at 3.

On April 2, 1991, the Petitioners appealed the Order of the Commission to the Commonwealth Court, asserting that no notice was received of the original proceedings, nor of the entry of an order, that the action of the Commission in refusing to rescind and set aside its order was illegal,

contrary to law, arbitrary and capricious and without record support. On April 8, 1991, the Protestants requested a stay of construction pending appeal, to which PECO replied on April 15, 1991. The Commission, by Order entered May 8, 1991, denied that Petition, finding that the Petitioners had not satisfied any of the four criteria expressed in the Virginia Jobbers case cited above. Commission Order of May 8, 1990, at 5.

The OCA intervened in the Appeal, Docketed to No. 761 C.D. 1991, on April 26, 1991.

The Commonwealth Court heard argument on May 22, 1991, and issued a Memorandum Opinion and Order on May 24, 1991. That order, by the Honorable Madaline Palladino, succinctly states that the Commission regulations within 52 Pa. Code §57.72(d) did not contemplate the "fact matrix" before the Court. The Court also held that the notice required by the regulations was insufficient, as it only required notice to entities owning property within the proposed right of way, and not to neighboring property owners who will be clearly affected by the new use of the right of way. The Court further held that the regulations contained within 52 Pa. Code §57.72(c)(11) do not provide the notice and opportunity to be heard to which the Petitioners are entitled.

As a remedy, the Court ordered a remand to the PUC for a hearing within 90 days upon the question of whether "they will be adversely affected by the reconductoring of the high

tension line at issue in this case." Commonwealth Court Order of May 24, 1991, at 2.

By Commission Order of June 14, 1991, the Commission ordered the case reopened for hearing and determination of the issue of whether Petitioners will be adversely affected by the reconductoring of the line, granted the Petition for Hearing filed by Protestants June 3, 1991 to that extent, and ordered a hearing for not later than August 22, 1991 on that issue.

Following the submission of prehearing memoranda, a prehearing conference was held telephonically on July 11, 1991, following which the Administrative Law Judge issued a prehearing order. That Order treated certain issues raised by the parties in their prehearing memoranda, and set the stage for the remand proceeding, stating in summary, the following:

1. PECO has the burden of proof as to items required to be submitted under 52 Pa. Code §57.72(d)(4), as the Commonwealth Court Order remanding the case only spoke to the issue of the insufficiency of the regulations as related to their failure to provide for notice to Petitioners and an opportunity for them to be heard.
2. Further, PECO's burden of proof is further limited to matters within the Commission's jurisdiction and within the scope of the proceeding as defined by the Commonwealth Court.
3. Petitioners have the burden of proof on all issues involved in the question of whether they will be adversely affected by the Woodbourne-Heaton 230 KV line, limited to matters within the Commission's jurisdiction.
4. Need for the line is not an issue.
5. Evidence as to alleged decreases in property values is outside the scope of the Commission's jurisdiction.

6. All parties were directed to the information requested by Commissioner Joseph Rhodes in his statement of June 13, 1991, encouraging all affected parties to intervene and participate in this proceeding, specifically providing for the record:

a. Information regarding the expected level of electromagnetic fields, at centerline and edge of right of way based upon the design of the line employed by the company.

b. Discussion of the line employed and whether mitigation of EMF has been maximized by the company efforts.

Prehearing Order at 3-5.

The Protestants moved to dismiss the Company's application (i.e. Letter Notification), or in the alternative to move the proceedings to encompass all relevant issues, including the issue of the "need" for the line, on August 20, 1991. Commission staff answered, stating that the "need" for the line was established by PECO and determined by the Commission in its February 9, 1990 Order.

The Protestants had served written requests for discovery in May, 1991, upon the Prosecutory Staff, which the Staff moved to suppress and to which objections were filed in July, 1991. Protestants also moved to compel answers to its discovery upon the Prosecutory Staff. The Commission entered an order on December 12, 1991, following Commissioner Rhodes' motion on October 23, 1991, that the Prosecutory Staff comply with certain of Petitioners' Requests, while not providing any advisory memoranda or reports on EMF.

The parties engaged in additional discovery, including the taking of the deposition of Protestants' witness Dr. Abraham Liboff.

On September 6 and 20, 1991, hearings were held for the purpose of taking the oral testimony of the Protestants. Hearings were also held on August 15, October 16, November 19, 20, 22 and, December 16, 17, 1991 and January 23, 24 and February 7, 1992 for the purpose of submission of testimony by expert witnesses and cross-examination by opposing parties. This Brief is filed in accordance with ALJ Smolen's Order of March 27, 1992, extending the deadline for Main Briefs to April 21, 1992. Attached to this Brief, in accordance with ALJ Smolen's Order, is a Summary of the OCA's Testimony as Appendix A, Proposed Findings of Fact as Appendix B, Proposed Conclusions of Law as Appendix C, and a Proposed Order as Appendix D.

II. QUESTION PRESENTED

1. Are persons who own land adjacent to a proposed transmission line right-of-way adversely affected by the construction, reconstruction or reconductoring of the transmission line?

OCA suggested answer: Yes

2. Are landowners adjacent to proposed transmission line rights-of-way entitled to timely notice and an opportunity to be heard on the full range of issues relevant to the siting application?

OCA suggested answer: Yes

III. SUMMARY OF POSITION

Judge Palladino, in her Order for the Commonwealth Court, directed that the Protestants be afforded an opportunity to be heard on the question of whether they will be adversely affected by the reconductoring of the high tension electrical line at issue in this case. Memorandum Opinion and Order of May 24, 1991. The OCA submits that the Petitioners have met the threshold burden of demonstrating that they are adversely affected by PECO's action.

The OCA submits that given the interpretation of the Commonwealth Court Order by the PUC, the Commission must now provide a full opportunity for hearing on all issues related to the siting of this transmission line, including need for the line, the safety of the line, and possible alternative routes for the line. It is only after such a full hearing that the Commission can make the findings required by 52 Pa. Code § 57.76 which are necessary to support an Order approving a transmission line siting application.

It is the OCA's position that the procedure which developed in this case should not set a precedent for future siting cases, i.e. adjacent landowners should not be required to first demonstrate an adverse affect before being given an opportunity to address other substantive issues. Rather, the Commission must recognize that the notice provisions contained in the Letter Notification regulations are no longer adequate

to provide due process protections to landowners living adjacent to or near transmission line rights-of-way.

However, the OCA submits that the landowners adjacent to this transmission line have met their burden of proving that they are "adversely affected" by the reconstruction and reconductoring of this line and have, in addition, shown that PECO has substantially altered the use of the right-of-way. As such, a full investigation into the need for the line, alternatives to the construction of the line, and possible alternative routes for the line, which would have occurred had PECO filed an Application under 52 Pa. Code § 57.72, is warranted.

This is not to say that the OCA concludes that this line should not be built, or that the Protestants must be awarded compensation due to the presence of the line. Rather, it is to say that landowners, living adjacent to rights-of-way, some as close as 37.5 feet (Tr. 179-181), are adversely affected by the uncertain risk of potential health effects, as well as the uncertain risk of declining property values as society reacts to the threat of EMFs. The OCA submits that these landowners therefore have a right to a hearing to address the questions of whether, where, and how such a line should be built.

It is the OCA's position that the evidence now available about the effects of EMFs is such that it warrants a reevaluation and modification of the Commission regulations

governing notice to "affected" parties, such as adjacent landowners, as well as a change in procedures so as to allow all affected parties the opportunity to present their concerns as to all material issues to the Commission in a single forum prior to the commencement of construction of a transmission line, as is generally required under 52 Pa. Code §§ 57.74-57.75.

In the present case, the Protestants were not initially provided the opportunity to present their concerns and to have those concerns properly considered by the Commission when it considered the Company's claim, through the Letter Notification procedure, that there was a need for the line and that the line would not "substantially alter the right-of-way." The fact that the Commission approved the Letter of Notification, when in fact this right-of-way is "substantially altered" by PECO's use of it in this manner, highlights the risk of an agency taking action when there has been no opportunity to consider opposing viewpoints and to develop an evidentiary record.

Moreover, the Protestants were not afforded an opportunity to review and determine whether the Company properly pursued a strategy of prudent avoidance in the design and selection of this line. As such, the OCA submits that the Protestants have adequately demonstrated an adverse affect from the reconductoring and reconstruction of this transmission line. Consequently, the OCA recommends that this proceeding be

continued to properly consider the need for the line, alternative routes, and the effect of continuing construction on these landowners, so that the Commission is better able to make findings to support an order in accordance with 52 Pa. Code § 57.76.

IV. ARGUMENT

- A. The Commission Order Of February 9, 1990, Which Approved The Letter Notification By PECO Is Not A Valid Order As To The Property Owners In This Proceeding.

The OCA recognizes that the Administrative Law Judge, as the Presiding Officer in this case, must work within the Orders issued in this proceeding, and that it is not within the power of the ALJ to reconsider prior orders of the Commission. The OCA submits, however, that at this juncture in the proceeding, the Commission itself must consider the validity of the previous Orders entered in this case, and the impact of this proceeding upon other siting cases. The OCA submits that the Commission Order of February 9, 1990 cannot be deemed to be valid as to those who received no notice of it, who had no opportunity to file a timely protest of it, and who have now proved in this hearing that their interests are adversely affected by the Company's actions colorably authorized by it.

The February 9, 1990 Order must be read in light of the Commonwealth Court's decision on the PAUSE appeal. The Commonwealth Court stated as follows:

The notice to entities owning property within the proposed right-of-way provided in 52 Pa. Code §57.72(d) is insufficient, where as here, it is clear that Petitioners, as neighboring property owners, will be affected by the new use of the right of way. Notice to municipalities given pursuant to 52 Pa. Code §57.72(c)(11) does not provide the notice and opportunity to be heard to which Petitioners are entitled.

(Emphasis added.) The Public Utility Code states in Section 316 as follows:

Whenever the commission shall make any rule, regulation, finding, determination or order, the same shall be prima facie evidence of the facts found and shall remain conclusive upon all parties affected thereby, unless set aside, annulled or modified on judicial review.

66 Pa. C.S. § 316. It is also worthwhile to note that the Administrative Procedure Act states as follows:

No adjudication of a Commonwealth agency shall be valid as to any party unless he shall have been afforded reasonable notice of a hearing and an opportunity to be heard.*

2 Pa.C.S.A. §504.

* Section 101 of the Administrative Law and Procedure Act defines "Adjudication" as "any final order, decree, decision, determination or ruling by an agency affecting personal or property rights, privileges, immunities, duties, liabilities or obligations of any or all of the parties to the proceeding in which the adjudication is made." "Party" is defined as "any person who appears in a proceeding before an agency who has a direct interest in the subject of such proceeding." No question exists as to the nature of the February, 1990 Order as an adjudication under this definition, nor that PAUSE and its individual members, through counsel, appeared to assert their direct interest in the subject matter of the Letter Notification.

The Commonwealth Court has long recognized the necessity of providing for notice and opportunity for affected persons to be heard before amending an existing order. Peoples Natural Gas v. Pa. P.U.C., 122 Pa. Commw. 445, 451, 552 A.2d 1135, 1138 (1989). The Court has stated that it must vacate an order entered by the Commission where constitutional rights have been violated. Westinghouse Electric Corporation v. Pennsylvania Public Utility Commission, 44 Pa. Commw. 407, 404 A.2d 712 (1979). Likewise, this principle requiring the Commission to provide notice and an opportunity for complainants to be heard prior to a general rate increase has also been reiterated by the Supreme Court in the Joseph Horne case challenging "option orders." See Joseph Horne Co. v. Pa. P.U.C., 506 Pa. 475, 485 A.2d 1105 (1984); see also Barasch v. Pa. P.U.C., 130 Pa. Commw. 299, 568 A.2d 276 (1989). The notice and hearing requirement have been the subject of a number of Commonwealth Court opinions, which require these constitutional protections where a utility company's proposed changes, impact upon substantial property rights. See eg. Allegheny Ludlum Steel v. Pa. P.U.C., 67 Pa. Commw. 400, 447 A.2d 675 (1982), aff'd 501 Pa. 71, 459 A.2d 1218 (1983)

These constitutional protections are no less important in transmission line siting cases. The Commonwealth Court has held that the Public Utility Commission is required to provide due process to parties appearing before it. Schneider v. Pennsylvania P.U.C., 83 Pa. Commw. 306, 315, 479 A.2d 10, 15

(1984); Fusaro v. Pa. P.U.C., 34 Pa. Commw. 14, 18-20 382 A.2d 794, 796-797 (1978). Despite the Protestants' efforts to participate in the process upon learning of the Company's new use of the railroad right-of-way, they were not permitted to participate. As recognized by the Commonwealth Court, in the portion of the opinion quoted above, the notice and opportunity to be heard to which these litigants were entitled was not provided.

The OCA submits, therefore, that under the Public Utility Code, the Administrative Procedure Act, the Commonwealth Court Order in this case, and prior appellate precedent, the Commission Order approving the Letter Notification submitted by PECO cannot be deemed to be valid as to these Protestants. Because of the limited nature of these hearings, these Protestants have still not been able to be heard on the full panoply of issues related to PECO's use of the right of way. No cross-examination or testimony was permitted concerning the Company's claim that the line is needed, nor on the issue of whether alternative rights of way would have been preferable. Regardless of any other finding which is made by this Commission based upon the record created in this series of hearings, the Commission should reconsider and vacate the order approving the letter notification and speaking to the issue of the need for the line, and provide for an opportunity to be heard on the issues which these Protestants have not yet had a chance to address. In addition,

the Commission should order that in other siting cases, persons owning property adjacent to newly built or reconductored transmission lines should be given timely notice and an opportunity to be heard on the issues set forth in 52 Pa. Code §57.72.

B. The Level Of Uncertainty Concerning The Health Effects Of EMFs Is Such That It Adversely Affects The Landowners Living Adjacent To Or Near The Transmission Line.

1. Adverse Effect.

This case presents the Commission with unique procedural circumstances. The case has been remanded by the Commonwealth Court so that the Protestants could be heard on the question of whether they will be adversely affected by the reconstruction and reconductoring of the transmission line at issue in this case. The OCA submits that these landowners need not prove certain harm to health in order to receive a hearing in this case. Rather, the landowners need only show "adverse affect" sufficient to gain standing to address the merits of the reconstruction and reconductoring of this transmission line.

As discussed below, the OCA contends that there is enough uncertainty regarding the question of the potential health effects associated with the electric and magnetic fields created by this transmission line to justify giving landowners adjacent to or near rights-of-way a chance to raise issues regarding the merits of the proposed transmission line

The potential health effects of exposure to EMFs from transmission lines is only one issue which the Commission must

ultimately weigh against need, reliability, economic benefits, and other engineering and safety issues. The OCA takes no position on these issues at this time but submits that evidence of adverse effects from the uncertain risk associated with exposure to EMFs is sufficient to justify providing neighboring landowners with the opportunity for a full hearing.

2. EMFs

a. Introduction

The major focus of this proceeding has been on the state of the scientific knowledge concerning the health effects of electric and magnetic fields (EMFs). It is the OCA's position in this case that the scientific evidence concerning the potential health effects of EMFs is not sufficiently developed to be able to draw certain conclusions. The OCA submits that there is persuasive evidence that EMFs can produce a variety of changes in biological systems. Even though there is no conclusive evidence that exposure to power frequency fields can result in harm to human health, the OCA submits that there is a growing basis for concern. This uncertainty creates difficult regulatory questions for both the Commission and public utilities.

The OCA submits that in the face of such uncertain risk, the Commission and public utilities must establish and pursue prudent policies in order to mitigate these risks to the public at reasonable cost. As OCA witness Rosenbaum testified:

In planning one should err on the side of safety, but not without considering the

cost. Of course, people can differ as to what cost is reasonable in a given situation. Given the confusing and sometimes conflicting results of studies of low-level power frequency, magnetic fields, it is not even entirely clear what erring on the side of safety means. Nevertheless, I believe that it is prudent to take measures to lower the public's exposure to magnetic fields if this is not too costly. "Too costly" is one of the things that needs to be worked out in public consultations with all affected parties.

OCA St. 2 at 8.

The OCA presented two witnesses to address the current state of scientific knowledge about EMFs and the appropriate public policy considerations in light of this knowledge. The OCA's witnesses are highly qualified to address both the scientific and technical areas of this question as well as the public policy implications.

Dr. David Rosenbaum has over twenty years of experience analyzing the effects and risks of exposure to ionizing and non-ionizing radiation. OCA St. 2 at 1. Dr. Rosenbaum is currently the President of Risk Analysis Corporation, and he was previously the President of Technical Analysis Corporation. Prior to joining Technical Analysis Corporation, Dr. Rosenbaum was the Deputy Assistant Administrator for Radiation Programs for the U.S. Environmental Protection Agency. OCA St. 2, Exh. DMR-1. In addition, Dr. Rosenbaum served as a consultant to the Comptroller General and directed and wrote the United States General Accounting Office report entitled "Somatic Health Effects of Low Level Ionizing

Radiation." OCA St. 2 at 1, Exh. DMR-1. Dr. Rosenbaum holds a Ph.D. degree in Physics from Brandeis University. A complete statement of Dr. Rosenbaum's qualifications can be found at OCA St. 2, Exh. DMR-1.

David Janes, who also testified on behalf of the OCA, is uniquely qualified to testify before this Commission on the health effects and policy implications of EMFs. Before joining Risk Analysis Corporation in 1989 as a Vice President, Mr. Janes directed the U.S. Environmental Protection Agency's program for controlling the exposure of the public to electromagnetic fields, including power line fields, radiowaves, and microwaves. OCA St. 1, Exh. DEJ-1. Mr. Janes has over thirty years experience in analyzing the effects and risks of exposure to ionizing and nonionizing radiation. Mr. Janes has held numerous positions with the U.S. Environmental Protection Agency, including the Director of Analysis and Support Division for the Office of Radiation Programs, Director of the Surveillance and Emergency Preparedness Division, and Chief of the Electromagnetic Radiation Analysis Branch of the Office of Radiation Programs. Mr. Janes holds an A.B. degree in Physics and has completed Postgraduate work in Radiological Physics and Biophysics. OCA St. 1, Exh. DEJ-1. Mr. Janes' qualifications are set forth fully at OCA St. 1, Exh. DEJ-1.

As the OCA witnesses testified, the possibility of harmful health effects from EMFs cannot be summarily or categorically rejected. OCA St. 1 at 10. As such, the

public's concerns about the potential health effects of EMFs are legitimate and should not be ignored or dismissed by those responsible for developing the appropriate regulatory response in cases where this issue is raised. OCA St. 1 at 1 and OCA St. 2 at 10.

b. Electric and Magnetic Fields.

The phrase electromagnetic fields, or "EMFs" is a short-hand way of referring to both the electric and magnetic fields that exist when electricity is present. It is important to note from the outset that there are two fields under discussion, the electric field and the magnetic field. OCA St. 1 at 2-3. As PECO witness Boeggeman explained, a field is a space or region in which an influence can be said to exist. PECO Direct No. 2 at 4. Electric and magnetic fields exist whenever electricity is present. Id. For a transmission line, such as the line at issue in this case, an electric field is created by voltage and expressed in the unit of measure of kilovolts per meter (kV/m). PECO Direct No. 2 at 5. The electric field is present at all times that the transmission line is energized.

The magnetic field is created by the flow of current on the transmission line. PECO Direct No. 2 at 5. The measure of the magnetic field is expressed in milligauss (mG). PECO Direct No. 2 at 5. If there is no current on the transmission line, then there is no magnetic field created. Tr. 47. Conversely, the higher the current on the line, the higher the

magnetic field. OCA St. 1 at 3; PECO Direct No. 2 at 5. The current that will flow on a line is also referred to as "loading" to represent the different amounts of current that will flow on the line depending on different conditions. PECO Direct No. 2 at 7.

The electric and magnetic fields that are created by a transmission line are often referred to as "weak" fields. OCA St. 1 at 2. OCA witness Janes explained the use of the term "weak" fields as follows:

I call electric and magnetic fields "weak" if the current density they induce in tissue is too small to affect the function of critical tissues such as the heart and central nervous system.

* * *

Since most environmental exposures to electric fields are less than 8 kilovolts per meter and environmental exposures to magnetic fields are well below 5,300 milligauss, environmental exposures involve weak electric and magnetic fields...

OCA St. 1 at 2-3. As Mr. Janes explained, the typical electric fields for high voltage transmission lines range from about 1 kV/m to 12 kV/m for the maximum field and from about 0.4 kV/m to 2.3 kV/m at the edge of the right of way. OCA St. 1 at 3 and Table 1.

The typical magnetic fields under high voltage transmission lines are variable depending on the "loading" of the line. Typical values, however, fall in the range of 20-140 mG under the center of the transmission line. It is

important to note that both electric and magnetic fields decrease with distance from the source. PECO Direct No. 2 at 6.

For PECO's 230 kV single circuit line, PECO has calculated a maximum right of way electric field of 1.9 to 2.3 kV/m, with electric fields at the edge of the right of way of 1.2 to 1.3 kV/m. OCA St. 1 at 3. The magnetic fields for this 230 kV transmission line will vary depending upon the "loading" of the line. Under what PECO projects to be normal loading conditions, the maximum field on the right of way has been calculated to be 42 milligauss. At the edge of the right of way, PECO calculates the magnetic field under normal loading to be 25 milligauss. PECO Direct No. 2 at 8-9. Under heavy or emergency loading conditions, however, these values will be greater. Under heavy loading conditions, the expected magnetic field is 70 milligauss in the middle of the right of way and 42 milligauss at the edge of the right of way. PECO Direct No. 2 at 9.

Both electric fields and magnetic fields induce currents in objects placed in the field. OCA St. 1 at 2. The electric fields that are induced inside the body are weaker than the external unperturbed and surface electric fields. OCA St. 1 at 5. The interaction of magnetic fields with people and animals is different from electric fields, however. As Mr. Janes explained:

The interaction of power frequency magnetic fields with human and animals causes currents inside the body, but unlike

electric fields, magnetic fields are not intensified at the surface of the body.

OCA St. 1 at 6.

Humans and animals are able to detect weak electric fields. One of the biological effects of weak electric fields is perception. OCA St. 1 at 6. Humans and animals are not able to detect magnetic fields in typical environmental exposures. Id. However, both weak magnetic and weak electric fields have been consistently observed to disrupt normal circadian rhythms. Id. Even though weak electric and magnetic fields affect biological systems, the connection between these effects and any harm to human health remains unclear. OCA St. 1 at 10.

c. Epidemiologic Evidence.

There are two primary bodies of research into the effects of EMFs on biological systems and human health. One of these areas is a developing and growing body of research in the field of epidemiology.

Epidemiology is the study of humans in their everyday environment. PECO Rebuttal No. 2 at 5. In addition to epidemiologic studies, there is biologic research in such areas as animal and cellular systems, including specialties such as endocrinology, immunology, and reproduction. OCA St. 1, OCA St. 2, PECO St. 1 and 2. PECO witness Cole explained epidemiology as a science as follows:

...[T]he major strength of epidemiology is that it pertains directly to human beings. As such, facts established through

epidemiologic research have direct implications for public health strategies, unlike most laboratory research. The great limitation of epidemiology is that it is a non-experimental science and, consequently, is highly susceptible to error. Both the strengths and the limitations of epidemiology must be recognized when conducting an evaluation of epidemiologic studies.

PECO Rebuttal St. 2 at 5.

As both PECO witness Cole and OCA witness Rosenbaum agree, epidemiology is a non-experimental science which often makes it difficult to prove a cause and effect relationship with epidemiologic data. PECO Rebuttal St. 2 at 7, OCA St. 2 at 5. However, some cause and effect relationships were established by epidemiology and then later confirmed by laboratory research. As PECO witness Cole explained:

Two commonly known cause-effect relationships that were established with epidemiologic data are the relationship between cigarette smoking and lung cancer, and the relationship between certain types of asbestos and mesothelioma. These relationships were eventually confirmed by the laboratory evidence.

PECO Rebuttal St. 2 at 6. However, as Dr. Rosenbaum cautions, the acceptance of these types of relationships in epidemiology did not materialize overnight. Dr. Rosenbaum stated:

It is very difficult to prove something with epidemiology. In fact, it is not at all clear what it means to prove something. Look how many decades it took to convince the medical establishment that smoking leads to lung cancer. Look at how the current wisdom about whether drinking moderate amounts of alcohol is good for you has changed so many times. . . .

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OCA St. 2 at 5-6.

The study of EMFs and harmful health effects is in the early stages of development. OCA St. 2 at 6. The current concerns regarding EMFs and potential harmful health effects appears to have become more prominent following an epidemiologic study conducted in the greater Denver area in the 1970s. PECO Rebuttal No. 2 at 12. In this study, often referred to as the Wertheimer-Leeper Study after the primary authors, the researchers reported an increased death rate from cancer among those near primary and secondary distribution wires. OCA St. 2 at 3. The Wertheimer and Leeper study has been criticized due to problems in the design, conduct and analyses of the study. PECO Rebuttal No. 2 at 13. However, this study can be viewed as an early exploratory study that raised the question of whether EMF is associated with cancer. PECO Rebuttal No. 2 at 13.

Subsequent to the Wertheimer and Leeper study, there have been approximately 50 epidemiologic studies published using a variety of research designs and obtaining varying results. PECO Rebuttal No. 2 at 10-11. For example, in 1988, Myers published a study that used distance from power lines as a surrogate for magnetic field exposure. PECO Rebuttal No. 2 at 14. Myers conducted this case control study in Yorkshire, England and reported a slight increase in cancer risk for those living near a power line, but an inverse association between estimated magnetic field strength and cancer risk. OCA St. 2

at 5 and PECO Rebuttal No. 2 at 14. PECO witness Cole explained as follows:

In other words, residences close to a power line were associated with a slightly smaller risk of cancer than those further away from a power line.

PECO Rebuttal No. 2 at 14. But, as Dr. Cole also noted, due to limitations in the study, the Myers study does not provide persuasive refutation of the hypothesis that magnetic fields are related to childhood cancer. PECO Rebuttal No. 2 at 14.

Another often discussed epidemiologic study was conducted by Tomenius in Sweden. Tomenius conducted a case-control study using both distance from power lines and measured fields rather than the classification used by Wertheimer and Leeper. OCA St. 2 at 3-4. The Tomenius study saw only three-tenths of the expected number of cases of leukemia in those more highly exposed to magnetic fields. OCA St. 2 at 4. In addition, PECO witness Cole notes that the Tomenius study also found an inverse relationship between cancer risk and measured magnetic fields. PECO Rebuttal 2 at 15. From this study, PECO witness Cole concludes that the Tomenius study provides no support for the hypothesis that EMFs are related to an increased risk of childhood cancer. PECO Rebuttal 2 at 15. However, as Dr. Rosenbaum cautions, Tomenius did note an increase in the incidence of brain tumors and benign childhood tumors among those with higher field readings and those nearer the power lines. OCA St. 2 at 4.

In addition, as Dr. Rosenbaum explained on cross-examination, the finding of an inverse relationship in the Tomenius Study is of limited value due to the confidence level associated with the results. Tr. 334. As Dr. Rosenbaum testified, the significance or the confidence interval is critical in determining what import to give to these results. Tr. 335.

Two recent epidemiologic studies conducted in the United States have received much attention in the debate regarding EMFs and cancer. These two studies are the Savitz study and the Peters study. As Dr. Cole noted, both the Savitz study and the Peters study show marked improvement in design, conduct and analysis over previous studies. PECO Rebuttal No. 2 at 16 and 18.

The Savitz study was also conducted in Denver. In addition to the use of wiring code, as was done in the Wertheimer and Leeper study, Savitz collected some data on measured magnetic fields as well as other data such as on parental smoking. PECO Rebuttal No. 2 at 15. Savitz reported only modest effects as a function of measured magnetic field strength in homes. OCA St. 2 at 4. However, Savitz again reported positive associations between wiring code and childhood cancer. Id.; PECO Rebuttal No. 2 at 17.

During the course of this proceeding, the Peters study--primarily authored by London--was published in the American Journal of Epidemiology. The Peters study is a

residential case-control study of childhood cancer conducted in California. PECO Rebuttal No. 2 at 17. Dr. Cole described the Peters study as follows:

The Peters study examined spot measurements of magnetic fields, 24-hour measurements of magnetic fields, and the wiring code.

PECO Rebuttal No. 2 at 18. As Dr. Cole notes, Peters found no association between either of the measures of magnetic fields and childhood cancer. PECO Rebuttal No. 2 at 18. However, the authors did report an association between wiring code and childhood leukemia. In the abstract of the published article, the researchers stated:

"Our results support an association between childhood leukemia risk and wiring configuration but not direct measurements of electric and magnetic fields."

Tr. 1129.

The studies discussed herein cannot and should not be relied upon as a complete discussion of the epidemiologic evidence. This discussion only highlights some of the most discussed studies and provides examples of the evidence that is developing on the question regarding the potential health effects of EMFs. Additional epidemiologic studies are discussed by OCA witness Rosenbaum, PAUSE witness Liboff and PECO witness Cole at OCA St. 2 at 3-5; Protestants St. 2 at 4-5; and PECO Rebuttal St. 2 at 14.

Dr. Rosenbaum, however, did perform a detailed review of the epidemiologic studies concerning cancer and EMFs. OCA St. 2 at 3-5. Dr. Rosenbaum summarized his review as follows:

The present epidemiological evidence is suggestive, but far from conclusive. Several studies by well qualified epidemiologists have reported associations between what may be surrogates for long-term average field strength and various types of cancer. Sometimes there is no apparent correlation when actual measured (short-term) field strength is used instead of the surrogate. Other studies have reported either no significant correlation or no relationship between fields or field surrogates and cancer. Authors of one study have observed negative correlations between exposure to high magnetic fields and cancer. Another study reports increased cancer, but lower total death rates (due to less cardiovascular disease for those exposed to high fields). One study reports high cancer incidence for people farther from a power line than for people closer to a power line. Excesses of different cancer show up in different studies.

OCA St. 2 at 3 (references omitted). Needless to say, the present state of knowledge from the epidemiologic literature is not conclusive.

Moreover, the present state of scientific knowledge about EMFs and potential human health effects is not very well developed. There is an important distinction between nonionizing radiation associated with power line fields, and ionizing radiation, such as X-rays (PECO Rebuttal St. 4 at 10), but there is an important comparison between our knowledge of the effects of these different forms of radiation on people. Dr. Rosenbaum explained:

Our understanding of the effects of ionizing radiation is far less certain than the public is led to believe. This is in spite of the fact that many billions of dollars have been spent on ionizing effects research and more than one hundred thousand papers

have been written in the field. . . . [O]ur knowledge of the effects of nonionizing radiation is about comparable to our knowledge of the effects of ionizing radiation in the 1920s.

OCA St. 2 at 6. As PECO witness Cole readily admitted, in the area of epidemiology, there are only about 50 epidemiologic studies that have been published which contain data on EMF and cancer. PECO Rebuttal St. 2 at 10.

Yet, in light of this lack of knowledge and these mixed results, PECO witness Cole concluded that there is no possible threat of cancer from this 230 kV transmission line. PECO Rebuttal St. 2 at 28. Dr. Cole stated no opinion as to whether the presence of a high voltage transmission line will cause other adverse health effects. Tr. 1084.

Dr. Cole appears to rely for his conclusions that there is no threat of cancer on the pattern of weaker associations appearing in the better-done studies. PECO Rebuttal St. 2 at 18.

However, as OCA witness Rosenbaum notes, there are several problems with this analysis. Most critically, as noted above, even though the Savitz and Peters studies showed no association between measured magnetic fields and childhood cancer, the positive association between wiring code and childhood cancer was again found in these studies. As Dr. Rosenbaum testified:

First, by far the most important thing is that all three studies, including the very carefully done Savitz and Peters studies,

found association between wiring
configuration and childhood leukemia.

OCA St. 2A at 2.

Dr. Cole also seems to imply that the better-done studies should get stronger results, not weaker results, if there is an effect. However, this is not necessarily true. If, for example, the more carefully done study eliminates technical problems, such as bias, the more carefully done study might give weaker results even if there is a real effect. OCA St. 2A at 2. As Dr. Rosenbaum concluded:

Thus, it is not clear that Wertheimer & Leeper's stronger results, compared to those of Savitz and Peters, is any evidence at all that the reported associations between wiring code classification and childhood leukemia are not evidence of a real effect.

OCA St. 2A at 2.

Finally, as Dr. Rosenbaum points out, it is difficult to compare the data contained in the Peters and Savitz studies because the figures compare different things and the confidence intervals associated with the calculations of the odds ratios* are very wide. OCA St. 2A at 4. The wide confidence interval in these studies means that neither the Savitz study nor the

* As Dr. Rosenbaum explained, the odds ratio is the measure of relative risk of "exposed" people compared to "unexposed" people. For example, an odds ratio of 2.00 means that the risk of the exposed is twice that of the unexposed. OCA St. 2A at 3. However, the odds ratio must be viewed in light of the associated confidence interval to determine whether the odds ratio is statistically significant. Id.

Peters study indicates that there is a 95% probability that there is a "true" positive correlation between wiring code classification and childhood leukemia. OCA St. 2A at 4. After reviewing these problems with Dr. Cole's analysis, Dr. Rosenbaum concludes:

I do not believe that the results of the Wertheimer & Leeper, Savitz and Peters study indicate that if better and better studies are done the reported association between wire code classification and childhood leukemia will eventually go away.

OCA St. 2A at 4.

The OCA submits that the epidemiologic evidence remains unclear and uncertain. Even though PECO witness Cole states that there will be no threat of cancer to these Protestants from PECO's 230 kV transmission line, even Dr. Cole admits that he is only 70% of the way to being convinced that EMFs do not increase the risk of cancer. Tr. 1102. But, as Dr. Cole readily admits, his expertise is not in public health policy and he is not charged with safeguarding the public health. In addition, he has no opinion as to PECO's information to its customers concerning policies of prudent avoidance. Tr. 1124. The OCA submits that the Commission is responsible for developing appropriate regulatory policies and therefore, cannot simply ignore a risk because that risk has not been clearly and unambiguously demonstrated.

In this case, there has been no persuasive refutation of the concern regarding the possible associations between EMFs and harmful health effects. Indeed, as this case progresses,

research into these issues continues. Even Dr. Cole, himself, is beginning an epidemiologic study that will have--as one of its considerations--exposure to EMFs. Tr. 1120-1121. The OCA submits that the Commission, charged in this instance with adopting a reasonable policy to safeguard the public health cannot in the face of this uncertain evidence and this continuing research summarily or categorically dismiss the concerns of the public.

d. Biological Evidence.

As Dr. Cole cautioned, however, the epidemiologic studies are only one aspect of the research being conducted into the question of harmful health effects and cancer. Also of importance, is the biological plausibility--particularly when epidemiology shows weak or inconsistent results. PECO Rebuttal No. 2 at 19. PECO witness Cole explained biological plausibility as follows:

Biological plausibility refers to the question of whether there is a credible biological mechanism that supports the hypothesis that exposure to the agent causes cancer. Biological plausibility can be established either through mechanistic research, or through animal research that shows that exposure to the agent causes cancer in experimental animals.

PECO Rebuttal No. 2 at 19.

Some of the witnesses in this proceeding also reviewed the growing body of biological research regarding the effects of EMFs on cellular and animal systems. As noted by OCA witness Janes, the literature on the biological effects of

exposure to power frequency electric and magnetic fields is large and has been extensively reviewed and analyzed. OCA St. 1 at 6. These studies have investigated a wide variety of biological effects in humans, animals, and cellular systems with both positive and negative results reported. OCA St. 1 at 6. OCA witness Janes summarized:

In general, many things are unaffected by exposure to weak electric and magnetic fields, including: growth and development, morbidity, blood cell populations, serum chemistry, and cardiovascular function. However, there is solid experimental evidence that some effects occur in exposed animal and cellular systems.

OCA St. 1 at 6.

One biologic effect of weak electric fields is perception, although this is not an effect of magnetic fields. OCA St. 1 at 8. However, the animal studies have observed effects from exposure to weak electric and magnetic fields on certain circadian rhythms. OCA St. 1 at 8. Some of the work being conducted in this field involves the effect of weak fields on the concentration of melatonin. OCA St. 1 at 8.

The research into the effect of electric and magnetic fields on the levels of melatonin is important due to studies which have suggested that melatonin appears to affect the incidence of chemically induced mammary tumors in rats. As PECO witness Bockman explained, melatonin is a hormone that is produced by the pineal gland. PECO Rebuttal No. 1 at 17. The exact function of melatonin is not well known, but among other things, it is a hormone that regulates sexual function and

development. OCA St. 1 at 17. Several studies have been conducted into the effects of electric and magnetic fields on the concentration of melatonin levels in animals and humans. In some of the laboratory studies, nighttime concentrations of melatonin in rat pineal glands were suppressed by exposure to 60 hertz electric fields. OCA St. 1 at 8.

In addition, another study by Kavaliers and co-workers reported an observation of the effect of a static magnetic field on the nocturnal response of mice to morphine. OCA St. 1 at 8. This observation is consistent with the reduction of nocturnal pineal gland activity and the levels of melatonin. Id. This effect, however, was reversed when the mice were removed from the exposure to the magnetic field. OCA St. 1 at 8. However, the mice were only exposed for a short period of time. Tr. 992-993.

As Dr. Bockman correctly notes, it cannot be said that the rat melatonin study provides a basis for concluding that power frequency electric or magnetic fields leads to adverse effects on human biologic rhythms. PECO Rebuttal No. 1 at 18. However, the OCA submits that PECO witness Bockman's conclusion that further research is a low priority (Tr. 974-75) and PECO witness Gelman's conclusion that there is no need for further research into these areas (Tr. 1174-75) is misplaced in light of the evidence.

As OCA witness Janes explained, melatonin is physiologically active in mammals even though its role in human

physiology may not be understood. In a study by Tamarkin published in 1981, melatonin appears to affect the incidence of chemically induced mammary tumors in rats. OCA St. 1A at 2.

Mr. Janes explained:

In a study by Tamarkin, melatonin significantly reduced the incidence of mammary tumors in rats treated with the tumor promoter DMBA and partially reversed the increased incidence of tumors in rats whose pineal glands had been removed.

OCA St. 1A at 2.

The study by Tamarkin, in addition to other studies that report a suppression of melatonin levels, raise obvious scientific questions that have not been resolved. Dr. Bockman sees no reason to do further research to seek answers to these questions. Tr. 1003. OCA witness Janes, however, who has considerable experience in addressing issues concerning risks to public health, reached a different conclusion. Mr. Janes explained:

In summary, exposure to extremely low frequency electric and magnetic fields affects melatonin levels and melatonin levels affect the incidence of chemically induced breast tumors in rats. In my view, it is important to establish by direct experiment whether exposure to these fields affects tumor incidence in rats and then whether the results in this experimental animal system can be extrapolated to humans.

OCA St. 1A at 2. Dr. Bockman agrees with Mr. Janes, and cautions that these studies cannot be extrapolated to humans. Tr. 994-95. However, the OCA would note that this is not the same as saying that these studies have no significance in the

study of potential human health effects. In addition, as noted by both Dr. Janes and Dr. Bockman, there have been some studies on humans using electric blankets that also reported effects on the levels of melatonin in humans after exposure to EMFs. Tr. 989-991.

The relationship between EMF effects on melatonin concentrations in animal systems and on humans is becoming more significant in light of recently published epidemiologic studies. Mr. Janes testified:

This is especially important in view of the recently published study of Demers et al., who report an association between occupational exposure to electromagnetic fields and breast cancer in men and the suggestion from Wilson's work that low frequency electromagnetic fields may affect melatonin levels in some humans.

OCA St. 1A at 2. The Demers study is a recent epidemiologic study entitled Occupational Exposure to Electromagnetic Fields and Breast Cancer in Men. Tr. 1464. The OCA submits that when these studies are reviewed as a body of literature, as was done by OCA witness Janes, one can only conclude that important questions remain unanswered. Neither Dr. Bockman nor Dr. Gelman reviewed or discussed the Tamarkin study in the preparation of their testimony in this proceeding. Tr. 1156-57 and 996. In addition, the Demers study was also recently published. OCA St. 1A at 2.

Other studies of cellular systems have also observed effects from exposure to weak fields. One important area of cellular research where effects have been seen is in the

synthesis and activity of biologically important macromolecules such as ribonucleic acid (RNA) and proteins. As Mr. Janes explained, RNA is important because it copies information from DNA so that proteins can be produced.* OCA St. 1 at 8.

The primary study into the effects of magnetic fields on the transcription of RNA and protein synthesis was conducted by Goodman. OCA St. 1 at 8. PECO witness Gelman explained:

Goodman has exposed various types of cells, including cells from insect salivary glands . . . to pulsed fields, modulated fields, and power frequency fields. She examined certain cellular processes in those cells after exposure to the fields.

PECO Rebuttal No. 3 at 16. In addition, Goodman has investigated the effects of magnetic fields on protein synthesis in tissue culture preparations of human cells. OCA St. 1 at 9. Goodman found alternations in the synthesis of both RNA and protein. OCA St. 1 at 10.

Other areas of research on cellular systems are being conducted in the area of cell proliferation. In a study by Byus and co-workers, there was an increase in ornithine decarboxylase (ODC) levels after exposure to 60 hertz electric

* During cross-examination, Dr. Gelman explained that changes in DNA are necessary to the causation of cancer. Once the DNA has changed, the cell has the capacity to repair the DNA. If the DNA is not repaired, there is a mutation, which, depending on the mutation, is important in the causation of cancer. Tr. 1153-54. Cancer promotion, however, is usually caused by an agent which facilitates cell proliferation, while the progression of cancer is something which can happen all by itself. Tr. 1153.

fields. OCA St. 1 at 9. ODC levels increase in growing and replicating cells. Id. As Dr. Gelman explained on cross-examination, cancer promotion is usually caused by an agent which facilitates cell proliferation. Tr. 1153.

In a study by Ross which combined extremely low frequency magnetic fields with static magnetic fields, Ross reported small decreases in the proliferation of cells. OCA St. 1 at 9. In a parallel experiment in which the frequency of the magnetic field was held constant at 100 hertz and its amplitude varied, cell proliferation first decreased and then increased as the magnitude of the magnetic field was increase. OCA St. 1 at 9. Again, the results of the experiments have produced diverse results.

Although these biologic effects have been observed in both animal and cellular systems, the mechanism of these effects are not known at this time. OCA St. 1 at 9. In light of this, OCA witness Janes recommends that further research must be conducted before any conclusions can be reached about the relationship between EMFs and harmful health effects in humans. OCA St. 1A at 1. As both Mr. Janes and Dr. Bockman agree, it is not possible at this time to draw conclusions as to human health from this animal and cellular systems research. OCA St. 1A at 2; Tr. 994-95.

As Mr. Janes noted, though, several interrelated conclusions can be drawn from an analysis of the animal and cellular studies. These conclusions are:

1. Weak electric and magnetic fields affect biological systems.
2. The biophysical and biological mechanisms that give rise to the observed effects of exposure to weak electric and magnetic fields are either not known or poorly understood at this time.
3. The effects seen in cellular systems are useful for investigating mechanisms and generating hypotheses to test in animal studies. Because isolated cells or cell preparations may function and react differently than the same cells in a live animal the results of these studies cannot be directly extrapolated to animals.
4. The weak field effects observed in animals are subtle and often transient or reversible; therefore, the connection between these effects and any harm to human health is unclear.
5. Since weak electric and magnetic field effects occur, the possibility of harmful effects cannot be summarily or categorically rejected, and concerns about harmful effects are legitimate.

OCA St. 1 at 10. The OCA submits that these interrelated conclusions demonstrate that the biologic evidence also remains uncertain. The biologic evidence provides no conclusive proof that EMFs do not result in an increased risk of harm to people who are constantly exposed to the fields.

e. Conclusion.

In conclusion, the OCA submits that the current state of scientific knowledge about the possible harmful effects of EMFs is unclear. At best, the research provides an uncertain picture, fraught with studies providing conflicting results. The OCA submits that it is not possible to conclude that there

is a cause and effect relationship between EMFs and harmful health effects, nor is it possible to conclude that no such cause and effect relationship exists.

This uncertainty, however, does have an adverse effect on those people who must now live near transmission lines. As the OCA witnesses have noted, the concerns raised by residents near these lines are legitimate concerns that cannot be ignored by government and industry. Rather, these concerns should form the basis of a determination as to the appropriate public policy in face of such uncertain risk.

C. Appropriate Public Policy In The Face Of Uncertain Risk.

1. Prudent Policy.

As discussed above, much scientific information has been presented in this proceeding, and there has been significant scientific debate about the quality, interpretation and credibility of the studies regarding EMFs and potential harmful health effects. There has been much criticism leveled at different studies and methodologies, and there have been challenges as to the scientific relevance of particular studies to any human health effects. PECO's witnesses have each reached a conclusion that they believe there is no scientific basis to conclude that power frequency electric and/or magnetic fields cause, promote, or contribute to the development of cancer or other adverse health effects. PECO Rebuttal St. 1 at 27; PECO Rebuttal St. 2 at 28; PECO Rebuttal St. 3 at 22; PECO Rebuttal St. 4 at 24. However, this is significantly different

from saying that it has been proven that there is no harmful or adverse effect. The OCA submits that there is no proof in this proceeding that exposure to EMFs does not result in adverse health effects. Rather, the evidence in this case demonstrates that there is a growing basis for concern. See, OCA St. 1; OCA St. 2; Protestants St. 2 at 5. The Commission, now, is faced with the question of what action it should require a utility to pursue in the face of this uncertain risk.

The OCA submits that given the uncertain risk associated with electric and magnetic fields, the public utilities must implement a prudent policy and the Commission should provide guidance in this area. Dr. Rosenbaum summarized the elements of such a prudent policy in the face of uncertain risk as follows:

1. Research on the effects of electric and magnetic fields should be continued.
2. The public should be informed about possible health effects proactively, impartially, and regularly.
3. The public should be involved in critical decision making processes from the beginning.
4. The cost and benefits of possible alternatives should be calculated before any construction decisions are made.
5. Err on the side of safety, but not without considering the cost.

OCA St. 2 at 8.

Of critical importance to this case is the fact that utilities must engage in these processes and analyses before the transmission lines are designed, sited, and constructed.

When a company considers a power line project, it should, at the very least, consider the costs and benefits of mitigative measures. Dr. Rosenbaum summarized some of the mitigative measures that the utilities should consider. Dr. Rosenbaum testified:

Mitigative measures that should be considered before construction begins may include, but are not limited to:

- avoiding heavily populated areas
- avoiding parks, schools, and other public facilities
- widening rights-of-way
- limiting public uses of rights-of-way
- using higher ground clearances
- designing the power lines to reduce fields

OCA St. 2 at 7.

In this case, however, PECO did not pursue these steps before it designed, located, and constructed this transmission line. Even though reductions in fields are possible by the use of appropriate engineering design (OCA St. 2 at 8, PECO Direct No. 2 at 11), PECO did not conduct any calculations of the electric and magnetic fields resulting from its design choice until after the construction of this line was virtually completed. Tr. 12-13, OCA Cross-Examination Exh. 1, and OCA St. 2 at 7. PECO did not make these calculations until after a request by the Office of Consumer Advocate during the discovery

stage of this proceeding--a point in time when the transmission line was almost 90% complete. Tr. 13.

Although PECO witness Silva did not believe that there was a temporal component to the application of policies such as prudent avoidance by utilities to mitigate exposure to EMFs (Tr. 1313-1314), the OCA submits that it is counter-intuitive to apply the concept of prudent avoidance after a line is constructed and no further design changes can be made. The OCA submits that it is not good public policy to determine after a line is built that it happened to be consistent with the concept of prudent avoidance. As Mr. Silva recognized, transmission lines last about 30-40 years. Tr. 1320. Thus, good public policy dictates that all relevant and appropriate measures be considered in the design and planning phases before transmission lines are built. In this case, this was not done.

PECO attempts to justify its approach by downplaying the significance of EMFs from this transmission line. PECO witness Silva testified that there is nothing unusual about the fields associated with the Woodbourne-Heaton 230 kV transmission line. PECO Rebuttal St. 6 at 19. In fact, Mr. Silva asserts that these fields are consistent with the range of fields that people encounter in their everyday life and that the fields meet existing field standards in other states. PECO Rebuttal St. 6 at 19. But, again, Mr. Silva misses the real issue.

As Mr. Silva noted and as PECO's literature explains, people can take measures to reduce their own environmental exposure to EMFs. For example, as the PECO brochure explains, people can move away from microwaves, computers, or televisions to reduce their own environmental exposure to EMFs. Protestants Exh. 1. However, with this transmission line, the residents cannot control their level of exposure to EMFs. Only the Company can control the exposure to EMFs through the design and loading of the transmission line. As the Company has testified, this transmission line will provide virtually constant exposure to EMFs to these residents. Tr. 10. The only alternative for the residents to avoid EMF exposure from the line is to move from their homes to a location where there is no such line. Tr. 133-134.

Moreover, in this case, these residents had no opportunity to determine prior to the construction of the line whether the Company had employed all reasonable design alternatives, and had considered other reasonable alternatives, to mitigate their exposure to the EMFs. These residents are placed in the difficult position of being asked to believe that the utility happened to be right, even though it admits that it conducted no prior analysis. Yet, these residents believe that their health and the value of their homes is at risk. The OCA submits that this is not the prudent policy for utilities to pursue. Rather, utilities and the government should foster public involvement before decisions are made to avoid

developing a situation where the public mistrusts both the government and the utility. OCA St. 2 at 7.

The OCA submits that PECO's approach to the siting of this transmission line was inappropriate and can no longer be the practice of utilities in Pennsylvania. Dr. Rosenbaum aptly described the approach used by PECO as follows:

It is like driving on a long trip with bad brakes and no seat belts and calling it prudent because you arrived safely.

OCA St. 2A at 5. The OCA submits that such an approach is inappropriate and must be discouraged by this Commission.

2. Consideration of Changes In Land Use And Enjoyment Of Property.

As public knowledge regarding the potential health effects emerges, public utilities and public utility commissions must recognize that the truisms and practices of the past may no longer be relevant or appropriate today. For example, conventional wisdom was that some people tended to purchase and build homes near rights-of-way because of the additional open space that was provided. Tr. 1288. However, as the public becomes more knowledgeable of the potential health effects of EMFs, this may no longer be true. Id. As such, the Commission's traditional view of the effects of transmission lines on neighboring properties must also evolve. The OCA submits that the Commission must fully consider all effects on adjacent land uses, including changes in use,

enjoyment, and value, when weighing the need for the transmission line and the location of the transmission line.

PECO witness Van Dyke noted that there are many variables that people consider when they decide where to locate a home. Tr. 1288. Such variables could include open space, view, schools or proximity to commercial facilities. Tr. 1288. In addition, PECO witness Van Dyke agrees that both public opinion and the factors that the public takes into account are relevant in establishing market value. Tr. 1290. As several of the Protestants have testified, they believe that there has been an effect on the market value of their homes from the proposed construction of the transmission line. See, e.g., Tr. 235-236, 238-239.

However, PECO witness Van Dyke concluded that the market value of homes would not be affected by the transmission line. PECO Rebuttal No. 5 at 14. But, as PECO witness Van Dyke admitted, he had only reviewed the testimony of PAUSE witness Turner when he reached his conclusion that the market effects of EMFs would already be included in the market price of homes along the proposed corridor. Tr. 1276. Mr. Van Dyke did not consider the testimony of Protestants in this proceeding nor did he review any additional information such as newspaper accounts of other proposed transmission lines in Pennsylvania. Tr. 1277. Moreover, Mr. Van Dyke's analysis is logically flawed in that the corridor, up until the time of the construction of this transmission line, was used primarily as a

railroad corridor. Thus, the effects that would be recognized in the market value would only have been those resulting from the fact that the properties are near a railroad corridor, not that they are near a transmission line corridor.

In addition, as many of the Protestants in the proceeding have testified, they believe that their use and enjoyment of their property will be significantly changed due to the presence of this transmission line. There are over fifty children, most under the age of twelve, living in the development through which the transmission line will run. Tr. 176. Some of the Protestants have testified that they plan to restrict their children's play in their backyards, which are adjacent to the right-of-way, in order to limit the children's exposure to EMFs. See, e.g., 144-145, 162-163, 203. Others have testified that they will no longer utilize the park area in the development because of its proximity to the transmission line. See, e.g., Tr. 188-189, 195. Thus, in an attempt to "prudently avoid" the potential health effects of EMFs created by this line as much as possible, these Protestants have testified that they will alter the way in which they use their property. Tr. 166, 203-204, 216, 223. Numerous Protestants have testified that they are attempting to sell their properties and move from the area due to their fear of potential health effects of EMFs. See e.g., Tr. 204-206, 234, 244.

PAUSE witness Turner recognized the change in public awareness of EMFs as evidenced by the Protestant's testimony in this proceeding. Mr. Turner testified:

In parallel with the significant national and international research, public awareness has grown at an extraordinary rate with regard to the exposure of this issue in the popular press. My own research and interviews lead me to the conclusion that there is a deep fear among knowledgeable citizens regarding the danger of exposure to all sources of electromagnetic fields.

Protestants St. 1 at 3.

After his extensive review, PAUSE witness Turner concluded that this new public awareness will alter both the planning and regulation of transmission lines, Mr. Turner concluded:

This uncertainty and fear which are now imbedded in the public perception constitute a new reality in the relationship of communities and persons to the sources of electromagnetic fields. As a land use planner, this variable is now a significant element in the planning and regulation of utility transmission lines and public facilities. I anticipate that environmental audits presently used by financial institutions in evaluating properties will soon include relationship to EMF generators like transmission lines. This inclusion would parallel radon tests that are now used as a matter of course in many residential sales.

Protestants St. 1 at 3.

PAUSE witness Turner also concluded that in light of the uncertain scientific opinion, the public policy issue becomes very difficult. As Mr. Turner notes, the public policy issues are analogous to the purpose of zoning, which has been

to promote, protect and facilitate the public health, safety, morals, and general welfare of the public. Protestants St. 1 at 5. However, as Mr. Turner recognizes, the power to zone is always tempered by the rights of individual property owners. PAUSE St. 1 at 5.

The OCA submits that, similarly, a utility's power to locate facilities and its power of eminent domain must always be tempered by individual property rights. This is the essence of the Commission's regulations regarding the siting of electric facilities. As the Commission stated as early as 1976 when it promulgated transmission line siting regulations:

It is essential in the siting, construction, and maintenance of overhead electric transmission facilities to minimize any adverse effect upon the environment and the quality of human life in the areas in which new facilities will be located, and to minimize any potential hazards to public health and safety. Therefore, the Commission is proposing a regulation which will provide for Commission reviews of the siting and construction of overhead electric transmission lines

Re: Proposed Electric Regulation, 49 Pa. PUC 706, 710. The Commission's clear intent to consider all impacts prior to the construction of a transmission line was, in fact, thwarted in this proceeding by PECO's use of the Letter of Notification procedure. The OCA submits that all issues of individual property rights as well as the utilities right to construct the line should be considered.

In zoning cases, these issues have been resolved by the courts. As Mr. Turner explained:

The municipality's power to zone, however, is always tempered by the rights of individual property owners; for this reason, land use law has been shaped by numerous cases involving "taking" and equal protection issues. In deciding such cases, the courts often perform, as with nuisance cases, a balancing of equities. They attempt to determine whether the potential threat to health, safety or welfare is greater than the threat to an individual's property rights.

Protestants St. 1 at 6.

In this case, however, no such analysis or balancing was done before approval of the line was granted. In fact, the Commission accepted PECO's assertion that the right-of-way would not be substantially altered even though the Conrail electric line has been de-energized since 1986, meaning that it has no voltage and creates no electric or magnetic field. The new PECO line, however, would be a 230 kV line that would be in continuous operation, except for scheduled maintenance or forced outages. Tr. 48.

It is important to note that when the Commission published its current regulations regarding the Letter of Notification procedure, the Commission specifically cautioned the utilities not to assume that "an increase in the voltage of an existing HV line can not result in a substantial alteration of the right-of-way." The Commission stated:

Our regulations do not prohibit us from rejecting a letter of notification and directing that a siting application be filed if we feel that the change in voltage, and the corresponding change in electromagnetic and electrostatic fields is significant

enough to result in a substantial alteration of the right-of-way.

13 Pa. Bulletin 131, 133 (January 8, 1983).

The OCA submits that the evidence in this proceeding supports a finding that the right-of-way has been substantially altered by PECO's construction of a 230 kV transmission line when no electric line had been energized on the right-of-way since at least 1986. Tr. 10. Therefore, the OCA submits that the Letter of Notification procedure should not have been utilized, and that the Protestants are entitled to a hearing on all issues, including those of the need for the line and alternative routes.

The balancing of equities in this case will be difficult. As Mr. Turner explains:

The balancing of equities in this case is made more difficult by the fact that we have scientific differences of opinion in regards to the exact nature of the health effects of EMF. In addition, this matter is confounded by the fact that the original corridor, or right-of-way was conditioned by that function. The overlay of this new use with apparently no significant modification of that right-of-way is, on the face of it, not responsive to public concerns regarding public health without substantial evidence regarding EMF levels.

Protestants St. 1 at 6. In this case, the existing right-of-way is as narrow as 60 feet with estimated EMF levels of 13-70 milligauss at the edge of the right of way. PECO Direct No. 1 at 5; PECO Direct No. 2 at 9. The range depends upon the level of loading which PECO will place upon the line. The OCA submits that the Protestants should be given an

opportunity to present all relevant evidence so that the Commission can properly balance the equities involved in this case.

3. The Commission Should Consider Amending Its Regulations To Provide For Adequate Notice.

This case has highlighted a fundamental flaw in the Commission's regulations providing for the Letter of Notification procedure for the approval of the location and design of transmission lines. In addition, this case has highlighted the need for the Commission to re-evaluate its current policies and precedents regarding transmission line siting applications.

Mr. Turner summarized this best when he echoed the conclusions of OCA witness, Dr. Rosenbaum. Mr. Turner testified:

[I]t is important for local jurisdictions, which have been given the right and responsibility to regulate in the interest of public health, welfare, and safety, to develop a strategy for dealing with EMF issues on an equitable and reasonable manner. "Prudent avoidance," a term introduced in an extensive study sponsored by the U.S. Congress' Office of Technology Assessment, is one such approach: "That is, look systemically for strategies which can keep people out of 60 Hz fields arising from all sources but only adopt those which look to be "prudent" investments given their cost and our current level of scientific understanding about possible risks."

Protestants St. 1 at 7. Clearly, in this case, this was not done.

As Commonwealth Court Judge Palladino recognized, the Commission's regulations did not contemplate the "fact matrix"

presented by this case. Even though the Commission was cognizant of the developing concern regarding EMFs when it proposed these regulations, the regulations were insufficient to insure that these affected property owners received notice of PECO's proposed construction prior to the work beginning.

Thus, the Commonwealth Court concluded:

The notice to entities owning property within the proposed right-of-way provided in 52 Pa. Code §57.72(d) is insufficient, where as here, it is clear that Petitioners, as neighboring property owners, will be affected by the new use of the right-of-way. Notice to municipalities given pursuant to 52 Pa. Code §57.72(c)(11) does not provide the notice and opportunity to be heard to which Petitioners are entitled.

Commonwealth Court Order of May 24, 1991.

The OCA submits that the Commission's regulations at 52 Pa. Code § 57.72(d) are not adequate to address the emerging concerns regarding EMFs and the effect that such concerns have on landowners adjacent to or near transmission line rights-of-way.

Moreover, the Commission's regulations that allow for the use of the Letter of Notification procedure are flawed in that the regulations require a finding of fact by the Commission that the use of the right-of-way will not be "substantially altered" without the receipt of evidence on that fact. The OCA submits that this case has highlighted the point that the factual determination as to what constitutes a substantial alteration of the right-of-way is one that requires

either evidence or specific guidelines from the Commission. This is even more important given the uncertain risk of potential health effects faced by those living near transmission lines.

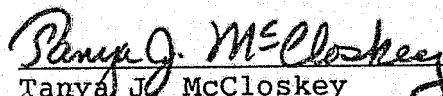
As such, the OCA submits that the Commission should consider amending its regulations to provide adequate notice to all neighboring landowners in transmission line siting proceedings. The OCA urges the Commission to propose amendments to the regulations, publish them in the Pennsylvania Bulletin and receive public comment on these regulations. It is only in this way that those affected by the construction, reconstruction, or reconductoring of transmission lines can be assured of adequate notice and an opportunity to be heard.

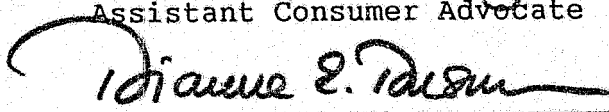
V. CONCLUSION

For the reasons set forth above, the Office of Consumer Advocate submits that the Protestants have met their burden of proving that they are adversely affected by the reconductoring and reconstruction of PECO's Woodbourne-Heaton 230 kV transmission line. In addition, the Protestants have shown that the right-of-way has been substantially altered by PECO's construction of its proposed transmission line. As affected parties, Protestants should have been provided notice and an opportunity to be heard on the merits of PECO's proposal prior to Commission action. The OCA urges the Commission to continue this proceeding to provide such opportunity.

Additionally, the OCA recommends that the Commission take the necessary steps to amend its siting regulations to provide for adequate notice to all affected parties.

Respectfully submitted,


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Dated: April 20, 1992

APPENDIX A
SUMMARY OF OCA TESTIMONY

SUMMARY OF OCA TESTIMONY

I. Evidence Offered by the Office of Consumer Advocate

A. Testimony of David E. Janes (OCA Statement 1; Exhibit DEJ-1; OCA Statement 1A)

OCA witness Janes is employed as Vice President of Risk Analysis Corporation, located in McLean, Virginia 22101, and has over thirty years of experience in analyzing the effects and risks of exposure to ionizing and nonionizing radiation. OCA St. 1, at 1.

Mr. Janes testified for the purpose of explaining the effect of power frequency fields upon biological systems. EMFs produce demonstrable and measurable effects upon humans, animals and cellular systems. Electric and magnetic fields of certain magnitudes, not commonly encountered in environmental exposures can be sensed by human beings tactilely and visually. Id. at 2. Weak electric and magnetic fields, i.e. those which are too small to affect the function of critical tissues such as the heart and central nervous system, also affect biological systems. Id. at 2.

Electric field strengths for typical 115 kV (double circuit) to 765 kV (single circuit) high voltage transmission lines range from 0.97 to 12 kilovolts per meter (kV/m) in the maximum field to 0.4 to 2.3 kV/m at the edge of a right of way (ROW). Id. at 3 and Table 1. PECO's 230 kV single circuit

line will generate maximum ROW fields of 1.9 to 2.3 kV/m and edge of ROW fields of 1.2 to 1.3 kV/m. Id. at 3.

Magnetic fields vary depending upon line current, which varies with transmitted power. Id. Typical values range from 20 to 140 milligauss and maximum values probably do not exceed 350 milligauss. Id. For the PECO 230 kV line carrying a normal load, the Company has calculated the maximum ROW fields to be 42 milligauss and the edge of the ROW fields to be 25 milligauss. Id.

Power frequency fields result in intensified electric fields at the outer surface of the body and weaker electric fields and currents inside the body, the current densities varying with body shape and orientation to field direction. Id. at 3, 5. The magnetic fields produced by power frequencies cause currents inside the body, but are not intensified at the surface; their magnitude is proportional to body size. Id. at 6.

A large body of literature exists pertaining to biological effects of exposure to power frequency electric and magnetic fields. Id. Both positive and negative results have been reported, and the witness cited examples of studies reported in journals which support the conclusion that effects occur in exposed animal and cellular systems. Id.; Tr. 396-397. Humans and animals can sense the presence of weak electric fields, but not weak magnetic fields. A consistently observed effect of weak electric and magnetic fields is that

they disrupt normal circadian rhythms, which are biological rhythms that repeat at approximately 24-hour intervals. Id. at 7-8.

Exposure to 60 hertz electric fields suppresses nighttime concentrations of melatonin, the hormone which regulates sexual function and development, among other things, in the rat. Exposure to 60 hertz electric fields also affects the circadian rhythm of neurotransmitters. Id. at 8. Cellular studies have shown that exposure to EMFs affects the synthesis of ribonucleic acid, and thus, protein synthesis. Id. at 7-8; Tr. 406-407. Magnetic fields also alter protein synthesis in tissue culture preparations of human cells. OCA St. 1 at 9. Exposure to 60 hertz fields has also been shown to affect ornithine decarboxylase (ODC), the controlling enzyme in cellular synthesis of polyamines. Id. Based upon the data showing that EMF exposure is capable of increasing ODC activity, one researcher has stated that it is conceivable that exposure may promote tumor formation, a hypothesis with which Mr. Janes does not disagree. Tr. 410. Extremely low frequency magnetic fields have also been shown to affect cell proliferation. OCA St. 1 at 9.

The mechanisms for the observed effects of weak electric and magnetic fields are not known, but some models have been suggested, although not experimentally established. Id.

Mr. Janes concluded that weak electric and magnetic

fields affect biological systems, but that the biophysical and biological mechanisms are either not known or poorly understood at this time. The effects seen in cellular systems are useful for generating hypotheses, but cannot be directly extrapolated to animals. The effects observed are subtle and often transient. Therefore, the connection between these effects and any harm to human health is unclear. Since weak field effects occur, the possibility of harmful effects cannot be summarily or categorically rejected and concerns about harmful effects are legitimate. Id. at 10.

On cross-examination, Mr. Janes clarified that if exposure to EMFs does turn out to pose a health problem, high voltage transmission lines may not be the only source of concern - however, he cautioned that there may be a dose response where effects are related to intensity. Tr. 378-379.

On surrebuttal, Mr. Janes responded to the position taken by PECO witness Dr. Edward Gelman as to the issue of the need for further research. Dr. Gelman took the position that no additional research need be performed concerning the relationship between EMF and the causation or promotion of cancer. Mr. Janes testified that additional research is needed to resolve present uncertainties about the role melatonin plays in carcinogenesis. Although the role of melatonin in human physiology is not understood, it is known that exposure to 60 hertz electric fields affects melatonin levels. OCA St. 1A at 1. Exposure to extremely low frequency electric and magnetic

fields affects melatonin levels and it has been suggested that melatonin levels affect the incidence of chemically induced breast tumors in rats. It is important to establish by direct experiment whether EMF exposure impacts upon tumor incidence in rats, and then to determine whether such results have any implication for human health. OCA St. 1A at 2.

B. Testimony of David M. Rosenbaum (OCA St. 2 and OCA St. 2A)

David M. Rosenbaum is the President of Risk Analysis Corporation in McLean, Virginia, and holds Doctorate, Master of Science and Bachelor's degrees in Physics. He has over twenty years of experience, both as a consultant and as a Deputy Assistant Administrator of the United States Environmental Protection Agency and Director of Radiation Programs with that agency, in analyzing the effects and risks of exposure to ionizing and nonionizing radiation in the context of formulating public policy. OCA St. 2, Exh. DMR-1

Dr. Rosenbaum testified as to the current state of knowledge regarding the effects of 60 hertz electro-magnetic fields on people and the issue of prudent decision making in the face of uncertain risk and cost.

Recognizing Mr. Janes' testimony as to the inability to summarily or categorically reject the possibility of harmful effects due to EMF and thus, the legitimacy of concerns about harmful effects, Dr. Rosenbaum testified as to his familiarity

with the present epidemiologic studies as to the associations between what may be surrogates for long-term average field strengths and various types of cancer. OCA St. 2 at 3. Dr. Rosenbaum summarized the results of the Wertheimer and Leeper, Barregard, Tomenius, Savitz, Rodwall, McDowell, Fulton, Myers, Coleman, Severson and later Wertheimer and Leeper studies. Id. at 4-5.

Dr. Rosenbaum testified as to the difficulty of proving a cause and effect relationship utilizing epidemiologic studies, and as to the confused picture presented by the studies summarized. He described the present state of knowledge about the effects of nonionizing radiation as very uncertain and compared it to the level of knowledge of ionizing radiation in the 1920s.

Dr. Rosenbaum testified that prudent policy requires continued research into the effects of electric and magnetic fields and the provision of information about the current research in EMF to the public, stressing the uncertainty and changeability thereof in an impartial manner. He testified further that public involvement in the decision making process is important in advance of critical decisions being made. He stressed that the costs and effects of mitigative measures should be considered before design and construction of a transmission line, which was not done in the case of the PECO 230 kV line. OCA St. 2 at 7.

Dr. Rosenbaum then testified as to examples of

mitigative measures which should be considered before construction begins: among other things, avoiding heavily populated areas, parks, schools and other public facilities; widening rights of way; using higher ground clearances, and designing the lines to reduce the fields. Id. The witness believes that substantial reductions in field strength can be obtained at reasonable cost, and stated that in planning it is prudent to take measures to lower the public's exposure to magnetic fields if doing so is not too costly. OCA St. 2 at 8.

On cross-examination, Dr. Rosenbaum clarified the differences between ionizing versus non-ionizing radiation, stating that ionizing radiation removes electrons from atoms and molecules of biological cells. Tr. 302-306. Dr. Rosenbaum elaborated on the concepts of prudent avoidance as those which lead a utility to make fields lower for people in situations where they are likely to experience the field for a long time. Tr. 315. The witness also pointed out that the information regarding the ability to reduce EMF by 50% to 75% was taken from information received from Pennsylvania Power and Light, concerning its expectations of results on newly constructed transmission lines. Tr. 353. He further testified that to fully develop a position on EMF, the Commission should consider both epidemiologic evidence and biological evidence. Tr. 362, 366.

On surrebuttal, Dr. Rosenbaum testified as to PECO witness Dr. Cole's use of the phrase "irregular statistically

significant associations" or irregular associations, which, in his opinion, had no technical meaning in the context of evaluating the epidemiologic studies. OCA St. 2A at 1. As to Dr. Cole's point that the Savitz study reported weaker associations than those reported by Wertheimer, Dr Rosenbaum pointed out that all of the studies showed an association between wiring code and childhood leukemia and further, that it is not necessarily so that a more carefully done study will achieve stronger results. Id. at 2. A more carefully done study may eliminate the results of bias, thereby getting weaker results, even in an instance where there is a real effect. Id. Dr. Rosenbaum also took issue with Dr. Cole's assertion that Peters finding as to an association was weaker than that found by Savitz, noting that on balance, one might call the two studies fairly comparable. Id. at 4.

APPENDIX B
PROPOSED FINDINGS OF FACT

PROPOSED FINDINGS OF FACT

1. The Woodbourne-Heaton line connects two substations, the Woodbourne substation in Middletown Township and the Heaton substation in Upper Moreland Township, Pennsylvania. PECO Direct No. 1 at 4.

2. The line is being built on an existing Conrail railroad right of way. PECO Direct No. 1 at 4.

3. Prior to the commencement of construction of the Woodbourne-Heaton line, the right-of-way in question had not been in use by electric locomotives since 1981, but an electric line had remained energized until 1986. Tr. 10.

4. From 1981 to 1986, the electric line was used as part of the railroad's bulk power transmission system. Tr. 10.

5. The voltage on the Conrail electric line at the time it was energized was 132,000 volts. Tr. 10.

6. The proposed PECO transmission line is expected to cost approximately \$19.8 million. PECO Direct No. 1 at 7.

7. Under normal loading conditions when the proposed PECO transmission line is constructed and in use, the maximum field in the middle of the right of way has been calculated to be 42 milligauss. PECO Direct No. 2 at 8-9.

8. Under normal loading conditions when the line is constructed and in use, the field at the edge of the right of way will be 25 milligauss. PECO Direct No. 2 at 9.

9. Under heavy loading conditions when the line is constructed and in use, the field at the middle of the right of way will be approximately 70 milligauss and at the edge of the right of way approximately 42 milligauss. PECO Direct No. 2 at 9.

10. "Emergency maximum" loading conditions will result in a field of approximately 117 milligauss in the middle of the right of way and approximately 70 milligauss at the edge of the right of way. PECO Direct No. 2 at 9.

11. Prior to construction, the Senior Engineer in charge of design and construction of the Woodbourne-Heaton line did not consider EMF a safety issue to be considered. PECO Direct No. 1 at 7-11; Tr. 35-36.

12. PECO did not conduct any calculations of the electric and magnetic fields resulting from its design choice until after the construction of the Woodbourne-Heaton line was substantially completed. OCA St. 2 at 7; OCA Cross-Exh. 1; Tr. 12-13.

13. Electric fields are detectable by humans and animals in laboratory settings. OCA St. 1 at 6.

14. Both weak magnetic and electric fields have been consistently observed in laboratories to disrupt normal circadian rhythms in animals. OCA St. 1 at 6.

15. Weak electric and magnetic fields affect biological systems. OCA St. 1 at 10.

16. A causal connection between the biological effects of electric and magnetic fields and harm to human health has not been scientifically proven, nor has a causal connection been disproven. OCA St. 1 at 10.

17. Through epidemiological studies, an association has been shown to exist between exposure to EMF or wiring code and some forms of cancer, including childhood leukemia. OCA St. 2

at 3; OCA St. 2A at 2; Prot. St. 1 at 3-4; PECO Rebuttal St. No. 2 at 18.

18. The biophysical and biological mechanisms giving rise to the effects of EMF exposure are either not known or are poorly understood at the present time. OCA St. 1 at 10.

19. Effects of EMF observed through cellular studies cannot be directly extrapolated to animals. OCA St. 1 at 10.

20. The nature and extent of risks to human health posed by exposure to EMFs are uncertain. OCA St. 2 at 8.

21. In the face of uncertain risk to human health, public utility companies should adopt prudent policies. OCA St. 2 at 8.

22. Public utility companies should consider measures to mitigate EMF exposure during the design of transmission lines, before any construction decisions are made. OCA St. 2 at 8.

23. Mitigative measures include, but are not limited to, avoiding heavily populated areas; avoiding parks, schools and other public facilities; widening rights-of-way; limiting public uses of rights-of-way; using higher ground clearances; designing power lines to reduce fields. OCA St. 2 at 7.

24. PECO provides its customers brochures advising them to consider actions which minimize or avoid exposure to EMF. Tr. 37.

25. Some of the recommendations in the brochure are: not to stand close to microwave ovens, dishwashers or television sets while they are turned on, move radios, answering machines and electric clocks so they are not close and keep video display terminals at least 18 inches away. Tr. 66-67; Prot. Exh. 1.

26. Because the possibility of harmful effects cannot be summarily or categorically rejected, concerns about harmful effects are legitimate. OCA St. 1 at 10.

27. The adjoining landowners have legitimate fears about exposure of themselves and their children to EMFs and the effects upon their health. Tr. 103; 184-185.

28. The adjoining landowners have fears about other aspects of living next to an energized transmission line, for example, poles falling onto their properties. Tr. 109.

29. Because some of the adjoining landowners have been advised to exercise "prudent avoidance," they will utilize their properties differently or limit the use of their

properties because of the proximity to an energized transmission line. Tr. 110, 195, 200-201.

30. Some of the literature describing the philosophy of "prudent avoidance" states that people are to "avoid unnecessary exposure" to EMF. Prot. Exh. 1; Tr. 123-124.

31. Some of the adjoining landowners do not believe that the rights of way are sufficiently wide to enable them to prudently avoid exposure to EMF. Tr. 180.

32. Because of the fear of exposure to EMF, people in general are concerned about purchasing a home adjacent to a power line right-of-way. Tr. 134.

33. The fear among knowledgeable citizens regarding the danger of exposure to EMF has led to a problem in selling residential structures within the area adjacent to transmission line rights of way. Prot. St. 1 at 3.

APPENDIX C
PROPOSED CONCLUSIONS OF LAW

PROPOSED CONCLUSIONS OF LAW

1. The Commission has jurisdiction over the subject matter and the parties to this proceeding.

2. The use of the letter notification procedure pursuant to 52 Pa. Code § 57.72(d)(1) is to occur only where the use of an existing right of way is not substantially altered.

3. The rebuilding and reconductoring of the abandoned railroad 138 kV transmission line, known as the Woodbourne-Heaton transmission line, constitutes a substantial alteration of the existing right of way.

4. PECO's use of the letter of notification procedure under these factual circumstances was inappropriate.

5. The pertinent Commission regulations, 52 Pa. Code §§57.71, 72(a)-72(c), and 57.74-.75 require filing and service of an application, in addition to publication notice and hearings no sooner than 45 days before the date set for the commencement of the hearing.

5. Had PECO adhered to the Commission regulations pertaining to these factual circumstances, Protestants and

other adjoining landowners would have received, at a minimum, publication notice of the reconstruction of the Woodbourne-Heaton line.

6. Notice to affected parties and an advance opportunity to be heard are constitutional and statutory requisites to valid Commission orders.

7. Protestants had no notice, nor advance opportunity to be heard, prior to the issuance of the Commission's order of February 9, 1990, approving PECO's Letter of Notification of November 21, 1989.

8. The Commission Order of February 1, 1990, is not binding upon the Protestants.

9. The Protestants are adversely affected by the rebuilding and reconductoring of the Woodbourne-Heaton line.

10. The Protestants have had no opportunity to be heard on the issues of whether there is a present and future necessity for the line and whether reasonable alternative routes are available. 52 Pa. Code §57.75(e)(1),(4).

11. The Protestants are entitled to an opportunity to provide evidence on all of the issues set forth in 52 Pa. Code

§57.75(e) related to the Woodbourne-Heaton transmission line.

15. To the extent that the Commission regulation at 52 Pa. Code §§ 57.72(d)(1) permits public utilities to reconductor or reconstruct an abandoned or unused high-voltage transmission line without providing to landowners adjacent to the right of way within which that line is sited notice and an opportunity to be heard on all of the issues relevant thereto, that regulation contravenes the Public Utility Code.

APPENDIX D
PROPOSED ORDER

PROPOSED ORDER

IT IS HEREBY ORDERED:

1. That the Commission Order of February 9, 1990, approving the Letter of Notification is hereby vacated;

2. That further hearings shall be scheduled in order to provide the Protestants an opportunity to be heard on any and all issues remaining;

3. That a record be developed concerning the issues upon which evidence has not yet been proffered and upon which the Commission is required to make findings and determinations under 52 Pa. Code § 57.76;

4. That the Office of Special Assistants prepare a proposed amendment to the Letter of Notification regulations codified at 52 Pa. Code § 57.72(d), which would, if finally adopted, require sufficient notice under that section to adjacent landowners and the scheduling of public hearings in the event of protests; and

5. That notice of the proposed amendment to 52 Pa. Code § 57.72(d) be published in the Pennsylvania Bulletin for public comment.

Not
Listed

P-1
A-110550F055
PHILA
RJS

I have heard about EMFs. What do the letters mean?

Electric and magnetic fields, often referred to as EMFs, are invisible fields of force. These fields are found wherever there's an electrical appliance or a power line of any kind.

How many kinds of fields are there?

There are two kinds of fields. When you plug a light cord into a wall socket, electrical force is in that cord, and an *electric field* is created. When you turn the lamp on, current moves through the cord creating a *magnetic field*. Electric fields are easily shielded by most objects such as a chair, a wall, or a tree. Magnetic fields, on the other hand, pass through most objects.

Where would I be exposed to fields?

Fields are a part of life. They are, for instance, the "glue" that holds the body's cells together. The earth itself is a huge magnet with poles at its ends. More specifically, EMFs surround the appliances and power lines that are essential to our daily lives. There are fields of force around the microwave oven you cook with, the video display terminal you work with, and the power lines you cross under on highways or in the countryside.

Are EMFs a health risk?

There have been reports linking EMFs to certain types of cancer, including leukemia, among children and utility workers. The reports have not been ignored. Many millions of dollars have been spent in many countries to address the question. And today the honest answer is, we just don't know. While some studies report a slightly higher incidence of disease among populations with high exposure to EMFs, other studies have presented conflicting information. In late 1990, the Environmental Protection Agency concluded: Prolonged exposure to

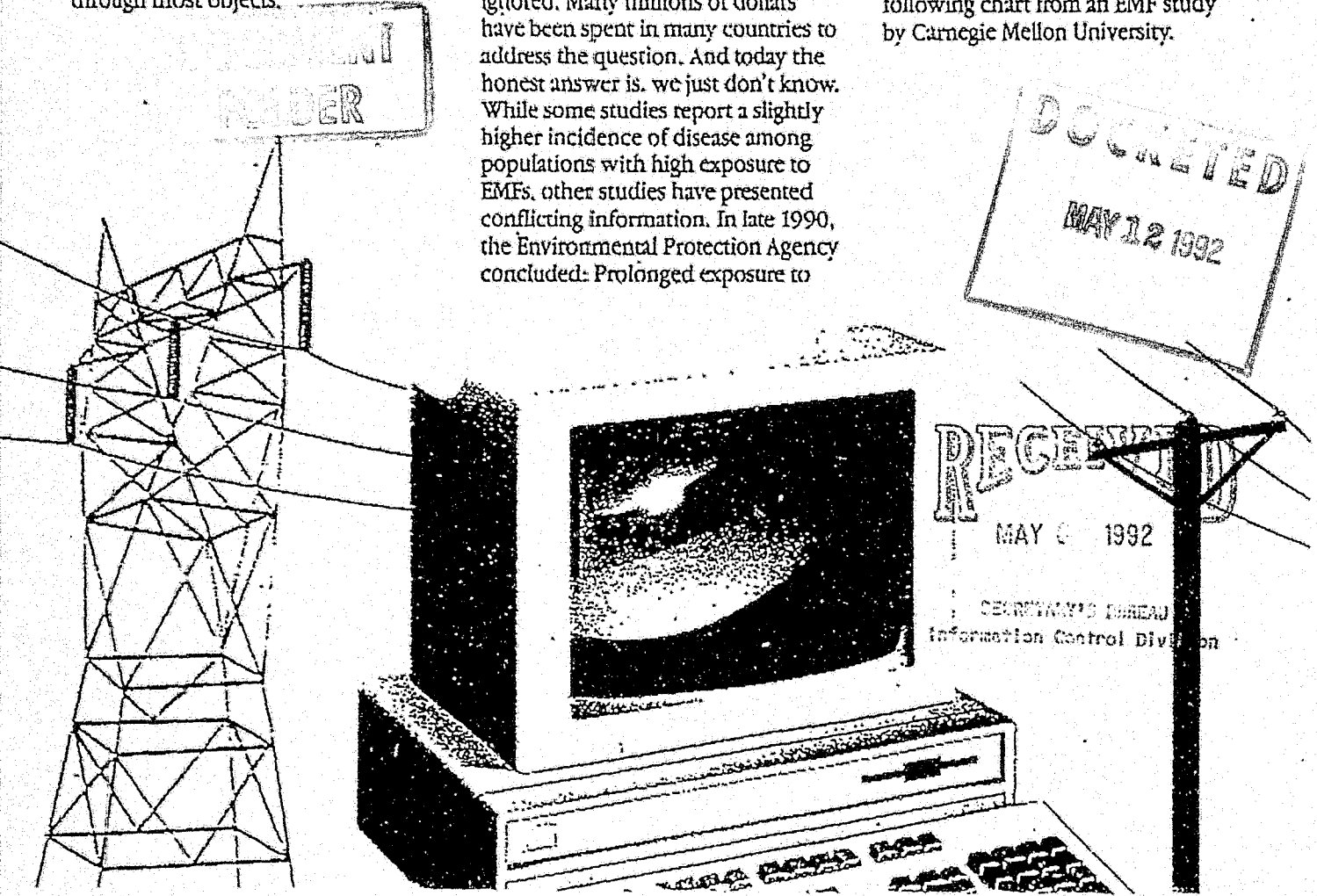
magnetic fields is a "possible, but not proven, cause of cancer in humans." (Emphasis supplied.)

If there is a health risk, how great is it?

Apparently it is very small. For instance, if EMFs are found to be linked to leukemia in children, the chances of developing the disease are increased from one in 20,000 children to 2.5 in 20,000. For all of us, there are far greater cancer-causing concerns: e.g., smoking, improper diet, chemical exposures, too much exposure to the sun, family history, and high stress levels. Consider that worst case risk of childhood cancer in relation to deaths from other causes, as listed in the following chart from an EMF study by Carnegie Mellon University.

DECLASSIFIED
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SECURITY INFORMATION BUREAU
Information Control Division



<i>Data on Deaths in the United States</i>		
Cause of death.	Approximate number of Americans who die each year from this cause.	Approximate odds that when the <i>average</i> American dies it will be from this cause.
Disease (all kinds)	2,000,000	1 in 1.1
Heart disease	770,000	1 in 2.7
Cancer (all kinds)	480,000	1 in 4.4
Accidents (all kinds)	95,000	1 in 22
Auto accidents	48,000	1 in 44
Diabetes	37,000	1 in 57
Suicide	31,000	1 in 68
Homicide	21,000	1 in 100
Drowning	5,900	1 in 360
Fire	4,800	1 in 440
Asthma	4,000	1 in 530
Firearm accidents	1,500	1 in 1400
Viral hepatitis	1,000	1 in 2100
Electrocution	850	1 in 2500
Car-train accidents	570	1 in 3700
Appendicitis	510	1 in 4100
Pregnancy and related	470	1 in 2200
Lightning	78	1 in 27,000
Floods	58	1 in 36,000
Tornados	58	1 in 36,000
Fireworks	8	1 in 260,000
Botulism	2	1 in 1,100,000

What kind of research is going on?

There are three kinds of studies being performed: (1) laboratory studies on cells and tissues, (2) laboratory experiments using animals such as rats and mice, and (3) statistical research analyzing relationships between exposure to electricity and various diseases in humans and grazing animals near power lines. Among the

groups conducting the studies are the National Cancer Institute, the National Academy of Sciences, the Department of Energy and numerous governments around the world. The Electric Power Research Institute, founded and funded by U.S. utilities, has already spent more than \$30 million researching the impact of electric and magnetic fields.

Assuming there is a hazard, how much EMF would it take to harm you?

The jury is still out. Laboratory studies have failed to identify any hazardous level. Also, the observable effects of EMF have proven to be unpredictable. To add to the confusion, there are cases in which EMFs are actually good for you. For years, doctors have used small amounts of electricity to speed the healing of broken bones. The use of magnetic resonance imaging (MRI)—an electromagnetic field—is considered to be far safer than the use of x-rays for lengthy examinations of the inner workings of our bodies. The questions are many and complex; the answers for now are few.

What is Philadelphia Electric's role in all this?

As a responsible member of the community, PECO wants to resolve the uncertainty. We are working toward that goal on a variety of fronts.

- PECO is participating in, funding, and monitoring several research efforts ongoing in the scientific community.
- PECO's own EMF task force, established four years ago, is a full-time multi-discipline team dealing with the question on an ongoing basis.



- PECO is investigating new engineering methods. For example, when we design and build new power lines, we evaluate construction practices designed to reduce EMFs.
- PECO is working with government officials at all levels, as well as school districts and members of the business community.
- PECO is openly communicating with its various publics to increase awareness about EMFs. This booklet is an example.

What can I do about EMF?

First, add a word to your vocabulary. The word is *milligauss*. It's a unit of measurement. Just as you and I measure our height and weight in inches and pounds, scientists measure magnetic field strength in units of milligauss. How much exposure you receive depends on three things:

1. How strong is the field at its source?
2. How far are you from the source?
3. How long is your exposure to the source?

How many milligauss units? Here are the magnetic field strengths of several household appliances.

Appliance	Average milligauss level
Television	1-3
Vacuum cleaner	1-11
Microwave oven	3-40
Refrigerator	1-8
Dishwasher	1-15
Computer	1-25
Electric alarm clock	1-12
Blow dryer	1-75
Electric blanket*	10-70
Lamp*	5-20
Toaster*	0.6-8
Electric coffee pot*	1-10
High voltage line* (at edge of right of way)	30-100
Low voltage line* (under line)	1-50

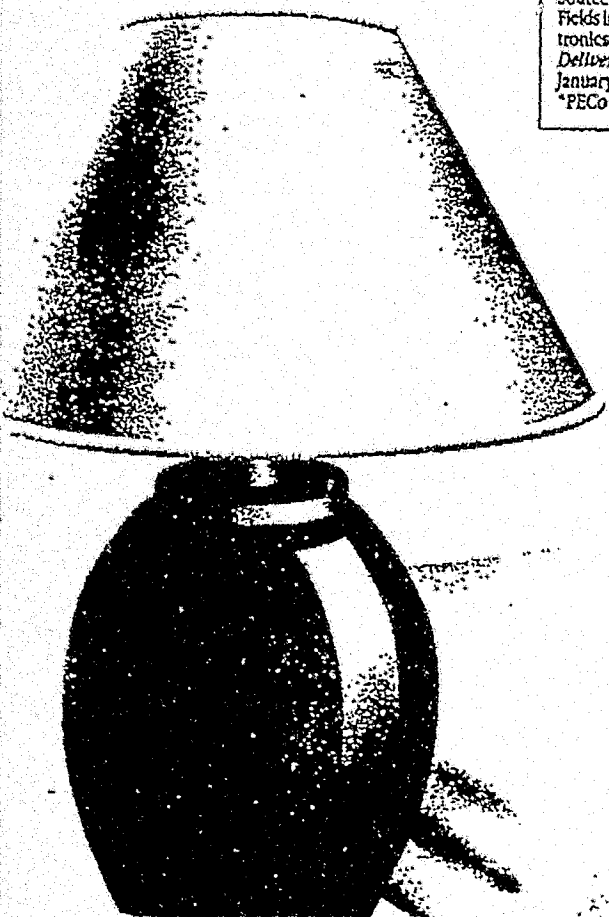
Source: Silva, et. al., "Power Frequency Magnetic Fields in the Home," Institute of Electrical and Electronics Engineers—*IEEE Transactions on Power Delivery*, Vol. PWRD-4, No. 1, pp. 463-478, January 1989.
*PECO data.

I understand milligauss as a unit of measure. Now what?

Consider what one researcher has called Prudent Avoidance. Prudent Avoidance is simply common sense reduction of your exposure to electric and magnetic fields. Some cases in point: Don't stand close to your microwave oven, your dishwasher or your television set while they're on. Move radios, answering machines, electric clocks and other appliances so they're not right next to you. Consider using your electric blanket to preheat your bed to a comfortable temperature, and then turn it off when you climb in for the night. At work, keep your video display terminal at least 18 inches from you.

What's down the road for EMFs?

A lot more research is needed. Philadelphia Electric Company is deeply committed to participating in that research, acting upon its findings, and sharing EMFs information with the 3.8 million residents in its service area.





COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P. O. BOX 3265, HARRISBURG, Pa. 17105

ORIGINAL

May 11, 1992

IN REPLY PLEASE
REFER TO OUR FILE

John G. Alford
Secretary
Public Utility Commission
P. O. Box 3265
Harrisburg, PA 17105-3265

AMH

RECEIVED
MAY 11 1992

SECRETARY'S OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia
Electric Company Relative to Reconstructing
and Rebuilding of the Existing 138 kV
Line in Montgomery and Bucks Counties,
Docket No. A-110550F055.

Dear Mr. Alford:

Enclosed please find an original and nine copies of
the Reply Brief of Commission Law Bureau Prosecutory Staff in
the above-captioned case. A Certificate of Service evidencing
service on Administrative Law Judge Herbert Smolen and all
other parties is also enclosed.



Respectfully submitted,

Patricia Krise Burket

Patricia Krise Burket
Assistant Counsel

Enclosures

cc: ALJ Smolen
All Parties

ORIGINAL

PENNSYLVANIA
PUBLIC UTILITY COMMISSION

BEFORE ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN

Letter of Notification of :
Philadelphia Electric Company :
Relative to Reconstructing and :
Rebuilding of the Existing :
138 kV Line to Operate As The :
Woodbourne-Heaton 230 kV Line :
in Montgomery and Bucks :
Counties :

Docket No.
A-110550F055

DOCKETED

MAY 13 1992

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MAY 11 1992

SECRETARY'S OFFICE
Public Utility Commission

REPLY BRIEF OF THE
COMMISSION LAW BUREAU
PROSECUTORY STAFF

Patricia Krise Burket
Assistant Counsel
Attorney I.D. #47567

Pennsylvania Public Utility Commission
Law Bureau Prosecutory Staff
P. O. Box 3265
Room G-30, North Office Building
Harrisburg, PA 17105-3265
(717) 783-2810

Dated: May 11, 1992

I. INTERIM MEASURES ADOPTED BY THE COMMISSION
ENSURE ADEQUATE NOTICE TO ADJACENT PROPERTY
OWNERS AND ALL INTERESTED PARTIES OF
CHAPTER 57 FILINGS.

At page 55 of its main brief, the Office of Consumer Advocate requests that the Commission amend its siting regulations so as to provide for more comprehensive actual notice to adjacent property owners. OCA counsel does not define the term "adjacent property owner", nor do they suggest the form which such notice should take.

The Prosecutory Staff does not see OCA's proposal as a viable solution to OCA's concern over sufficiency of actual notice of legitimately affected property owners. Unless the term "adjacent property owner" is defined carefully, additional problems may arise. If notice were to be personally given to adjacent property owners, defining "adjacent property owners" as those persons owning property within "x" feet of a proposed line's right-of-way, persons owning property within "x + 1" feet of the line may be unfairly excluded from receiving notice. On the other hand, the current practice of defining "adjacent property owners" as those owning property contiguous to the proposed line's right-of-way would exclude those who own property which is non-contiguous to the line's right-of-way but perhaps as close as a few feet away. Parenthetically, under either definition, many Protestants in the instant proceeding still would not have received notice of the Woodbourne-Heaton 230 kV line because many do not own property contiguous to

Conrail's property, which contains PECO's right-of-way, and some do not own property within 500 feet of the proposed line (N.T. 165, 172-173, 194, 199, 219, 264 and 475). The Prosecutory Staff, thus, does not see OCA's suggestion as a cure to perceived due process concerns in current notification procedures.

The Prosecutory Staff submits that the Commission has already taken steps to ensure adequate notification to owners of adjacent properties and to all interested persons of all Chapter 57 siting application filings. On July 16, 1991, in conjunction with a letter of notification filed at Docket No. A-11250F038 by West Penn Power Company, the Commission adopted a motion sponsored by Vice Chairman Joseph Rhodes, Jr. which provided for newspaper publication of all future and current electric transmission line filings pending amendment of the siting regulations. Pursuant to 52 Pa. Code 57.741(e) which allows the Commission to direct the provision of additional notice, electric utilities are apprised of this newspaper notice publication requirement by the New Filing Section of the Commission's Secretary's Bureau whenever a transmission line filing is made.

The newspaper publication requirement not only provides notice of the filing to the broadest spectrum of interested individuals, but also eliminates the need to split hairs in defining terms like "adjacent property owners". Considering the problems which has been identified above in

defining such a term, Prosecutory Staff believes that providing newspaper notice of Commission transmission line filings is a fairer method of providing notice of such a filing to the public. Moreover, although newspaper publication technically constitutes only constructive notice, general circulation and readership of the popular press effectively assures that meaningful notice will reach all parties potentially impacted by the proposed project.

II. THE PROTESTANTS, WHO HAVE NOT SHOWN THAT
THEY WILL BE ADVERSELY AFFECTED BY THE LINE
HAVE NO DIRECT INTEREST TO BE PROTECTED
WHICH REQUIRES THE HOLDING OF FURTHER
HEARINGS IN THIS PROCEEDING.

Both OCA and Protestants argue that because Protestants did not initially receive notice of PECO's filing of its letter of notification, the Protestants' due process rights require that they be given an opportunity for further hearing on all related issues (OCA Main Brief, pp. 14-18; Protestants' Main Brief, p. 10). Both cite Judge Palladino's May 24, 1991 order at 761 C.D. 1991 in support of this position but ignore the clear intent of the order - - to provide the Protestants with a hearing so that their standing in this proceeding could be ascertained.^{1/}

To be considered a party in a Commission proceeding a person must have "a direct interest in the subject matter" of the adjudication. 52 Pa. Code §1.8. The Commission regulations are silent on what constitutes a "direct interest". Although standing before an administrative agency is within the agency's discretion and is dissimilar from standing to appeal,

^{1/} In her May 24, 1992 order, Judge Palladino stated that:

This Court concludes that Petitioners are entitled to a hearing on the question of whether they will be adversely affected by the reconductoring of the high tension electrical line at issue in this case.

Small v. Pa.PUC, order entered May 24, 1992 at 761 C.D. 1991 at p. 2.

Re L & H Trucking Company, Inc. 55 Pa.PUC 469 (1982), judicial decisions can be used as a guideline in defining the term, "direct interest".

The test for standing was established by the Pennsylvania Supreme Court in William Penn Parking Garage, Inc. v. City of Pittsburgh, 464 Pa. 168, 346 A.2d 269 (1975) and was applied by this Commission in Appalachian Gas Sales, Inc. v. PECO, 67 Pa. PUC 246, 249-250 (1988). Under the William Penn test, a party has standing if it can show (emphasis added):

1. That the party has a direct interest in the subject matter, i.e., there must be a cause or harm to that interest;
2. That the interest of the party is substantial, i.e., it must be discernible adverse effect to some interest other than having others comply with the law; and
3. That the interest of the party is direct, immediate and not a remote consequence of the harmful action, i.e., there must be a cause or connection between the action complained of and the injury of the party.

Despite best efforts of Protestants and OCA to convince the presiding officer otherwise, the record does not support any finding that the Protestants will be adversely affected by the construction or operation of PECO's Woodbourne-Heaton 230 kV line. As the Protestants have not shown any harm to any direct interest in the subject matter of this proceeding, it is unnecessary to afford them an opportunity for yet further hearing on other issues, such as, inter alia, need for the line.

Moreover, if OCA and Protestants were unhappy about the scope of the hearing ordered by Commonwealth Court Judge Palladino in her May 24, 1991 order or by the Commission in its June 14, 1991 order, implementing the Judge's order, both had an opportunity for appeal at that time. Neither did. Therefore, the decision to grant the Protestants additional hearings on other aspects of the letter of notification for the Woodbourne-Heaton 230 kV line rests solely on whether the Protestants have established that they will be adversely affected by the line. Again, because the Protestants have not shown any adverse effect, no additional hearings are necessary.

III. THE INADEQUACY OF NOTICE TO ADJACENT
PROPERTY OWNERS IDENTIFIED BY A COMMON-
WEALTH COURT JUDGE IN COMMISSION SITING
REGULATIONS DOES NOT CONSTITUTE A
VIOLATION OF PENNSYLVANIA'S ENVIRON-
MENTAL AMENDMENT, ARTICLE I, SECTION 27.

In their "main" Brief,^{2/} Protestants argue that Article I, Section 27 of the Pennsylvania Constitution provides "the people as a matter of Constitutional right, to clear air, and the benefits of the natural environment. Protestants then assert that "[w]ithin the framework for implementation of Article I, Section 27, compliance with regulations is one of the critical tests." Protestants' Main Brief, p. 10. They continue that:

[t]hrough failure to give petitioners notice of these proceedings, there was a clear lack of compliance with the regulations, as interpreted by Commonwealth Court in Small vs. PUC. Therefore, one of the basic tests of Article I, Section 27, having failed, hearing at this time is constitutionally required.

Protestants' Main Brief, pp. 10-11.

The above argument is without merit. The test for review of agencies decisions under Article I, Section 27, was

^{2/} Although the Protestant's Brief is captioned as their Main Brief, many of the arguments are made in response to arguments raised in the main briefs of PECO and the Law Bureau Prosecutory Staff. See Protestants' Main Brief, page 7, lines 22 to 27 and page 12, lines 8 to 10. It would seem that the mechanical failure which prevented Protestants from providing Prosecutory Staff with in-hand service of their main brief on its due date of April 21, 1992 also afforded Protestants the unfair opportunity to include in their main brief arguments properly presented in their reply brief.

established in Payne v. Kassab, 11 Pa. Commonwealth Ct. 14, 312 A.2d 86 (1973), aff'd, 468 Pa. 226, 361 A.2d 263 (1976), and requires, inter alia, that a showing of compliance with all applicable statutes and regulations relevant to the protection of the Commonwealth's public natural resources be made. The Commission regulation, 52 Pa. Code §54.74 which was the subject of Judge Palladino's May 24, 1991 order in Small v. Pa.PUC, was not one which was relevant to the protection of the environment, but one which protected procedural due process rights by identifying persons to whom notification of a transmission line filing had to be made. Therefore, the Protestants' argument that noncompliance with this regulation requires that they be given an opportunity for further hearings is without foundation.

Moreover, any injury to Protestants' individual due process rights caused by lack of notice of PECO's original filing has already been cured by the Commission's implementation of the remedy prescribed in Judge Palladino's May 24, 1991 order -- to allow the Protestants to have a hearing to present evidence on how they would be adversely affected by PECO Woodbourne-Heaton 230 kV line. If the Protestants were able to establish that they will be adversely affected by PECO's line, they would have standing to proceed further with other issues related to this letter of notification. See previous Argument II at pp. 3. Protestants, however, have failed to demonstrate any legally sufficient

adverse effect, and therefore, additional evidentiary hearing is unnecessary and inappropriate.

IV. PENNSYLVANIA'S CONSTITUTIONAL ENVIRONMENTAL AMENDMENT, ARTICLE I, SECTION 27, PROTECTS PUBLIC NATURAL RESOURCES AND NOT PRIVATE PROPERTY INTERESTS.

Article I, Section 27 reads as follows (emphasis added):

Sec. 27. Natural Resources and the Public Estate.

The people have a right to clear air, pure water, and the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all people.

The above highlighted language of Section 27 clarifies that the amendment was meant to protect public and not private natural resources. This interpretation is strengthened by the legislative history of the amendment. The amendment, which originated as House Bill No. 958 in the 1969 session was sponsored by then Rep. Franklin L. Kury and read as follows (legislation notation omitted, emphasis added):

Section 2. Natural Resources and the Public Estate.--
The people have the right to clear air, pure water, and to the preservation of the natural scenic, historic and esthetic values of the environment. Pennsylvania's natural resources including the air, waters, fish, wildlife and the public lands and property of the Commonwealth are the common property of all the people, including generations to come. As trustee of these resources the Commonwealth shall preserve and maintain them in their natural state for the benefit of all the people.

In his article "Natural Resources and the Public Estate -- A biography of Article I, Section 27 of Pennsylvania's Constitution" ("Natural Resources"),^{3/} Rep. Kury explains key changes that were made to the original bill and the purpose of those changes (emphasis added; appendix references deleted):

The bill was amended in the House Conservation Committee. The phrase "in their natural state" was deleted from the last sentence of the bill. This was done at the suggestion of then Speaker Herbert Fineman of Philadelphia, who feared that otherwise the proposal could be used to block urban renewal and other community development projects in urban areas.

The bill went to the Senate and was referred to the Committee on Constitutional Changes on June 3. Most important, the bill was allowed to cool. In contrast to the House's rapid action, the Senate kept the bill for nine months before releasing it and passing it on March 17, 1970 by a vote of 39 to 0.

The Senate Committee made three further amendments: (1) In the second sentence the word "Public" was inserted before the phrase "natural resources"; (2) the list of natural resources to be protected (air, water, fish, wildlife and the public land and property) was removed from the Trusteeship clause; and (3) the word "conserve" replaced "preserve" in the Commonwealth's mandate.

^{3/} Kury, Franklin L., "Natural Resources and the Public Estate - a biography of Article 1, Section 27 of the Pennsylvania Constitution", Reed Smith Shaw & McClay (1985). This pamphlet was later updated and retitled as "The Environmental Amendment to the Pennsylvania Constitution; 20 Years Later and Largely Untested", 1 Villanova Environmental Law Review 123 (1990).

"Public" was inserted before "natural resources" to clarify that the amendment was not to apply to purely private property rights. The itemized list of specific resources was removed so that it could not be claimed that items not mentioned (e.g. aesthetic values) were not included. "Conserve" instead of "preserve" was suggested by Secretary of Forests and Waters Maurice Goddard to be sure that the amendment could not be interpreted as freezing the environment in its status quo.

"Natural Resources", p. 4.

From the above discussion it is clear that Article I, Section 27, which provides the basis, along with 66 Pa. C.S. §§1101 and 1501, for the Commission's siting regulations, is not meant to protect private property interests. While it may be appropriate for the Protestants to assert an interest on behalf of protecting Pennsylvania's public natural resources, it is disingenuous for them to do so while requesting a remedy which is clearly personal in nature -- that the Commission condition any approval of the Woodbourne-Heaton 230 kV line on PECO's "purchasing all of the adjoining properties along the line in order to enable individuals to avoid adverse effects on their health." Protestants' Main Brief, p. 13 (emphasis added).

- V. THE PROSECUTORY STAFF'S PURPOSE IN THIS PROCEEDING IS TO REPRESENT THE COMMISSION STAFF'S POSITION ON THE ALLEGED ADVERSE HEALTH EFFECTS OF ELECTROMAGNETIC FIELDS, ADOPTION OF THE POLICY OF PRUDENT AVOIDANCE AND THE PROPER INTERPRETATION OF THE PUBLIC UTILITY CODE AND THE COMMISSION'S SITING REGULATIONS.

Throughout the course of this proceeding Law Bureau Prosecutory Staff has endured innumerable insults and innuendoes from Protestants' counsel regarding its participation. The numerous snide comments in Protestants brief to Prosecutory Staff are the last straw. We will answer these comments seriatum:

- A. The Office of Prosecutory Staff (sic) has in another proceeding (Duquesne Light) argued that the doctrine of prudent avoidance entails siting as well as design.
Protestants' Brief, p. 2.

The Prosecutory Staff regards this as an irrelevant comment to the instant proceeding because our position is that prudent avoidance should be applied on a case-by-case basis. The Staff position in regard to the Duquesne Light-GPU 500 kV line siting application is without consequence and immaterial as to the instant proceeding.

- B. It is only by intense thought reversal that the advocates of this line, including the Commission's Prosecutory Staff, are able to formulate a set of words which disassociates the effects on the Protestants from safety considerations.
Protestants Brief, p. 9.

The Prosecutory Staff is at a loss to explain this comment, except to state that the Prosecutory Staff believes

that safety considerations are a legitimate concern in the evaluation of siting applications. However, it is the Prosecutory Staff's position that "people simply abandoning their property along the line" to avoid an alleged safety hazard, Protestant's Brief, p. 8, is too remote to be considered under the umbrella of safety, as is also the issue of disinvestment or decrease in property values allegedly caused by neighborhood abandonment.

- C. In its prehearing memoranda, PECO and the Prosecutory Staff suggests that the rule on land monetary damages precludes considerations of effects on land use. While PECO makes such an argument, it is hard to understand how the Prosecutory Staff of the Commission can so far depart from the Commission's precedent rulings as to make such a novel argument. Protestants' Brief, p. 12.

The Prosecutory Staff first notes that Protestants have mischaracterized our position. The Prosecutory Staff believes land use on property burdened with a transmission line is of legitimate concern in evaluating siting applications. In the instant proceeding, none of the Protestants' property has actually been physically burdened by the line. Moreover, we believe that it is unseemly for Protestants' counsel to personally attack another attorney for making a legitimate legal argument.

- D. The role of the Prosecutory Staff in EMF cases has been questioned by the Commission in its Order of April 10, 1992, reversing itself regarding the participation of OTS in the Duquesne Light Powerline Case.
Protestants' Brief, p. 12.

The Prosecutory Staff regards this statement as hearsay has no basis in fact whatsoever. The addition of Office of Trial Staff to the GPU Duquesne Light proceeding was accomplished to meet public concerns about Commission objectivity in that proceeding caused by a misleading and totally inaccurate newspaper article in which a member of the Prosecutory Staff was quoted out of context about the merits of the case. The decision to include OTS in the GPU/Duquesne litigation does not constitute a reversal of Commission position, and moreover, is absolutely irrelevant to any issue in the instant case.

- E. In these circumstances it is hard to know who the Prosecutory Staff is speaking for, but it is clear that the Prosecutory Staff is not speaking for the Commission.
Protestants' Brief, p. 12.

Bingo! Protestants' counsel finally got one right. From the beginning, the Prosecutory Staff has made it clear that its position is not that of the Commissioners. When Prosecutory Staff, or for that matter Office of Trial Staff, appears before the Commission as a participant in a litigated on-the-record proceeding, it is clear that the staff is not

representing the Commissioners and has no greater influence over the Administrative Law Judge or the Commissioners than does any other participant. Like other participants in the proceeding, the Prosecutory Staff is prohibited from ex parte communication with the Administrative Law Judge or the Commissioners on the merits of the case.

The Prosecutory Staff's purpose in this proceeding is to represent the staff's positions on the alleged adverse health effects of electromagnetic fields, the adoption of the policy of prudent avoidance and the proper interpretation of the Public Utility Code and the Commission's siting regulations consistent with the public interest. We have never contended other wise.

- F. In this regard, it is noteworthy that the Prosecutory Staff has been responsible for "educating" the Commissioners on EMF. In the literature and references produced by the Prosecutory Staff after orders by this ALJ and the Commission itself, it has emerged that the Prosecutory Staff has failed to involve a single scientist that opined that EMF effects human health in its Commission education. Thus, the Prosecutory Staff has elected to limit its knowledge, and that of the Commission, with the effect that its arguments regarding landuse must be discounted because of its bias.
- Protestants' Brief, p. 13.

The Prosecutory Staff in the past has acted as advisors to the Commission on EMF matters, but discontinued that role upon entering appearance as Prosecutory Staff in this proceeding on June 26, 1991. Because the Commission's decision

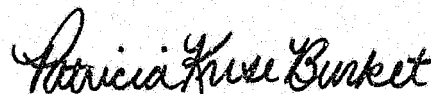
on EMF and adverse health effects in this proceeding will be made on the record evidence presented in this proceeding any information the staff may have given to the Commission in the past is irrelevant. Furthermore, as Prosecutory Staff is a participant in this proceeding, it is totally appropriate that we take a position on the EMF issue as has every other participant.

Finally, the position that the Prosecutory Staff holds regarding the alleged health effects caused by EMF has absolutely no bearing on the legal arguments on land use and other considerations pertinent to siting application regulations which were presented in our Main Brief. The merits of our legal arguments should be judged on the basis of the supporting authority and case law presented, and not on our position on a factual issue.

CONCLUSION

WHEREFORE, as the Protestants have not shown that they will be adversely affected in any way by the reconstruction of the former Conrail 138 kV line as PECO's Woodbourne-Heaton 230 kV line, Prosecutory Staff respectfully requests that the Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval, filed September 14, 1990 be denied, that no further hearings be held in this proceeding and that the Commission reaffirm its February 3, 1990 order approving Philadelphia Electric Company's Letter of Notification in the above-captioned proceeding.

Respectfully submitted,



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Dated: May 11, 1992

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I hereby certify that three copies of the Reply Brief of Commission's Law Bureau Prosecutory Staff have been served on this date on the following persons in the manner indicated:

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Dated: May 11, 1992

COMMONWEALTH OF PENNSYLVANIA



AMH

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May 11, 1992

RECEIVED
MAY 12 1992

SECRETARY'S BUREAU
Information Control Division

John G. Alford, Secretary
PA Public Utility Commission
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Harrisburg, PA 17120

Re: Letter of Notification
of Philadelphia Electric
Company Re: Proposed 230 KV
Woodbourne to Heaton
Transmission Line,
Docket No. A-110550, F. 055

Dear Secretary Alford:

Enclosed please find for filing an original and nine (9) copies of the Office of Consumer Advocate's Reply Brief in the above-captioned proceeding.

Copies have been served upon all parties of record as shown on the attached Certificate of Service.

Sincerely,

Dianne E. Dusman
Assistant Consumer Advocate

Enclosures
cc: All parties of record

CERTIFICATE OF SERVICE

Re: Letter of Notification
of Philadelphia Electric
Company Re: Proposed 230 KV
Woodbourne to Heaton
Transmission Line,
Docket No. A-110550, F. 055

I hereby certify that I have this day served a true copy of the foregoing document, Office of Consumer Advocate's Reply Brief, upon parties of record in this proceeding in accordance with the requirements of 52 Pa. Code § 1.54 (relating to service by a participant), in the manner and upon the persons listed below:

Dated this 11th day of May, 1992.

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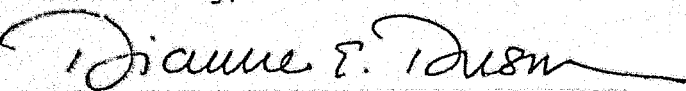
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ORIGINAL

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

LETTER OF NOTIFICATION
OF PHILADELPHIA ELECTRIC
COMPANY RE: PROPOSED 230 KV
WOODBOURNE TO HEATON
TRANSMISSION LINE

:
:
:
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Docket No. A-110550, F. 055

RECEIVED
MAY 12 1992

SECRETARY'S BUREAU
Information Control Division

REPLY BRIEF OF
THE OFFICE OF CONSUMER ADVOCATE

DOCKETED
FEB 11 1992

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DATED: May 11, 1992

DOCKETED
MAY 14 1992

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I. INTRODUCTION.

The Office of Consumer Advocate (OCA) has, to a great extent, anticipated and addressed many of the arguments of Philadelphia Electric Company (PECO or the Company) and the Prosecutory Staff in its Main Brief. It is, therefore, not the purpose of this Reply Brief to respond to all of the arguments contained in the Main Briefs of those parties. The OCA will limit its Reply to those issues which were not fully or directly addressed in the OCA's Main Brief. In addition, the OCA will not respond to each individual proposed conclusion of law and finding of fact of those parties, but does object to those that are inconsistent with the OCA's position.

The OCA has, in its Main Brief, expressed its position that adjoining landowners are adversely affected by the construction and reconductoring of a high voltage transmission line. As such, those persons are entitled to timely notice and an opportunity to be heard on the full range of issues relevant to siting applications. In deciding the appeal filed by some of the adjacent landowners, from the Commission Order approving the Letter Notification filed by PECO, the Commonwealth Court recognized this procedural deficiency. Because of the manner in which this case has progressed, the Protestants have not yet had an opportunity to be heard on the full range of issues.

As for the issues upon which the Protestants have been able to present evidence, both the Company and the Prosecutory Staff have articulated those issues in an unnecessarily narrow

way. In their Briefs, both express the two issues to be decided as "health effects from EMF" and "decrease in market value" of the Protestants' property. The Protestants offered evidence on many adverse effects which do not necessarily fall into those two narrow categories, e.g. limitations upon use of property consistent with "prudent avoidance," difficulty in selling property, fear of health effects, including exacerbation of existing health problems such as diabetes by EMF, family conflict and anxiety, fear of other transmission line-related safety problems, and others. The OCA submits that the Commission should not limit its consideration of "adverse effects" to only the evidence offered by the Protestants to that which falls within the very narrowly-articulated categories as expressed by the Company and the Prosecutory Staff. Nor should the Commission accept the Company's assertion that Protestants must meet an evidentiary burden sufficient to warrant disapproval of the line.

Furthermore, the breadth and variety of the evidence proffered by the various participants in this proceeding make it clear that EMF concerns present a public policy issue that cannot be ignored. Sound public policy requires an administrative agency to treat this issue in a manner which maximizes consideration of and responsiveness to public concerns, from both substantive and procedural standpoints. For these reasons, among others expressed in its Main Brief, the OCA submits that the Commission should give weight to the

public policy recommendations addressed by OCA witnesses Janes and Rosenbaum.

In addition, however, from a procedural standpoint, the OCA submits that these Protestants are entitled to cross-examine Company witnesses and to offer their own evidence on issues which have not yet been litigated, such as need and alternative routes, which may be material to a final Commission decision in this matter. To litigate all other issues prior to that of "need for the line," as was done in this case due to its unique procedural circumstances, is definitely "putting the cart before the horse" -- and inconsistent with concepts of prudent avoidance and prudence in general. The administrative inefficiency in proceeding in this manner is great. In cases where it may be shown that a company has not met its burden of proving that a proposed line is needed in order to continue to provide service, enormous and needless litigation, construction and other attendant costs may be incurred by utilities, participants and by the Commission itself during the pendency of litigation.

The OCA submits, therefore, that the Commission should take the necessary steps to ensure that its regulations comport with the Commonwealth Court Order entered in Small in order to avoid the "piecemeal" litigation which has occurred in this proceeding. Such a piecemeal approach is inconsistent with the prudent policy which should be employed in the face of uncertain risk, in that all relevant issues, particularly the

threshold determination of need, should be developed in a single proceeding.

The OCA specifically responds to the arguments presented in the Main Briefs of the Company and the Prosecutory Staff below.

II. OCA RESPONSE TO PECO.

A. OCA Response to PECO's Statement of the Case, Statement of Questions Involved and Burden of Proof.

First, the OCA would note that the Company refers to this proceeding as a "reopened hearing." Initial Brief of Philadelphia Electric Company ("PECO Brief"), at 1, 3 (emphasis added). The OCA takes issue with this characterization, as no hearings were convened in this matter prior to the Commonwealth Court's remand. There were, therefore, no hearings to reopen. This proceeding is a hearing on remand from the Commonwealth Court, consistent with the Order of May 24, 1991.

Second, the OCA takes issue with PECO's unnecessarily narrow statement of the questions involved in this proceeding. At page 3 of its Brief, PECO states that "[p]rotestants were granted this reopened hearing to present evidence on their claim that the Woodbourne-Heaton line will cause adverse health and land use impacts that warrant disapproval of the line" under Commission standards, citing as support for that statement the Commonwealth Court Order, the Commission Order of June 14, and the ALJ's Prehearing Order. This is an incorrect representation of the nature of this proceeding, and none of

those three orders supports that statement. As shown below, none of the orders governing this proceeding requires the Protestants to meet an evidentiary burden "sufficient to warrant disapproval of the line."

Specifically, Judge Palladino's Order stated as follows:

It is clear to the court that the letter notification process of 52 Pa. Code §57.72(d), under which Philadelphia Electric Company proceeded before the PUC, did not contemplate the fact matrix before this court in which an existing right-of-way, previously utilized for rail service, is put to a new use. . . . This court concludes that Petitioners are entitled to a hearing on the question of whether they will be adversely affected by the reconductoring of the high tension electrical line at issue in this case.

Commonwealth Court Order of May 24, 1991, at 1-2. (Emphases added.)

The Company's reliance, therefore, on the Commonwealth Court's order for its statement that the hearings were held to permit the Protestants to present evidence "on their claim that the Woodbourne-Heaton line will cause adverse health and land use impacts that warrant disapproval of the line under these Commission standards [52 Pa. Code § 57.76]" is misplaced. The Court did not limit the Protestants as to the type of evidence they could offer to show how they are "adversely affected" and moreover, did not require them to provide proof "sufficient to warrant disapproval of the line" under Commission standards.

Similarly, the Commission Order of June 14, 1991, did

not define the issues in the way that the Company represents, nor did it state that the Protestants had to provide proof sufficient to warrant disapproval of the line. The Commission ordered therein:

. . . That pursuant to Judge Palladino's May 24, 1991 order as supplemented by order dated May 29, 1991 the record at Docket No. A-110550, F.055, be hereby reopened for hearing and determination of the sole issue of whether the Petitioners will be adversely affected by the reconductoring of the former Conrail transmission line

Commission Order of June 14, 1991, at 1 (emphasis added). In addition, ALJ Smolen respected this broad statement of the issue in his order, by saying that the ". . . . Petitioners/Protestants . . . have the burden of proof and of going forward with the evidence in connection with the respective contentions concerning adverse effects of the line, and particularly those regarding health effects from EMF." ALJ Order of July 18, 1991. The ALJ thus also recognized that the issues to be addressed by the Protestants, while including evidence as to health effects from EMF, was not limited to that issue.

The OCA takes issue with one additional point in the Company's Statement of Questions Involved. The Company asserts therein as follows:

The Commission has ruled that it has no jurisdiction over alleged decreases in property values. See e.g. March 8 Order at 10, n.9

PECO Brief at 3. The footnote relied upon as support for that assertion reads as follows:

The Petitioners contend that they would have also raised the issue of depreciation of their property values caused by the electric transmission line, and that, in fact their properties were taken by "inverse condemnation". However, these issues are outside the Commission's jurisdiction. Thus, the desire of the Petitioners to raise this issue at a hearing is irrelevant and does not support their request to reopen the record.

Commission Order of March 8 at 10, n. 9 (Emphasis added.) The Company argues from this statement that no evidence as to impacts on value should be considered.

It is beyond question that the Commission does not have jurisdiction to decide an inverse condemnation case. The Company confuses, however, a jurisdictional limitation with the issue of relevancy of evidence to the matter of "adverse effects." The OCA agrees that the Commission cannot order that a check be written to these Protestants in a certain amount. This does not mean that probative evidence as to whether these Protestants have experienced any "adverse impacts" due to the reconductoring of this line should be excluded from consideration totally, simply because it might also be probative of a decrease in fair market value. ALJ Smolen recognized this difference when he denied PECO's motion to strike portions of Protestants' witness Turner testimony having to do generally with impacts upon land value and land use

resulting from construction of high-voltage transmission lines. Tr. 605.

As an evidentiary burden has been imposed upon the Protestants herein, the Commission should give all probative evidence due consideration within the full scope of the proceeding as established by the Commonwealth Court Order, the Commission's Order and ALJ Smolen's Order - not limit its consideration according to the way in which the the Company would prefer to read those Orders. It cannot be denied that "adverse impacts" can include such things as experiencing difficulty in selling one's house or restrictions upon use of property in the interest of "prudent avoidance" - although such evidence may not necessarily impact, ultimately, upon fair market value measured in dollars and may not necessarily fall within the scope of "land use" under Commission regulations.

In conclusion, the Company's reliance upon the Orders governing the scope of this proceeding for its statement that the Protestants have not met their burdens herein, and for its characterization as to the character and quantum of evidence required, lacks merit. Having discussed these general issues, the OCA will address the Company's specific assertions as to the issues as it defines them below.

B. OCA Response to PECO Argument.

1. Health Effects.

The OCA submits that these Protestants have presented sufficient evidence to prove that they are adversely affected

by the reconductoring of this line. OCA M.B. at 18-42. As shown specifically above, the Company interprets the Commonwealth Court Order, the Commission Order and ALJ Smolen's Order in a distorted manner. The Commission should not accept the argument that those Orders require the Protestants to prove that the EMF from the line will cause adverse health effects sufficient to warrant disapproval of the line. The Commission should conclude, based upon the evidence presented by the Protestants and OCA, that a sufficient basis exists for going forward with evidentiary hearings as to all of the issues set forth within the regulatory standards.

Focusing upon the limited issue of EMF and adverse health effect, however, the Company would have the Protestants meet a burden of proof to a degree of conclusiveness and certainty which its own cast of experts could not meet. For example, Company witness Dr. Cole did not testify that EMFs are not carcinogenic; rather, he concluded that "there is no demonstrated relationship between EMF and cancer in human beings" and that he was "of the opinion that EMF's have not been demonstrated to be carcinogenic." PECO Rebuttal St. No. 2 at 28. Later, on cross-examination by the OCA, he stated as follows:

Q. Can you assess your own degree of certainty with respect to your opinion that E/MFs have not been demonstrated to be carcinogenic?

A. Yes. . . . the three points on the spectrum [of certainty] are minus 100: E/MF has been demonstrated not to cause cancer in

human beings; zero: we are relatively uncertain about whether it has been demonstrated not or demonstrated to cause cancer; and to the extreme right we have plus 100, which is E/MF has been certainly demonstrated to cause cancer in human beings. Now on this full spectrum of the credibility of ideas, my position is minus 70. I believe that it is much more likely to be true than not that E/MF will be demonstrated not to cause cancer in human beings. . . . I haven't actually drawn the inference by which I would understand to mean once again this firm conclusion idea, that I am absolutely sure that E/MF does not cause cancer in human beings. I am 70 percent of the way there. I'm not 100 percent of the way there.

Tr. 1100-1102. Similarly, PECO witness Bockman stated his overall conclusion as follows:

[T]here is no basis to conclude that power frequency electric and/or magnetic fields have adverse effects on the health and function of the endocrine or immune systems.

PECO Rebuttal Statement No. 1 at 27 (emphasis added.) Dr. Bockman as well was unable to testify conclusively that EMFs do not adversely affect health; he could only go so far as to say there exists no basis to conclude adverse effects on health based upon information evaluated prior to submitting testimony.

Moreover, based upon the information he chose to evaluate for purposes of testifying in this case, PECO witness Dr. Gelmann also concluded:

The extensive research on molecular and cellular biology and cancer provides no scientific basis to conclude that power frequency electric and/or magnetic fields cause, promote, or contribute to the development of cancer or other adverse health effects.

PECO Rebuttal Statement No. 3 at 22 (emphasis added). The assertions that there is currently no scientific basis to conclude adverse effects still leaves open the possibility that there may be a basis to so conclude in the future or even that a causal connection exists, but has not yet been proved. In addition, Dr. Gelmann himself admitted, on cross-examination by the Protestants, as follows:

Q. . . .[I]n your field of oncology is it necessary to consider epidemiological evidence in forming opinions as a matter of scientific practice?

A. Yes.

Tr. 1175. Earlier, however, Dr. Gelmann had stated as follows, also on cross-examination by PAUSE:

Q. Do you consider it appropriate -- do you have an opinion about whether your field (sic) considers it appropriate to exclude epidemiology in forming opinions in your field?

A. Yes, I have an opinion.

Q. What is your opinion?

A. My opinion is that in scientific knowledge one must take all information and assess it for its worth.

Q. Well, did you assess the epidemiology for its worth?

A. I was not asked to assess the epidemiology, and it's beyond the scope of my expertise.

Tr. 1170-1171. Therefore, although conceding that he considered it necessary to consider epidemiological evidence in forming opinions in the field of oncology, the witness did as

he was asked, and refrained from considering the epidemiological evidence concerning health effects of EMF for purposes of testifying in this proceeding. As such, he excluded from consideration a large body of epidemiological research which shows a weak, but consistent association between wiring code and cancer, specifically childhood leukemia. OCA St. 2A at 2-5.

Finally, PECO witness Dr. Murray Rosenberg, despite his many years of experience and impressive credentials, could do no more than conclude that:

Based upon my knowledge and understanding of biophysics, medicine and the research publications on power frequency fields, there are very good reasons to believe that exposure to power frequency fields does not cause any significant biological effects, and it is my opinion that exposure to electric and/or magnetic fields from the Woodbourne Heaton line will not result in adverse health effects in humans.

PECO Rebuttal Statement No. 4 at 21 (emphasis added). As such, Dr. Rosenberg's conclusion leaves open the possibility that there are also reasons to believe the opposite conclusion.

The OCA submits, therefore, that the PECO witnesses essentially do not disagree with OCA witnesses Janes and Rosenbaum that the possibility of adverse human health effects due to EMF exposure cannot be rejected. OCA St. 1 at 10. The OCA also submits that regardless of how many different carefully crafted conclusions can be drawn by knowledgeable scientists, the Commission cannot simply accept them at face

value when making a decision that will unquestionably have an adverse impact upon the lives and property of the adjacent landowners. What must be accepted and acted upon is that the uncertainties expressed by the Company witnesses themselves are evidence, in and of themselves, that the fears of the adjoining landowners are justified. What must be decided by this Commission is the proper course of administrative action, substantively and procedurally, in the presence of so much controversy and scientific uncertainty.

In conclusion, it should again be recognized that neither the Protestants nor the OCA had the burden of proving, to a scientific certainty, that EMFs cause cancer, or childhood leukemia, or changes in melatonin or adverse immune effects, as the Company implies. FECO Brief at 27-44. Nor were they required to make any evidentiary showing sufficient to justify disapproval of the line by the Commission. The burden was to make a threshold showing that they were adversely affected by the reconductoring of the line. By presenting evidence, along with the OCA, that some scientific and epidemiological evidence causes justified and legitimate concerns about the possible health effects associated with exposure to EMFs, the Protestants have met their burden of proving that they are adversely affected by the reconductoring of the line and should be permitted a full hearing on the issues not yet litigated. Again, it should be kept in perspective that meeting the burden of proving "adverse effects" does not necessarily warrant

disapproval of the line, where no opportunity has been provided for litigation of need and alternative routes.

2. Land Use.

The Company argues that the evidence presented by witnesses Oedemann and Boeggeman established that the compact delta design resulted in the lowest fields. PECO Brief at 18. Although responsive to Commissioner Rhodes' June 14, 1991 statement, the OCA submits that this evidence does not prove that mitigation of EMFs has been maximized by Company efforts and should not be deemed to be conclusive on the "prudent avoidance" issue, which will be discussed below.

As OCA witness Rosenbaum noted, the Company did not consider costs and effects of possible mitigative measures before construction decisions were made. OCA St. 1A at 5. The mitigation of EMFs was apparently coincidental - and not due to a determined Company effort to do so. See OCA Main Brief at 43-46.

The Company also argues, based upon witness Silva's testimony, that the range of the magnetic fields from EMF are similar to those encountered in everyday life. PECO Brief at 18-19. This is misleading, however, because the exposure to this normal "range" from this transmission line is virtually constant, and cannot easily be avoided by those living adjacent to the line. In fact, the only way for these adjacent landowners to completely avoid exposure to the EMFs generated by the Woodbourne-Heaton line is to move - which some have

stated an express intention to do. See OCA Main Brief at 47-48.

The Company argues further that Protestants did not meet their burden of proving that the line will cause adverse land use impacts sufficient to warrant disapproval of the line. PECO Brief at 19-27. Again, it should be noted initially and as stated above, that the OCA disagrees with this narrow statement of the issue involved and with the assertion that the meeting of that burden would warrant automatic disapproval of the line. The issue is whether Protestants will be adversely affected - in any manner - by the reconductoring of the line, and if they meet that broader burden, what the response on the part of the Commission should be.

As support for its assertion that there are no adverse land use impacts, the Company relies primarily upon witness Van Dyke's analysis of the land uses within 400 feet of the transmission line corridor. PECO Brief at 20-21. Mr. Van Dyke, however, did not review the substantial testimony offered by the Protestants in this proceeding as to the impacts upon their individual use and enjoyment of the residential properties adjacent to the right-of-way. OCA Main Brief at 48-50. Although conceding that the variables that people consider are many, Mr. Van Dyke chose not to consider the testimony of the Protestants in this case as to certain of those variables, e.g., proximity to a transmission line and justified fears of adverse health impacts of EMFs generated by such lines. Id. Although conceding that both public opinion

and factors taken into account by the general public are relevant to market value, Mr. Van Dyke chose not to consider the opinions of the members of the general public participating in this case. OCA Main Brief at 49.

Most important, Mr. Van Dyke's conclusion that the market value of residential property adjacent to this transmission line will not be affected thereby is logically flawed. The witness concluded that the market effects due to proximity to EMFs generated by the line would already be included in the market price of homes along the corridor--completely failing to consider that the previous use of the right-of-way was, primarily, as a railroad corridor. OCA Main Brief 49-50. Most of the prior purchasers or owners would not have had to consider, at the time of purchasing a residence next to a railroad right-of-way, the impacts of exposure to EMFs or the limitations upon use of their properties that concepts of "prudent avoidance" might require. In addition, information and concern about exposure to EMFs is a more recent and developing concern that has grown enormously in recent years. See Protestants St. 1 at 3. Those adjacent landowners who purchased since the deenergization of the line in 1986 had absolutely no ability to consider these issues at the time of purchase.

As the OCA stated in its Main Brief, these types of concerns are the very reason for the existence of Commission regulations pertaining to aerial transmission lines. OCA Main

Brief at 52-53. PAUSE witness Turner's testimony as to the justifiable fears among knowledgeable citizens and the resulting impact upon the real estate market also support the need for enhanced consideration of and responsiveness to public concerns by the Commission. These considerations are, in substantial part, the foundation for the OCA's recommendations that the Commission provide further opportunity to be heard and take the necessary steps to amend the regulations in accordance with the Commonwealth Court Order. These remedies will, in the future, avoid the possibility of administratively uneconomical "piecemeal" litigation.

At page 21 to 23 of the Company Brief, PECO argues that the Protestants did not prove that the Woodbourne-Heaton line will cause decreased property values. The OCA would note that the Company repeatedly objected to any evidence as to decrease in value. See, e.g., Tr. 104, 580-582. The Company now maintains, paradoxically, that the Protestants' failure to prove such a decrease is a reason for denying them any further relief. Once again, however, proving a decrease in property values is not a requisite to showing "adverse impact" upon these Protestants. The Protestants have sufficiently shown that their ability to continue to use their properties in the same manner as they have in the past, to sell their properties, or to derive anticipated value therefrom has been jeopardized - even though they have not substantiated a "sum certain" in dollars attributable to these adverse impacts.

In conclusion, PECO's arguments that the Protestants have failed to meet their burden herein are based upon an overly narrow reading of the orders entered and an exaggeration of the nature and quantum of evidence necessary to meet the threshold showing. For all of the foregoing reasons, and those stated in the OCA's Main Brief, the arguments by PECO should be rejected.

III. OCA RESPONSE TO LAW BUREAU PROSECUTORY STAFF.

The OCA submits that the the Prosecutory Staff's argument is unjustifiably limited to (1) whether the Protestants have proved adverse health effects due to EMF exposure and (2) the impact upon market values of their properties, which the Prosecutory Staff submits the Commission does not have authority to consider. The OCA will reply to each of these discussions in turn.

A. Adverse Effects.

As stated in its Main Brief, the OCA believes the evidence presented by OCA witnesses Janes and Rosenbaum, in conjunction with the evidence presented by the Protestants, supports a Commission conclusion that the Protestants will be adversely affected by the reconductoring of the Woodbourne-Heaton transmission line. OCA M.B. at 18-43; 48-55. Initially, it should be noted that the Prosecutory Staff's articulation of the issues pertaining to adverse

effects is incorrect for all of the reasons enunciated by the OCA above at pages 4-8.

Turning to the specifics of the argument, however, the Prosecutory Staff also states that because there is no conclusive scientific evidence that EMF present a hazard to human health, the Protestants have failed to prove that they will be adversely affected by the reconductoring of this transmission line. Staff Main Brief at 9-15.

It would be just as appropriate to conclude, then, that because the Company has not presented conclusive scientific evidence that EMF do not present a hazard to human health, the Company has likewise not met its burden of proving that the line is safe. As discussed above at pages 9-13, the Company witnesses themselves left open the possibility that a cause-effect relationship between EMF exposure and adverse effects of some sort upon human health could be proved in the future. The OCA witnesses provided testimony that effects upon living things have been scientifically shown to occur - also leaving open the possibility of future proof of adverse effects upon human beings. OCA M.B. 43-45. Conclusive scientific proof should not be required as a basis for the Commission to act, in carrying out its statutory role, to protect the public. Rather, in the face of such uncertain risk the Commission should adopt a policy that encourages reasonable measures to mitigate this risk.

The OCA submits, therefore, that the record is amply clear that the state of science on this question is uncertain - rendering the Protestants' concerns fully justified. As such, the adverse impacts upon the Protestants shown extends beyond scientifically provable impacts upon health by EMF and it would be error to articulate the issue to be decided so narrowly as to encompass only that issue. The adverse effects shown are not only the potential for future adverse health effects by EMF, but also upon the quality of these Protestants' lives and the use and enjoyment of their property due to the uncertainty of the current state of science and the well-founded concerns of the Protestants and others who would otherwise be inclined to purchase the adjacent properties.

B. Commission Jurisdiction to Consider Adverse Impact Upon Use and Value of Property.

The OCA disagrees with the Staff's argument pertaining to Commission jurisdiction to consider the impacts of a transmission line upon the environment and upon market values of adjoining property. The OCA submits that the Commission has jurisdiction to consider the impacts upon land use and the environment and should exercise that jurisdiction in this and all transmission line siting cases. The fact that the Commission cannot order a public utility to write a check for a certain amount because of a "taking" does not lead inexorably to an inference that the Commission cannot even consider evidence as to the effects upon an adjacent landowner's use and

enjoyment of the property or, for that matter, the impact of a transmission line upon land use principles in general.

In support of the premise that the Commission has no jurisdiction to consider anything having to do with land value, the Staff cites Borough of Moosic v. Pa. P.U.C., 59 Pa. Commw. 338, 429 A.2d 1237 (1981) ("Moosic"). The Protestants in that case invoked Article 1, Section 27 of the Pennsylvania Constitution in an attempt to procure a Commission order over an entity which was not a public utility and thus outside the Commission's jurisdictional reach. Moosic, 59 Pa. Commw. at 343, 429 A.2d at 1240. The citation is inapposite. No one questions that the Commission has jurisdiction over PECO, a public utility, which is seeking permission to construct a transmission line. The Moosic case stands for the proposition that the Commission has jurisdiction to consider environmental issues when it is in the course of exercising its powers over a public utility pursuant to Sections 501 and 1501 of the Code, 66 Pa.C.S. §§501 and 1501.

The OCA does not disagree with the Staff's assertion that the Commission does not have authority to assess and to order the payment of damages, as that matter is within the power of the courts under the Eminent Domain Code, 26 P.S. § 101-1, et seq. It does not follow to argue that from that general principle that the Commission does not have the power to consider evidence presented to it by Protestants as to the impacts of a public utility's transmission line project upon

surrounding land use and value. In fact, it is important to note that the Commission's powers are derived by statute, City of Philadelphia v. Philadelphia Electric Company, 504 Pa. 312, 317-318, 473 A.2d 997, 999-1000 (1984); and that agencies empowered by statutes must exercise those powers consistent with state constitutional requirements. Hartford Accident and Indemnity Company v. Insurance Commissioner, 505 Pa. 571, 576-577, 487 A.2d 542, 554-555 (1984). The Commission must, therefore, exercise its powers giving due consideration to constitutional principles.

As such, the OCA submits that that the Commission should consider the impact upon adjacent landowners' use and enjoyment of their property, in conjunction with environmental impacts set forth in Art. 1, Section 27 of our Constitution, where such issues are raised in the course of a siting application proceeding. If the Commission were to accept, in this case, that it has no jurisdiction to consider such evidence, an order to that effect could seriously hamstring the Commission in determining siting applications in the future. The OCA submits, therefore, that evidence as to adverse impacts upon land use and value should definitely be considered by the Commission. The Commission should concomitantly refrain from determinations of actual dollar amounts of damages, properly deferring that issue to the Courts of Common Pleas, as required by the eminent domain code.

At pages 25 to 34 of the Main Brief, the Staff contends that the legislative history of the siting regulations support its premise that adverse impact upon land use and value in general may not even be considered by the Commission. The regulations, and the history of their promulgation, contain more to support the opposite contention, i.e. that the Commission should, in exercising its powers while giving deference to constitutional considerations, consider impacts upon land use and landscape in residential areas.

The misapprehension of the Staff is apparent at 33 of the Main Brief, where it is stated:

While the Commission may examine the environmental impact of the proposed line on an individual property which will be physically burdened with the line's presence, and on adjacent properties as to aesthetics and safety, Prosecutory Staff does not believe that the intent behind the above-cited regulations permits the Commission to assess damages (decrease in market value) as a result of that environmental impact on property which will be physically burdened with the line or a fortiori, on property adjacent to the line.

The Staff therefore concedes that the Commission may examine the impact of a proposed line on adjacent properties as to aesthetics and safety, which are beyond question the types of adverse impacts which the Protestants have presented evidence herein. The Staff then fails to take into account that evidence as to damages, i.e. the setting of a dollar amount of compensation where property has been taken, may indeed overlap evidence as to general impact upon value of residential

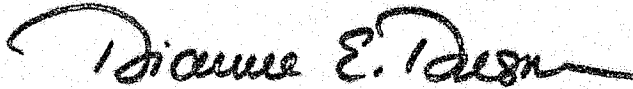
properties where aesthetics and safety may be jeopardized. In other words, although some of the evidence offered by the Protestants may be relevant in an inverse condemnation suit, for example, that same evidence may also be probative of "adverse effects" which is the issue here.

The OCA submits that the evidence submitted by the Protestants regarding impact upon their use of their properties, and as to land use in their area can and should be considered by the Commission along with all of the other evidence. Although such evidence cannot lead to findings and conclusions outside the scope of Commission jurisdiction, these factors are within the scope of items which, among other things, are material to making a determination which the Commission is empowered to decide - the siting of a transmission line.

IV. CONCLUSION.

For all of the foregoing reasons, and for the reasons set forth in the OCA's Main Brief, the Office of Consumer Advocate respectfully submits that the Commission should adopt the findings and conclusions as set forth in the OCA's Main Brief, Appendices B and C, respectively, and enter an order as proposed in Appendix D.

Respectfully submitted,



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Dated: May 11, 1992
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May 11, 1992
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VIA OVERNIGHT MAIL

Mr. John Alford
Secretary
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North Office Building
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Re: Letter of Notification of Philadelphia Electric Company Relative to
Reconstructing and Rebuilding of the Existing 138 KV Line to Operate
as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks
Counties; Docket No. A-110550,F.055

Dear Mr. Alford:

Enclosed are an original and nine copies of Philadelphia Electric Company's
Reply Brief in the Woodbourn-Heaton proceeding. Copies have been served on the
ALJ and all parties today.



Respectfully yours,

Ward L. Smith

cc: (via Overnight Mail)
Hon. Herbert S. Smolen
Robert J. Sugarman, Esquire
Tanya J. McCloskey, Esquire
Patricia Krise Burket, Esquire
Jesse A. Dillon, Esquire

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MAY 11 1992

SECRETARYS OFFICE
Public Utility Commission

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54.

By Overnight Mail

The Honorable Herbert S. Smolen
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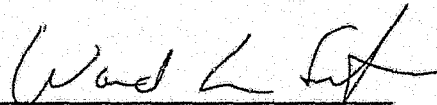
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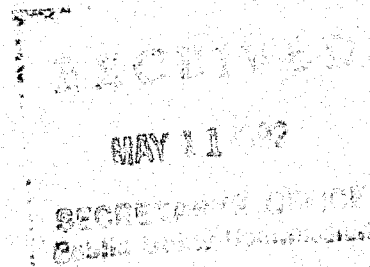
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Dated: May 11, 1992



**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Letter of Notification of
Philadelphia Electric Company
Relative to Reconstructing and
Rebuilding of the Existing 138 kV
Line to Operate as a Woodbourne-
Heaton 230 kV Line in Montgomery
and Bucks Counties

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Docket No.
A-110550, F. 055

**REPLY BRIEF OF
PHILADELPHIA ELECTRIC COMPANY**

BEFORE ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN

Counsel for Philadelphia Electric Company

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MAY 11 1992

**SECRETARYS OFFICE
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May 12, 1992



**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Letter of Notification of
Philadelphia Electric Company
Relative to Reconstructing and
Rebuilding of the Existing 138 kV
Line to Operate as a Woodbourne-
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Docket No.
A-110550, F. 055

**REPLY BRIEF OF
PHILADELPHIA ELECTRIC COMPANY**

BEFORE ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN

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May 12, 1992

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Introduction

This reply brief responds to the Main Briefs of Protestants and the Office of Consumer Advocate. ("Protestants' Brief" and "OCA Brief.")

The sole question in this hearing was, and remains, whether Protestants will be adversely affected by the reconductoring and energization of the line sufficient to warrant disapproval of it. Protestants claim that EMF from the line will adversely affect their health and that EMF from the line will change land uses in a way that will adversely affect them.

With regard to the health claim, it is PECO's position that Protestants did not prove that EMF from the line will cause adverse health effects. Their only health witness, Dr. Liboff, was not an expert in the medical and scientific disciplines in which he testified. His analysis and the bases for his conclusions were flawed. And his conclusions were shown to be untrue by medical scientists in the fields of oncology, biophysics, epidemiology, and endocrinology. *See* PECO Brief at 27-42. Notably, even the argument in Protestants' Brief does not mention Dr. Liboff's name. As demonstrated in the body of this brief, the arguments used in Protestants' Brief in lieu of reliance on Dr. Liboff do not prove that exposure to EMF leads to adverse health effects.

For its part, the OCA frankly stated that adverse health effects were not proven:

"At best, the the research provides an uncertain picture, fraught with studies providing conflicting results. The OCA submits that it is not possible to conclude that there is a cause and effect relationship between EMFs and harmful health effects, nor is it possible to conclude that no such cause and effect relationship exists."

OCA Brief at 42-43. (emphasis added.)

It is PECO's position that since "it is not possible to conclude that there is a cause and effect relationship between EMFs and harmful health effects," then it is not possible to conclude that Protestants' health will be adversely effected by energizing the line. And since adverse effects are the sole issue in this case, such a

conclusion should close the examination of the health question.

The OCA, however, argues that "enough" uncertainty can prove adverse effects "sufficient" to warrant an additional hearing:

"The OCA submits that these landowners need not prove certain harm to health in order to receive a hearing in this case. Rather, the landowners need only show "adverse affect" sufficient to gain standing to address the merits of the reconstruction and reconductoring of this transmission line."

"[T]he OCA contends that there is enough uncertainty regarding the question of the potential health effects associated with the electric and magnetic fields created by this transmission line to justify giving landowners adjacent to or near the right-of-way a chance to raise issues regarding the merits of the proposed transmission line."

OCA Brief at 18 (emphasis added.)

This argument turns the burden of proof on its head. ¹ "Uncertain" harm to health is unproven harm to health. Evidence cannot become more and more uncertain until it becomes uncertain "enough" to constitute proof. To the contrary, as it becomes more and more uncertain, it moves further away from being proof.

Recent Commission decisions on the meaning of the burden proof establish that this is the case. The Commission recently reiterated the meaning of the term "burden of proof" as applied in Commission proceedings:

"The Pennsylvania Supreme Court has held that the term 'burden of proof' means a duty to establish a fact by a preponderance of the evidence.

Pennsylvania Public Utility Commission v. Columbia Gas of Pennsylvania, 127 PUR

¹ In its brief, the OCA made several statements that demonstrate that it had reversed the burden of proof in its analysis. See e.g. OCA Brief at 34 ("In this case, there has been no persuasive refutation of the concern regarding the possible association between EMFs and harmful health effects."); *id.* at 42 ("The biologic evidence provides no conclusive proof that EMFs do not result in an increased risk of harm to people who are constantly exposed to the fields."); *id.* at 44 ("The OCA submits that there is no proof in this proceeding that exposure to EMFs does not result in adverse health effects.")

4th 179, 182 (Pa. PUC, Sept. 30, 1991) (emphasis added.)² The "fact" that is at issue here is whether energizing this transmission line will cause adverse health effects to Protestants. Protestants and the OCA were just given a full hearing to "establish that fact by a preponderance of the evidence," and they failed to do so.

Nor did Protestants and the OCA prove that EMF from the line will change land uses in a way that will adversely affect them. Protestants only expert witness on land use, Mr. Turner, based his opinions upon a flawed land use study. He was contradicted in his opinions by the very articles that he relied upon. And his conclusions were shown to be untrue by the detailed land use analysis conducted by Mr. Van Dyke. See PECO Brief at 19-26.

With regard to land use issues, Protestants' Brief contains an incorrect statement of the ALJ's evidentiary rulings:

"In ruling on evidentiary matters, the ALJ has already determined that effects on patterns of land use, including the use of land by protestants, is relevant to the issue of effects. These evidentiary rulings are not subject to reversal at this stage."

Protestants' Brief at 1 (emphasis added.)

This is simply untrue. Land use matters are within the Commission's jurisdiction, but the ALJ did not rule that the individual Protestants' anticipated changes in property use are "effects" sufficient to warrant disapproval of the line."

To the contrary, the ALJ was never asked to address that question. His evidentiary rulings during the individual Protestants' testimony were limited to (1) rulings that the Protestants would not be allowed to give testimony on the question of whether their property in fact would decrease in value after the line is energized,

² The Commission continued its discussion of burden of proof as follows: "The term preponderance of the evidence means that one party has presented evidence which is more convincing, by even the smallest amount, than the evidence presented by the other party. We recognize that in order to determine whether or not a party has satisfied its burden of proof, it is incumbent upon us to ensure that our decision is supported by substantial evidence in the record. We hasten to point out that the the term 'substantial evidence' has been defined by the Pennsylvania Supreme, Superior, and Commonwealth Courts as such relevant evidence that a reasonable mind might accept as adequate to support a conclusion. More is required than a mere trace of evidence or a suspicion of the existence of a fact sought to be established."

T.S. at 478, (2) that the Commission does not have jurisdiction over *de facto* takings and would not hear evidence on them, T.S. at 135, and (3) that he reserved ruling on the question of whether evidence on property values can properly be used to prove any issue within this proceeding. T.S. at 104. ³

Moreover, this testimony by individual Protestants is clearly insufficient to meet Protestants' burden of proving that EMF from the line will cause land use changes that adversely affect Protestants.

First, the individual Protestants are not land use experts, and their testimony was received subject to that representation by Protestants' counsel. *See e.g.* T.S. at 135, 190-91.

Second, Protestants' counsel assured the ALJ that the the testimony of individual Protestants was proffered only as evidence of effects the Protestants "perceived" would occur if property values decreased. *See e.g.* T.S. at 190-91, 456. ⁴ Protestants failed to make that showing through expert testimony or otherwise.

Most importantly, however, the individual Protestants' concerns are merely reallegations of the complaints that lead to this hearing. Those concerns, no matter how deeply felt, are not grounds for further hearings in this proceeding. Rather, the instant hearings were granted precisely for the purpose of allowing Protestants the opportunity to prove that energizing the line will cause such adverse effects. Were it otherwise, local residents could "prove" that every transmission line violates the Commission's environmental standards simply by testifying to the Commission that, if the line was built, they would move.

³ As demonstrated in PECO's Initial Brief, the ALJ and the Commission need not reach this issue since Protestants failed to prove that energizing the line will cause a decrease in property values. *See* PECO Brief at 3-4, 21-23.

⁴ *See* T.S. at 190-91: Mr. Sugarman: "The witness is not an expert and has not tried to sell his house. There will be other testimony. I misunderstood you question before. So I am changing my answer. The testimony is offered for the fact that if the property devalues it will have an effect on the witness." (emphasis added); T.S. at 456: Mr. Kaplan: "Your honor, the witness stated that he would be vacating the house if the line is energized, and I would like the record to indicate the degree of his fear in terms of what he would be giving up and in terms of his concerns about the harm."

In sum, Protestants' Brief is simply incorrect on the kinds of evidence that can be used to prove such effects. The burden is on Protestants, and that burden cannot be met by reiterating individual Protestants' concerns. The Commission knew of those concerns before the Protestants testified. The purpose of this hearing was to provide Protestants an opportunity to prove their allegations.⁵ And, and the following argument demonstrates, Protestants and the OCA have failed to met their burden on that issue.

Argument

I. Protestants Did Not Meet Their Burden of Proving that They Will Be Adversely Affected by Energization of the Line

A. Protestants Did Not Prove that Energizing the Line Will Cause Adverse Health Effects

Protestants claim to have proven the existence of adverse health effects through the testimony of individual Protestants and their expert witnesses (Protestants' Brief at 5-7), by inference from the concept of "prudent avoidance" (*Id.* at 4-5), and from the testimony of expert medical witnesses appearing on behalf of PECO (*Id.* at 2-4). Protestants have not met their burden.

1. Protestants' Evidence Did Not Prove That Energizing the Line Will Lead to Adverse Health Effects

Protestants' Brief claims that: "The protestants evidence . . . clearly indicated that there is definite scientific evidence of adverse biological effects of EMF on health." Protestants' Brief at 5.

Protestants presented the testimony of 22 individual Protestants, Mr. Ronald Turner (a land use planner), and Dr. Abraham Liboff (a physicist.) None of that

⁵ See, e.g., T.S. at 135: Judge Smolen: "I understand what you are driving at. We want testimony of experts in expert fields and we want the testimony of these residents as to how they perceive they are going to be affected by the line." Mr. Sugarman: "Exactly." (emphasis added.)

testimony proved that exposure to EMF from the line will lead to adverse health effects.

The individual Protestants did not provide any expert testimony on EMF and health. Protestants' counsel stipulated that the individual Protestants' were not presenting expert testimony on EMF and that their testimony "would not be cited as such in the briefs." T.S. at 95-96.

Mr. Turner did not provide any expert testimony on EMF and health. In fact, he admitted that he is "not technically competent to read a technical article on, let's say, human cell biology or other matters," T.S. at 656, that he had no independent scientific perspective to judge the issue, T.S. at 657, and that he is not qualified as an independent scientific source to render an opinion as to whether or not there are adverse health effects. T.S. at 658. As Mr. Turner aptly summarized:

"I am not giving you any independent evidence on health effects. That would be absurd."

T.S. at 656-57.

The only witness who Protestants proffered as an expert on EMF and health was Dr. Liboff. Yet the argument in Protestants' Brief does not contain a single reference to Dr. Liboff or his testimony.

The numerous problems with Dr. Liboff's testimony were detailed at length in PECO's Initial Brief, and will only be quickly summarized here. He has no medical training, or indeed any graduate level training, in the medical and scientific disciplines in which he testified. He had only actually read a small percentage of the studies that he relied upon. He based his opinion on studies using inapplicable pulsed fields and microwave fields that are completely unlike the 60 Hz fields that will be associated with the line. And he ignored an extensive body of well-done research on key assays related to carcinogenesis, the endocrine system, and the

immune system. See Peco Brief at 27-42. ⁶

It cannot be seriously argued that this evidence meets Protestants' burden of proving that energizing the line will lead to adverse health impacts.

2. The Concept of "Prudent Avoidance" Does Not Prove that Energizing the Line Will Lead to Adverse Health Effects

Protestants' Brief also discusses the concept of "prudent avoidance" and claims that: "In itself, the consideration of prudent avoidance establishes the validity of the effect argument." Protestants' Brief at 9, *see also id.* at 4-5.

This argument is premised on a basic misunderstanding of the concept of prudent avoidance, which assumes that no health effects have been demonstrated. As Mr. Silva explained:

"Prudent avoidance . . . is based on the assumption that health effects from exposure to electric and magnetic fields have not been demonstrated. Prudent avoidance is a concept that recognizes that a scientific determination cannot be made that changes in EMF levels will have any effect on health, and thus prudent avoidance advocates only a modest effort in making such changes."

Silva Rebuttal at 15-16 (emphasis added.)

Even Protestants' own witness Mr. Turner testified that, in his opinion, prudent avoidance is an interim strategy for use during times of "uncertainty." T.S. at 639-41.

⁶ Protestants' Brief also argues that: "The lack of precise knowledge of the mechanism and character of the adverse effects is not a basis for ignoring them. Protestants' Brief at 8-9. Protestants' Brief misses the point. In this proceeding, the burden of proving health effects is on the Protestants. It cannot be argued that an admitted "lack of knowledge" is affirmative proof of adverse health impacts.

Moreover, Protestants' Brief is incorrect in its characterization of the state of knowledge on mechanisms. This is not a case in which science seeks "precise knowledge of the mechanism." It is a case in which no mechanism at all has been identified, and even Dr. Liboff admits that "The power input of these signals is simply too small to invoke any conceivable mechanism." Liboff Statement at 1-2. That is why Dr. Liboff is on his quest to find a mechanism. T.S. at 781.

Protestants' Brief implies that the testimony of Mr. Ron Oedemann, a PECO engineer, somehow proves that the line is unsafe: "Mr. Oedemann testified for PECO that the company seeks to lower EMFs to make the line safe but tried to say that EMF is not really a safety issue." Protestants' Brief at 5.

Mr. Oedemann's testimony does not prove that EMF will lead to adverse health effects. Mr. Oedemann testified on behalf of PECO that the company is aware of past and ongoing research on EMF, T.S. at 23, that this research to his knowledge has not demonstrated adverse health effects of EMF, T.S. at 23, 25, that the company is aware that the public is nonetheless concerned about EMF, and that the company seeks every opportunity to take actions consistent with prudent avoidance "because we care" about our neighbors. T.S. at 23, 36, 66. This does not prove that EMF causes adverse human health effects; it proves that the company is keeping abreast of the EMF issue and acting responsibly with regard to it.

Protestants' Brief concludes its discussion of prudent avoidance with the following statement:

"While Company witnesses Boeggeman and Oedemann spoke of prudent avoidance as being an approach suited to a situation wherein there is great uncertainty and question about risk as research continues, other PECO witnesses in scientific testimony said that no additional research was desirable (N.T. 975, 1147-48)."

Protestants' Brief at 5.

The fact that PECO pursues prudent avoidance despite the highly qualified conclusions of medical experts that additional research on some issues is not necessary merely underscores that PECO has acted responsibly in this matter. In that respect, Dr. Gelmann's comments on further research are worth describing at some length. Dr. Gelmann was asked on cross-examination his opinion as to whether more EMF research should be conducted in the fields of cellular and molecular biology. Dr. Gelmann responded that it "depends upon what questions you want to ask by doing that research," T.S. at 1147, but that in his opinion no further research is needed on EMF and carcinogenesis. Dr. Gelmann then explained that research

may well continue for reasons unrelated to the state of scientific knowledge on EMF and cancer:

"[M]y opinion is that sometimes research is instigated by important scientific issues, sometimes by political concerns and sometimes in response to public concerns that may or may not have any basis in scientific fact. A good example of that, of the latter, is the research that was done with the anti-cancer agent Laetrile, which had a tremendous amount of interest among cancer patients. There were books written about it. There was a huge amount of hope and money on the part of the suffering public expended in seeking this agent, in many cases in illegal ways. And finally the National Cancer Institute was basically forced by the situation to sponsor a very rigorous trial which after a lot of public funds were expended and a lot of cancer patients were enrolled showed that the stuff was absolutely worthless. But at least it put the question to rest."

T.S. at 1148-49.

In sum, it is true that PECO generally seeks opportunities to practice prudent avoidance, that this line was designed in a manner consistent with prudent avoidance, and that PECO has included discussions of prudent avoidance in materials distributed to the public. PECO submits that this should be viewed as responsible corporate behavior. Protestants, on the other hand, would have the Commission find that a utility that practices or publicly discusses prudent avoidance has, by those actions, proven that EMF causes adverse human health effects that create an "unreasonable risk to the public's health and safety" under the Commission's regulations.

3. PECO's Expert Medical Witnesses Did Not "Concede" That Energizing the Line Will Cause Health Effects

Protestants' Brief also asserts that the testimony of PECO's expert medical witnesses "proves" that energizing the line will cause Protestants to have adverse health impacts:

"[PECO's expert witnesses] conceded that electromagnetic fields do have health effects and biological effects. . . . No PECO expert medical witness denied that studies in different areas of science and medicine demonstrated

biological effects of EMFs that either are or could be linked to adverse health effects. The company witnesses . . . continually acknowledged their familiarity with positive results in a number of studies in a number of areas."

Protestants' Brief at 3 (citations omitted, emphasis added.)

Protestants' Brief has confused the issue. A study that reports biological change (a "positive result") does not prove that adverse effects will result from that change. As Dr. Gelmann explained, an evaluation of the medical and scientific implications of the reported change must occur before conclusions can be drawn about health implications

"The number of biological endpoints is not the relevant issue. The question is whether the processes that are involved are related to an adverse health outcome. To illustrate, breathing fresh air causes an immense number of biological effects in the human, but the process of breathing does not cause cancer or other adverse health effects. The argument that biological effects must lead to adverse health is contrary to basic biological and medical facts."

Gelmann Rebuttal at 22. ⁷

Moreover, it is patently untrue that PECO's witnesses "conceded" health effects of exposure to EMF. Each of those medical scientists evaluated the health implications of the positive results and concluded that those results do not provide evidence of adverse health effects. See Rosenberg Rebuttal at 20, Gelmann Rebuttal at 21, Bockman Rebuttal at 26-27, Cole Rebuttal at 28.

Protestants' Brief specifically claimed that Dr. Cole had admitted the exposure to EMF leads to adverse health effects: "One witness, Dr. Cole stated that the evidence was inconclusive or evenly divided between positive results and negative results. (N.T. 1097, 1523)." Protestants' Brief at 3.

This statement provides no support for Protestants' position. Dr. Cole had previously explained that epidemiology is an imprecise science in which great care

⁷ Dr. Liboff also discussed the difference between biological effects and health effects: "[T]here are all sort of biological effects that under simple conditions need not be hazardous. . . [Y]ou can have a biological effect merely by going from an air-conditioned room out into the sun. And in your body you can measure physiological changes . . . I don't think anybody would think of this as hazardous under reasonable circumstances." T.S. at 778-79.

must be taken in the interpretation of a body of research, Cole Rebuttal at 5, and that due to this imprecision an evenly divided body of research with some weak positive and some weak negative results is precisely what is expected when there is no underlying association between the agent and the disease. *Id.* at 6-7, 28-29. And the transcript citation relied upon in Protestants' Brief is quite clear in not providing support for Protestants' position:

"My testimony is that there is a large amount of evidence now pertinent to the question. There is some on one side, there is some on the other. Thus for me the question becomes how does one integrate this information and try to come to a statement as to what it shows today and what reality is likely to be. And from that perspective my own view is that the available evidence is just about equally divided between that which is supportive and that which is contradictory. And my experience leads me to say that this is a pattern for associations that end up fading away."

T.S. at 1522-23. (emphasis added.)

In short, the testimony of PECO's expert witnesses provides no support for the proposition that EMF exposure leads to adverse health effects.

4. PECO's Medical Witnesses Are Highly Qualified to Render Opinions of EMF and Health

Protestants' Brief also includes a critique of PECO medical experts. Protestants' Brief at 3-4. That critique, though given further specific content in the Protestants' argument, was succinctly stated as follows:

"These PECO expert witnesses all confined their testimony to their areas of specialization and stated that their opinions as to adverse health effects were limited to those areas."

Protestants' Brief at 3.

This is a flaw? Testimony outside of the witnesses area of expertise would be of no use to the Commission.

Protestants' Brief, however, claimed that the areas of specialization of PECO's witnesses were too "narrowly limited" and that "certain areas were altogether unsupported by testimony, either in direct or rebuttal." Protestants' Brief at 3.

PECO's experts' areas of expertise are not "narrowly limited" -- they are the normal, standard areas of expertise into which the medical and scientific disciplines have been categorized over the years. Thus, Dr. Gelmann is a medical doctor certified in medical oncology and a Professor of Cell Biology, and he testified regarding cellular biology and cancer; Dr. Rosenberg is a medical doctor and physicist, and he testified regarding the health implications of the physics and mechanisms research; Dr. Bockman is medical doctor certified in endocrinology who conducts endocrine and immune research, and he testified regarding the endocrine and immune systems; Dr. Cole is a medical doctor and epidemiologist, and he testified regarding the epidemiology studies.

This can be compared to Dr. Liboff, who has no training in any of those disciplines, T.S. at 755, yet testified in them all.

Nor was there any area that was "altogether unsupported by testimony, either in direct or rebuttal," as Protestants Brief claims. It is noteworthy that Protestants' Brief does not identify any area that was "uncovered." And in fact PECO's expert witnesses covered a broad range of medical and scientific disciplines, including all of the medical and scientific disciplines testified to by Protestants' witness, the physicist Dr. Liboff.

Similarly, Protestants' Brief claims of PECO's expert witnesses that: "None would survey the entire range of EMF research. . . [They] often showed a disregard for studies conducted in other fields, refusing to give significant weight to their results. Epidemiologic studies often surfaced in this regard." Protestants' Brief at 3-4 (citations omitted.)

One example from the Protestants' list of citations will suffice to show that this argument has no merit. At pages 1051-1062 of the transcript, Mr. Sugarman and Dr. Bockman engaged in a dialogue regarding the role epidemiology studies played in Dr. Bockman's analysis, opinions, and conclusions. In that colloquy, Dr. Bockman stated that he had studied epidemiology in medical school, T.S. at 1051, that he uses many of the methodologies of epidemiology in his own research, *id.*,

that he is familiar with the epidemiology research that has looked at immune and endocrine system endpoints, T.S. at 1059, that he discussed those studies in his written testimony, T.S. at 1060, that he has read the epidemiology studies on EMF and cancer, is familiar with them, and has formed an opinion about them, T.S. at 1054-55, that he considered them in a broad sense in reaching his conclusions, T.S. at 1057, but that "I based my opinion in the endocrine and immunological fields on primary literature in those fields." T.S. at 1056 (emphasis added.)

This is not "disregard" for the epidemiology studies -- it is the careful evaluation by a scientist and medical doctor as to the weight to be accorded to various types of studies in reaching a medical conclusion.

The final specific element of Protestants' critique is that:

"The experts exhibited an obstinacy with regard to results from other fields whose implications they could not reconcile with preconceived scientific beliefs. The general trend was to play down information as to EMF effects if it clashed with theories regarded as certain within ones own field."

Protestants' Brief at 4 (citations omitted).

These highly qualified medical experts reviewed an extensive body of research and rendered opinions based upon their experience, training, and review of the research. *See e.g.* Bockman Rebuttal at 26. Each carefully described the analysis and methods leading to those opinions, and each "refused" to testify in areas outside of their field of expertise. Protestants' may not like that approach, or even find it obstinate, but such a dislike is not relevant to the propriety of the approach. As was explained in Dr. Gelmann's testimony, this is the normal approach used by these medical scientists in their research and medical work:

"Q. How did you approach this work [of assessing the EMF research for purposes of your testimony in this proceeding]?"

A. In the same manner as I would normally in the course of my responsibilities as a physician and a researcher of the molecular and cellular biology of cancer.

Gelmann Rebuttal at 5-6.

B. Protestants Did Not Prove that Energizing the Line Will Cause Adverse Land Use Effects

Protestants' Brief also claims that energizing the line will cause adverse land use impacts. *See e.g.* Protestants' Brief at 11.

It is worth noting at the outset that most of Protestants' Brief is dedicated to the question of whether property value related land use impacts are within the Commission's jurisdiction. As stated in PECO's Initial Brief, the Commission need not reach this question because Protestant's have failed on the evidence to prove an adverse land use effect. PECO Brief at 3-4.

The only witness who was proffered by Protestants as an expert in land use was Mr. Turner. Protestants' Brief contains only cursory reference to Mr. Turner's testimony. In fact, the Protestants' Brief's entire discussion of Mr. Turner's testimony is found in two sentences. The first states that:

"As testified by Mr. Turner, without essential contradiction, moreover, because of the accumulative effect of individual landuse decisions by individual property owners, an unsafe line in a populated area can have a significant effect on the overall character of the land use."

Protestants' Brief at 11 (emphasis added).

Protestants' Brief correctly indicates that Mr. Turner's opinion of adverse land use effects is based upon his general speculations of what might occur near "an unsafe line." Protestants, however, simply have not proven that the line will be "unsafe."

Moreover, it is untrue that Mr. Turner's testimony was "without essential contradiction." Mr. Van Dyke proved through his detailed analysis of land uses and property values that because of urbanization patterns directly next to the line the area is not, and will not become, a heavily populated. Van Dyke Rebuttal at 11. As indicated previously, his analysis of the area near the line and the regional area demonstrated that no such changes in the "overall character of the land use" has occurred near utility functions in this area and is not expected to occur after

energization of the line. *Id.* at 11-14.

The second sentence in Protestants' Brief referring to Mr. Turner's testimony is that:

"Mr. Turner was un rebutted in his conclusion that it [the line] would deter future buyers of the property, and thereby limit the opportunity of families who "vote with their feet."

Protestants' Brief at 9 (emphasis added).

It is untrue that Mr. Turner was "un rebutted" in his property valuation conclusions. Mr. Van Dyke conducted a detailed analysis of land uses within 400 feet on either side of the line, an area designated as the "Corridor Study Area," as well as an analysis of all existing utility functions in a 60 square mile area surrounding the line, and concluded that (1) no decrease in property values had occurred near existing utility functions in the area, Van Dyke Rebuttal at 14-15, (2) the land uses, zoning, and property values near the line all had developed in the immediate context of the existing utility corridor, *id.* at 13-14, (3) the market for property near the line would already have compensated for the proximity to utility functions and would in any event be dominated by the intrusive rail use, *id.*, and (4) based on the above facts, no decrease in property values is expected to occur after energization of the line. *Id.* at 13-15.

Just as importantly, however, Mr. Turner's evidence regarding property values is entitled to no weight of its own accord. As described in PECO's Initial Brief, Mr. Turner's analysis was fatally flawed: his analysis did not include data on property near or abutting the line, he reviewed only a small portion of the aerial photographs necessary to conduct a full analysis of the line, he did not know the EMF levels that will be associated with the line, he had no market data of any sort to support his property valuation opinions, and the articles relied upon by him to establish a decrease in property values in fact stated that transmission lines had no effect on market value. PECO Brief at 21-23.

II. The OCA Did Not Meet Its Burden of Proving That Protestants Will Be Adversely Affected by Energization of the Line

A. The OCA Stated That It Did Not Prove That Energizing the Line Will Cause Adverse Health Effects

The OCA's position as to what it proved in this proceeding regarding EMF and health was clearly set out in its brief:

"The OCA submits that it is not possible to conclude that there is a cause and effect relationship between EMFs and harmful health effects, nor is it possible to conclude that no such cause and effect relationship exists."

OCA Brief at 43. (emphasis added.) In fact, in at least 25 different places in its brief, the OCA characterized its evidence on adverse health effects as "uncertain," "unclear," or "undeveloped." ⁸

In short, the OCA consistently and convincingly stated that it did not meet its burden of proving that energizing the line will cause adverse human health effects.

Unfortunately, the discussion of the science in the OCA's Brief contains numerous errors that, if left uncorrected, would tend to present an incorrect view of the record evidence in this proceeding. The next sections of this brief address and correct those errors.

B. OCA's Citations to the EMF Research Were Incomplete, Incorrect, and Implied "Uncertainty" and "Risk" That are Not Supported by the Record

⁸ See e.g. OCA Brief at p. 12 ("uncertain"), p. 13 ("uncertainty," "need not prove certain harm," "enough uncertainty"), p. 19 ("uncertain risk," "not sufficiently developed to be able to draw certain conclusions," "no conclusive evidence," "uncertainty," "uncertain risk"), p.25 ("the connection between these effects and any harm to human health remains unclear"), p. 27 ("in the early stages of development"), p. 31 ("epidemiologic literature is not conclusive," "not very well developed"), p. 34 ("unclear and uncertain," "risk has not been clearly and unambiguously demonstrated"), p. 37 (no "basis for concluding"), p. 41 ("not possible at this time to draw conclusions"), p. 42 ("biologic evidence also remains uncertain," "no conclusive proof," "unclear," "an uncertain picture," "not possible to conclude that is a cause and effect relationship"), p. 44 ("this uncertain risk," "the uncertain risk"), p. 51 ("uncertain scientific opinion"), p. 57 ("uncertain risk").

1. The OCA's Citations to the Molecular and Cellular Research Were Incomplete, Incorrect and Implied "Uncertainty" and "Risk" That are Not Supported by the Record

The OCA's Brief discussed three cellular studies: Goodman's research on RNA transcription, Byus and Adey's research on ornithine decarboxylase ("ODC"), and Ross's research on cell proliferation. OCA Brief at 40-41.

The OCA's brief claims that these three studies are relevant to the question of whether EMF exposure is related to cancer, thus implying that these studies are evidence of a "risk" from EMF exposure. See OCA Brief at 40-41.

That claim is simply contradicted by the record evidence. Dr. Gelmann specifically addressed the cancer implications of these three studies. With regard to the Goodman research, he concluded that:

"Goodman's work deals with normal cell processes unrelated to carcinogenesis.

Gelmann Rebuttal at 16. (emphasis added.)

With regard to Byus and Adey's research on ODC, Dr. Gelmann concluded that:

"The magnitude and timing of the ODC increases reported in this research are inconsistent with a carcinogenic effect. "

Gelmann Rebuttal at 18. (emphasis added.)

With regard to the Ross research on cell proliferation, Dr. Gelmann concluded that:

" The Ross study, for example, reported decreased proliferation of cells in vitro. This is exactly the opposite of what one would expect from a carcinogen.

Gelmann Rebuttal at 19-20 (emphasis added.)

The OCA's Brief's discussion of the molecular genetics research also contains an incorrect and incomplete conclusion regarding the state of development of the

molecular and cellular science:

"Although these biologic effects have been observed in both animal and cellular systems, the mechanism of these effects are not known at this time. OCA st. 1 at 9. In light of this, OCA witness Janes recommends that further research must be conducted before any conclusions can be reached about the relationship between EMFs and harmful health effects in humans. OCA Statement 1A at 1. As both Mr. Janes and Dr. Bockman agree, it is not possible at this time to draw conclusions as to human health from this animal and cellular systems research. OCA St. 1A at 2; Tr. 994-95."

OCA Brief at 41 (emphasis added).

The best that can be said about this paragraph from the OCA Brief is that it contains a careless use of record citations in implying that the cited statements from Mr. Janes and Dr. Bockman are related to the molecular and cellular research. The cited statement from Mr. Janes' surrebuttal testimony unambiguously applies only to the melatonin research, not to the body of EMF research as a whole, and certainly not to the molecular research. See Janes Surrebuttal Statement at 1.

The cited pages of the transcript referring to Dr. Bockman's testimony also discuss melatonin, rather than the molecular and cellular research. ⁹

⁹ In that testimony, Dr. Bockman does not say that "it is not possible to draw conclusions as to human health," he says that because the rat is a nocturnal animal "you certainly can't extrapolate to man." T.S. at 995. This citation is made even more troublesome by the fact that Dr. Bockman was specifically asked in his direct testimony: "What are the implications of the reported change in rat melatonin?" and responded:

"There are no known or reported biologic consequences of the reported change in dark cycle melatonin levels, either in rats or humans. Nor is there evidence of any effect of EMF on any other major biologic rhythm or any other hormone. it is important to reiterate that these effects on the melatonin rhythms are not associated with changes in other major biologic rhythms such as sleep/wake cycles, body temperature, eating patterns, or the circadian release of other hormones. Also, it should be noted that the reported changes in dark cycle melatonin levels are limited to rats exposed to electric fields, not magnetic fields. In addition, when human subjects were studied, there was no reported decrease in pineal melatonin levels. Consequently, it cannot be said that the rat melatonin study provides a basis for concluding that power frequency electric or magnetic fields leads to adverse effects on human biologic rhythms.

Bockman Rebuttal at 18. This is clearly far different than saying that "it is not possible at this time to draw conclusions."

These errors are compounded by the fact that Dr. Gelmann, who is a medical oncologist and an expert in a molecular genetics and cell biology, testified as to state of development of the EMF research on molecular genetics and cellular biology:

"There is a substantial body of well-done research examining known processes and endpoints related to carcinogenesis, including mutations, chromosomal change, whole animal tumor formation, and tumor growth in intact animals. This research on processes that are known to be related to carcinogenesis has consistently shown that exposure to power frequency fields does not affect the process of carcinogenesis."

Gelmann Rebuttal at 21-22 (emphasis added.)

When the entire record on molecular and cellular research is reviewed the OCA's conclusions regarding "uncertainty" and "risk" in the molecular and cellular research are clearly not supported.

2. The OCA's Citations to the Melatonin Research Were Incomplete, Incorrect and Implied "Uncertainty" and "Risk" That are Not Supported by the Record

The OCA Brief also discusses the melatonin research. OCA Brief at 36-39. The discussion goes to the question of whether more research is needed on EMF and melatonin, with the OCA making the following claims:

"[T]he OCA submits that PECO witness Bockman's conclusion that further research is a low priority (Tr. 974-75) and PECO witness Gelmann's conclusion that there is no need for further research into these areas (Tr. 1174-75) is misplaced in light of the evidence."

OCA Brief at 37. Its discussion of the melatonin science is replete with error that must be corrected.

The research on EMF and melatonin involves two separate scientific disciplines: endocrinology and oncology. As Dr. Gelmann explained:

"The effects on the pineal gland in animals is an endocrinologic question. The issue of whether the primary pineal hormone, which is melatonin, which has something to do with cancer in humans is an oncologic question, and the answer is that it has nothing to do with with cancer in humans."

T.S. at 1181.

The OCA's Brief discusses research on the "endocrinologic question" of whether exposure to EMF has been shown to effect levels of pineal melatonin in humans, including Wilson's rat research and Wilson's human electric blanket study. OCA Brief at 37.¹⁰

The discussion of the Wilson rat research is incomplete. The brief cites Mr. Janes' discussion of the melatonin research in his rebuttal testimony, OCA Brief at 36, and quotes his subsequent statement that: "[E]xposure to extremely low frequency electric and magnetic fields affects melatonin levels." OCA Brief at 38, *quoting* Janes Surrebuttal at 2. It does not, however, include the transcript citations for Mr. Janes' admission under cross-examination that it has not been proven that magnetic fields alter melatonin levels in either animals or humans. T.S. at 1436-37. Given the OCA's burden of proof in this proceeding, Mr. Janes' admission is an important part of the record.

The discussion of the Wilson human electric blanket research is inaccurate. The OCA's Brief states that:

"In addition, as noted by both Mr. Janes and Dr. Bockman, there have been some studies on humans using electric blankets that also reported effects on the levels of melatonin in humans after exposure to EMFs. Tr. 989-991."

OCA Brief at 39 (emphasis added).

First, it is not "some studies on humans" -- it is one study, by Wilson. *See* T.S. at 989-991, Janes Surrebuttal Statement at 2. Second, at the cited portion of the transcript, Dr. Bockman stated with regard to that study that: "[I]f I am correct in understanding the [data in] table 2, there seems to be little or no change, really." T.S. at 991. There is a significant difference between "some studies that report an effect"

¹⁰ The OCA's Brief also discusses the Kavaliers study, OCA Brief at 37, which used a static magnetic field, not a 60 Hz field like those that will be associated with the line. *See* OCA Brief at 37.

and "one study that reports little or no change." ¹¹

The OCA's Brief also discusses the "oncologic question" of whether melatonin has something to do with cancer in humans. The entire discussion involves two studies on breast cancer, by Tamarkin, and by Demers. OCA Brief at 36-39.

The OCA's Brief begins its discussion of the oncologic question by stating that the melatonin research "is important due to studies which have suggested that melatonin appears to affect the incidence of chemically induced mammary tumors in rats [No citation in brief]." OCA Brief at 36 (emphasis added.) (referring to a single study by Tamarkin in 1981. See Janes Surrebuttal at 2.)

The OCA Brief then states that: "Neither Dr. Bockman nor Dr. Gelmann reviewed or discussed the Tamarkin study in the preparation of their testimony in this proceeding. Tr 1156-57 and 996." The implication in OCA's statement, of course, is that Dr. Gelmann's and Dr. Bockman's opinions on breast cancer issues are entitled to less weight if they had not read the Tamarkin study. It would not be surprising if Dr. Bockman, who is an endocrinologist, had not reviewed the Tamarkin cancer study (though his actual response was "Not off the top of my head I don't recall that study."), but that fact is not of any importance, since he extensively reviewed the endocrine studies on this issue. See Bockman Rebuttal at 6. The claim in the OCA Brief that Dr. Gelmann had not reviewed the Tamarkin paper, however, is inaccurate. The cited pages of the transcript show that Dr. Gelmann responded as follows:

¹¹ The OCA's Brief also makes several references to the physiological role of melatonin, claiming that it "regulates sexual function and development," OCA Brief at 36-37, and that "its role in human physiology may not be understood." OCA Brief at 37-38. (In both cases, referring to Mr. Janes' testimony.) Mr. Janes admitted that he is not an expert in endocrinology, and specifically not an expert in sexual function. T.S. at 371, 415, 416-17, 1439. Dr. Bockman, who is an expert in endocrinology and reproductive functions, testified that the pineal gland, which produces melatonin, has "no known function in human beings; one theory holds that it is a vestigial gland that no longer serves a biologically significant function in humans." Bockman Rebuttal at 17. Given Mr. Janes' admission that systematic investigations of the pineal gland have been ongoing since the 1880's, T.S. at 1442, the claim that "its role may not be understood" is an overstatement at best. A more accurate characterization would be that, after more than a century's research, the pineal gland has no known function in humans.

"Yes . . . I have read that paper. There were some effects shown. To discuss specifics I would need you to give me a copy. I have not read it, reviewed it, recently. But there were some effects after penelectomy and also as a result of administering the melatonin to the rats as a I recall."

T.S. at 1156.

Moreover, in addition to his other qualifications, Dr. Gelmann's *curriculum vitae* (Exhibit EPG-1) lists more than 20 publications on the carcinogenesis of breast cancer.¹² The OCA's implication that Dr. Gelmann's opinion on human breast cancer questions is not entitled to weight is simply unwarranted.

The OCA's Brief also claims that the melatonin research is "becoming more important in light of recently published epidemiologic studies." OCA Brief at 39 (emphasis added) (referring to a single study by Demers. See Janes Surrebuttal at 2.) The OCA's Brief then quotes Mr. Janes' conclusion that the melatonin research is becoming more important in light of the Demers study which "report[s] an

¹² See e.g. Secretion of heparin binding growth factors by breast cancer cells and their role in promoting cancer cell growth, *Cancer Chemotherapy, Challenges for the Future* (1990) (c.v. reference # 121); Role of oncogenes in human breast cancer, in *The Breast* (1991) (#118); Absence of cell adhesion molecule uvomorulin expression in human breast cancer cell lines. *Cell Growth Differen*, in press, 1991 (c.v. # 117); The role of the ras H oncogene in the tumorigenesis of MCF-7 human breast cancer cells. *Cancer Res.* (1990) (# 113); Heterogeneous expression of erbB-2 mRNA in human breast cancer. *Cancer Res* (1989) (#111); Vimentin expression in some hormone-independent breast cancer cell lines . . . *Cancer Res* (1989) (#109); Alterations in phosphoinositide metabolism associated with 17-g estradiol and growth factor treatment of MCF-7 breast cancer cells. *Molec. Endoc.* (1988) (#102); Effects of steroid hormones and peptide growth factors on protooncogene c-fos expression in human breast cancer cells *J Steroid Biochem* (1988) (#100); LHRH antagonists and human breast cancer cells. *Nature* (1987) (#99); Oncogenes and Breast Cancer. . . *Trends in Pharmacological Sciences* (1987) (#98); Epidermal growth factor receptor gene expression in estrogen-receptor positive and negative human breast cancer cell lines. *Molec. Endocrin* (1987) (#96); Activation of growth factor secretion in tumorigenic states of breast cancer induced by 17g-estradiol or v-H-ras oncogene. *Proc. Nat. Acad. Sci* (1987) (#95); Autocrine and paracrine growth regulation of human breast cancer *J Steroid Biochem* (1986) (#93); The role of the ras oncogene in human mammary cancer. *Steroid Receptors in Health and Disease* (1988) (#92); Mechanisms of estrogenic and antiestrogenic regulation of growth and polypeptide factor secretion in human breast carcinoma *Proceedings of the Symposium on Hormonal Manipulation of Cancer* (1986) (#91); Growth regulation of human breast carcinoma occurs through regulated growth factor secretion *J Cellular Biochem* (1987) (#90); Mechanisms of growth regulation of human breast cancer. *Advances in Gene Technology Molecular Biology of the Endocrine System* (1986) (#88); Autocrine and paracrine regulation of human breast cancer *Breast Cancer Res. Treat.* (1986) (#87); Transcriptional control of kinase gene expression by estrogen and antiestrogens in MCF-7 human breast cancer cells. *J. Biol. Chem.* (1986) (#83); Harvey murine sarcoma virus DNA transfected into MCF-7 human breast cancer cells bypasses their dependence on estrogen for tumorigenicity. *Science* (1985) (#69)

association between occupational exposure to electromagnetic fields and breast cancer in men." OCA Brief at 39. (emphasis added.)

Mr. Janes is not an expert in epidemiology. T.S. at 1445. Under cross-examination, he admitted that the Demers study did not report an association between EMF exposure and cancer, T.S. at 1445 -- in fact, its authors stated that the design of the study "preclude[s] any formal evaluation of breast cancer risk in relation to either intensity of [EMF] exposure or duration of [EMF] exposure. T.S. at 1445-46.

In addition, Dr. Cole, who is an expert in epidemiology whose research interest for over 20 years has been the epidemiology of the cancer of the breast, T.S. at 1465, discussed the Demers study at length and concluded that it does not demonstrate an association between EMF exposure and breast cancer. *See e.g.* T.S. at 1463-1473. Moreover, Dr. Cole testified that research into breast cancer causation has focused "almost entirely on the endocrine causes of this disease" for over 65 years. T.S. at 1468. When asked whether that research supports a role for melatonin in causing breast cancer, he replied: "None at all. The vast majority of research suggests that some other hormones and endocrine substances may be related to breast cancer but I know of none that supports the idea that melatonin is." T.S. at 1473.

The OCA's Brief suggests that Mr. Janes' opinion of the state of the research is entitled to more weight than the opinions of Drs. Gelmann, Bockman, and Cole:

"The study by Tamarkin, in addition to other studies that report a suppression of melatonin levels, raise obvious scientific questions that have not been resolved. [No supporting citation in brief.] Dr. Bockman sees no reason to do further research to seek answers to these questions. Tr. 1003. OCA witness Janes, however, who has considerable experience in addressing issues concerning risks to public health, reached a different conclusion." (Text of OCA Brief then stating Mr. Janes' conclusion.)

OCA Brief at 38. 13

Mr. Janes is a physicist, and he admitted that he is not an expert in endocrinology, epidemiology, or oncology, T.S. at 371,1445, the three disciplines involved in the melatonin/breast cancer question. Dr. Bockman is a medical doctor board-certified in endocrinology who is Head of the Endocrine Service at Cornell Hospital for Special Surgery, with an adjunct appointment at the Memorial Sloan-Kettering Cancer Center. Bockman Rebuttal at 1-2. Dr. Cole is a medical doctor and epidemiologist, specializing in breast cancer epidemiology, who has provided advice on cancer epidemiology matters to the National Cancer Institute, the United States House of Representatives, and the States of Maine and Vermont. Cole Rebuttal at 4. Dr. Gelmann is a medical doctor and molecular geneticist who is a liason from the American Society of Clinical Oncology to the National Cancer Advisory Board, which oversees cancer research in the United States. Gelmann Rebuttal at 5.

In sum, the record evidence demonstrates a far different picture regarding the state of melatonin research than suggested by the OCA's Brief. And in any event, the record evidence clearly does not show an adverse effect sufficient to warrant disapproval of the line -- which is the sole issue in this proceeding.

3. The OCA's Citations to the Epidemiologic Research Were Incomplete, Incorrect and Implied "Uncertainty" and "Risk" that are Not Supported by the Record

The OCA's Brief also discusses the epidemiologic research on EMF. OCA Brief at 25-35. Again, the discussion goes primarily to the question of the state of development of the epidemiologic research, with the OCA stating that: "The study of EMFs and harmful health effects is in the early stages of development." *Id.* at 27.

13 It should be noted that the transcript citation used in the OCA Brief at page 38, line 16 (T.S. at 1003) to support its conclusions regarding Dr. Bockman's opinion on the melatonin research actually involves a discussion of the calcium efflux studies, which are wholly unrelated to the melatonin research. Dr. Bockman's opinion regarding the state of the melatonin research, which is discussed in text, can be found at T.S. at 974-75.

Again, OCA's discussion of the science contains numerous errors that must be corrected.

The OCA's Brief discusses a study by Tomenius. OCA Brief at 28-29. It correctly notes Dr. Cole's conclusion that the Tomenius data showed an inverse trend between childhood cancer and measured magnetic fields. *Id.* The OCA's Brief, however, then continues to state:

"However, as Dr. Rosenbaum cautions, Tomenius did note an increase in the incidence of brain tumors and benign childhood tumors among those associated with higher field readings and those nearer power lines. OCA St. 2 2 at 4."

"In addition, as Dr. Rosenbaum explained on cross-examination, the finding of an inverse relationship is of limited value due to the confidence level associated with the results. Tr. 334. As Dr. Rosenbaum testified, the significance or the confidence interval is critical in determining what import to give these results. Tr. 335."

OCA Brief at 29 (emphasis in original.)

The Tomenius study was limited to issues of childhood cancer. Cole Rebuttal at 15. It looked at childhood leukemia, brain cancers, and other cancers. *Id.*, Rosenbaum Rebuttal Statement at 4. It found no association between leukemia and measured fields, and no association between leukemia and distance from electrical installations. Cole Rebuttal at 15. For the other cancers studied, Tomenius did, as Dr. Rosenbaum stated, show an increase in cancer in the study population -- but it was an increase with an inverse trend: "increased exposure resulted in lower cancer risk." *Id.* And Dr. Cole concluded that:

"Due in part to the inverse trend apparent in the Tomenius data, I concluded that the Tomenius study provides no support for the hypothesis that EMF's are related to an increased risk of childhood cancer. In fact, it provides some evidence against that hypothesis."

Cole Rebuttal at 15.

Moreover, Dr. Rosenbaum did not testify that "the finding of an inverse relationship is of limited value due to the confidence interval associated with the results." He testified that, never having actually seen a copy of the Tomenius study,

T.S. at 338, he had no idea what the confidence intervals were and therefore could not attach weight to the study results. T.S. at 334-36.

The OCA's Brief also reiterated Dr. Rosenbaum's arguments regarding the childhood cancer studies by Wertheimer & Leeper, Savitz, and Peters. OCA Brief at 32-34.

First, the OCA's Brief reiterates Dr. Rosenbaum's argument that the "most important thing" about the Wertheimer & Leeper, Savitz, and Peters childhood cancer studies is that all three reported a "positive association between wiring code and childhood cancer." OCA Brief at 32-33.

When questioned about this statement during cross-examination, Dr. Rosenbaum testified that the question of what is the most "obvious" or "important" thing about these studies is a matter of professional judgment. T.S. at 1410-11. Dr. Rosenbaum is not an epidemiologist. Rosenbaum Rebuttal Statement at 2. Dr. Cole, on the other hand, is a medical doctor and epidemiologist with over 20 years experience conducting and analyzing epidemiologic studies. Cole Rebuttal at 1-5. Dr. Cole was asked whether he agreed that "the most obvious thing" to say about these studies is that they reported an association with wiring code. He responded that:

"I think that is one thing that can be said. But I think it much more important to look into the data, to look into each of the individual studies and ask somewhat more detailed questions about what they actually say regarding this association between wiring code and leukemia and more especially about magnetic field and leukemia."

"What Savitz says, to my mind, with regard to the wire code and leukemia is despite making innumerable comparisons I cannot find any consistent, that is, regular, monotonic statistically significant relationship between wire code and leukemia. And what he says with regard to magnetic field is despite the serious limitations of [the] magnetic field data . . . I can find no relationship between magnetic field measurements and leukemia."

"What Peters says is that despite [a] very refined study, much larger, much more focused . . . I find after reducing all of this data down once again a non-monotonic or inconsistent, that is, irregular relationship between wire code and disease risk, and it is weaker than that of Savitz; and I find now despite

reasonably sophisticated magnetic field measurements . . . no relationship whatever between the magnetic field measurement and disease risk."

"So what this tells me is that at least at the present time there is no evidence that magnetic fields, setting aside the question of wire code, there is no evidence that magnetic fields are associated with childhood leukemia."

T.S. at 1486-88 (emphasis added.)

In his written testimony, Dr. Cole noted that the reported odds ratios in the childhood cancer studies have become weaker as the design and conduct of the studies has improved, and stated that: "In epidemiology, we expect that if a reported statistical association in one study is truly descriptive of an association that is occurring in the real world, that association will become stronger, not weaker, as design and conduct of subsequent studies improves." Cole Rebuttal at 17. In his written surrebuttal testimony, Dr. Rosenbaum argued that this is "not necessarily true." Rosenbaum Surrebuttal Statement at 2. In its brief, the OCA addressed this testimony, arguing that:

"Dr. Cole also seems to imply that the better-done studies should get stronger results, not weaker results, if there is an effect. However, this is not necessarily true. If, for example, the more carefully done study eliminates technical problems, such as bias, the more carefully done study might give weaker results even if there is a real effect."

OCA Brief at 33 (Citations omitted.)

Dr. Cole addressed this argument at length in his live testimony on the final day of hearings. T.S. at 1478-80. Most importantly, he concluded that while it may not be "necessarily so" that a downward trend in associations as studies means the association will disappear in future studies:

"[I]n my experience it has always been so . . . I don't know of any instance where we have seen an association get weaker with the passage of time in epidemiologic data and yet eventually come to be accepted as valid."

T.S. at 1479.

Finally, the OCA's Brief asserts that the EMF epidemiologic research "is in the

early stages of development," OCA Brief at 27, claiming that Dr. Cole "readily admitted there are only about 50 epidemiologic studies," *id.* at 32 (emphasis added), and the "Dr. Cole admits that he is only 70% of the way to being convinced that EMFs do not increase the risk of cancer." *Id.* at 34.

Dr. Cole did not testify that there are "only" 50 studies. He testified that there are 50 studies, establishing a long-term time trend of weaker results as study design improves. T.S. at 1088-89. And Dr. Cole did not "admit that he is only 70% of the way to being convinced." He testified that, on the causal spectrum of positive 100 (proven to be a carcinogen) to negative 100 (proven not to be a carcinogen), "my position is minus 70. I believe that it is much more likely to be true that EMF will be demonstrated not to cause cancer in human beings." T.S. at 1101 (emphasis added.)

In sum, the only qualified epidemiologist who testified in these proceedings stated that there is a long-term time trend in the epidemiologic research, T.S. at 1088-89, and that sufficient research has been completed to take him to negative 70 on the causal spectrum. T.S. at 1101. This is very different than the "growing basis for concern" asserted by the OCA. OCA Brief at 19.

B. The OCA Did Not Meet Its Burden of Proving Adverse Land Use Effects

The OCA's Brief makes no claim that adverse land use effects of the line have been proven. Instead, the OCA's Brief states only that there is an "uncertain risk of declining property values." OCA Brief at 12.

In its discussion of property values, however, the OCA's Brief discussed the testimony of Mr. Van Dyke. It correctly notes that public opinion is one of many factors, such as quality of schools, proximity to open space or commercial facilities, that are relevant to establishing market value. OCA Brief at 48-49. It then states that:

"However, as the public becomes more knowledgeable of the potential health effects of EMFs, this may no longer be true. Tr. 1288. As such, the Commission's traditional view of the effects of transmission lines on

neighboring properties must also evolve. "

OCA Brief at 48.

The transcript citation used as support by the OCA does not state the traditional state of affairs "may no longer be true." In that passage, Mr. Van Dyke clearly testifies that it is the current state of affairs. This misstatement is especially egregious in light of Mr. Van Dyke's clear testimony at numerous places in the record that, in his opinion, the fact that some prospective purchasers consider EMF in their purchase decisions will not affect the overall market values near the line. See e.g. Van Dyke Rebuttal at 15.

The OCA Brief relies upon the testimony of individual Protestants to prove that market values will decrease, OCA Brief at 49, despite the assurances of Protestants' counsel that their testimony did not go that issue and would not be used to prove that issue. T.S. at 190-91.

The OCA Brief also criticizes Mr. Van Dyke's conclusions regarding property values, claiming that:

"[A]s PECO witness Van Dyke admitted, he had only reviewed the testimony of PAUSE witness Turner when he reached his conclusion that the market effects of EMFs would already be included in the market price of homes along the corridor. Tr. 1276. Mr Van Dyke did not consider the testimony of Protestants in this proceeding nor did he review any additional information such as newspaper accounts of other proposed transmission lines in Pennsylvania. Tr. 1277."

OCA Brief at 49.

Again, OCA mischaracterizes the transcript. At the cited quotation, Mr. Van Dyke was not asked to state the basis for his opinion that market effects would already be included in the market price of homes along the corridor. Rather, having testified that "I am aware that there is a public fear of EMFs and did take that consideration into account," T.S. at 1276, Mr. Van Dyke was asked by the OCA's counsel whether, in forming his opinion that there is a public fear, he had reviewed Mr. Turner's testimony (yes), the individual Protestants' testimony (no), or recent newspaper accounts (no). T.S. at 1276-77. He did not state that these were the "only"

bases for his opinion on public fear, nor did he state that his public fear analysis was the "only" basis for his conclusions regarding market value.

And, as his testimony clearly demonstrates, he considered far more than that, including detailed analysis of land use, zoning, and property values both near the line and near all utility functions in the region. Van Dyke Rebuttal at 12-15.

Finally, the OCA's Brief argues that:

"Moreover, Mr. Van Dyke's analysis is logically flawed in that the corridor, up until the time of the construction of the line, was used primarily as a railroad corridor. Thus, the effects that would be recognized in the market value would only have been those resulting from the fact that the properties are near a railroad corridor, not that they are near a transmission line."

OCA Brief at 50 (emphasis added.)

The OCA's Brief contains no record citation for this key factual allegation, and none exists in the record. The expert testimony on this issue demonstrates that quite clearly there is no "logical flaw" in Mr. Van Dyke's analysis. He considered the question of whether the addition of an energized transmission line to the existing rail use would have an effect market values and concluded that it would not have any such effect:

Current uses of the utility corridor include an active high speed freight railway. Recent uses of the utility corridor included an electrified railway. It would be expected that the market for residential property in the CSA would already have compensated for these current and recent utility corridor uses. In addition, it is my understanding that this utility corridor has had transmission poles and conductors since the 1930's. The market would also be expected to have compensated for these factors.

From a land use planning perspective, it would not be expected that re-energization of electric facilities after a short hiatus, as is contemplated here, would cause further market compensation. This is especially true when the current utility use is highly intrusive, as is the case with the existing high speed freight railway. I thus would not expect any effect on market values from energization of the Woodbourne-Heaton line.

Van Dyke Rebuttal at 14.

The OCA had the opportunity to present expert testimony on this issue, and

chose not to do so. It cannot now attempt to prove -- through what is essentially testimony in its brief -- that the line will have an effect on market values. The expert testimony is clear that such an effect will not occur.

III. The Relief Requested by the Protestants and the OCA is Not Warranted

A. Additional Hearings are Not Warranted

The primary relief requested in Protestants' Brief is "further hearings in order to balance the need against the adverse effects." Protestants' Brief at 2. *See also* Protestants' Brief at 10, 13. The OCA also requests that the Commission order further hearings to "weigh [the uncertain risk] against need, reliability, economic benefits, and other engineering and safety issues." OCA Brief at 19.

No adverse effects were proven in this proceeding. There is nothing to "balance" or "weigh." It is especially difficult to understand exactly what the OCA would have the Commission "weigh," since it has already admitted that the scientific evidence does not establish that EMF is a health risk. OCA Brief at 42.

The OCA's Brief elsewhere describes the purpose of such a proposed hearing in a slightly different manner:

"[T]he Commission must now provide a full opportunity for hearing on all issues related to the siting of this transmission line, including need for the line, safety of the line, and possible alternative routes for the line. It is only after such a full hearing that the Commission can make the findings required by 52 Pa. Code §57.76 which are necessary to support an Order approving a transmission line siting application."

OCA Brief at 11 (emphasis added).

This request is both unwarranted and wasteful. This is a reopened proceeding. The Commission already has evaluated the need for this line and made a finding, pursuant to 52 Pa. Code § 57.76, that the line is needed. *See* May 2 Order at 5. It has now held an additional 12 days of hearings allowing Protestants and the OCA the opportunity to prove that energizing the line will cause adverse effects that

would warrant disapproval of the line under the "health and safety" and "environment" requirements of 52 Pa. Code § 57.76. They failed to do so. The Commission has before it a full record sufficient to allow a determination of all findings required by 52 Pa. Code § 57.76.

Finally, Protestants claim that such hearings are Constitutionally required:

"These considerations are enhanced by Article 1, Section 27 of the Pennsylvania Constitution. That provision entitles people, as a matter of Constitutional right, to clear air, and the benefits of the natural environment. EMF is an intrusion on that. Within the framework for implementation of Article 1 Section 27, compliance with regulations is one of the critical tests. Through failure to give petitioners notice of these proceedings, there was a clear lack of compliance with the regulations, as interpreted by the Commonwealth Court in Small v. PUC. Therefore, one of the basic tests of Article 1 Section 27 having been failed, hearing at this time is constitutionally required."

Protestants' Brief at 10-11.

Protestants' Brief misses the point. They already were granted full hearings on environmental issues, and those hearings were just completed. During those hearings, Protestants' failed to prove any adverse effects. There is no need to hold hearings to "balance the need against the adverse effects," because no adverse effects were shown. ¹⁴

¹⁴ It is worth noting that Protestants have informed the Commission of at least one form of relief that they would request if they were granted such additional hearings. The Protestants' Brief contains this request for relief as its final sentence:

"[The Commission] must condition such an approval on an effort to minimize safety impacts, which would include purchasing all of the adjoining properties along the line in order to enable individuals to avoid adverse effects on their health."

Protestants' Brief at 13 (emphasis added.)

In other words, if Protestants are granted another hearing, they will request the Commission to find that PECO has inversely condemned Protestants' properties and to order PECO to pay fair market value for those properties. In short, they will request the Commission to conduct a condemnation hearing. There is no reason to hold additional hearings when it is known at this time that, if granted those hearings, Protestants will simply ask the Commission to convert them into a condemnation hearing.

B. The OCA's Requested Relief Based on the Concept of Prudent Avoidance Is Outside the Scope of This Proceeding

The OCA's Brief discusses the concept of prudent avoidance at some length, but the only request it makes in regard to prudent avoidance and this line is that: "PECO's approach to the siting of this transmission line was inappropriate and can no longer be the practice of utilities in Pennsylvania The OCA submits that such an approach is inappropriate and must be discouraged by this Commission." OCA Brief at 48. *See also* OCA Brief at 44 ("the public utilities must implement a prudent policy and the Commission should provide guidance in this area.")

It is noteworthy that the OCA does not even suggest that the justification for such Commission action would be a finding of adverse effect in this proceeding. Rather, it is clear that the OCA is merely using its brief in this proceeding as a vehicle to request the Commission to "provide guidance" to utilities on prudent avoidance. PECO takes no position at this time on whether the Commission should provide such guidance, or the form such guidance should take if the Commission determines to take such action. This proceeding, however, is not the appropriate forum for such decisions.

Given the OCA's request that the Commission "discourage" certain actions, however, PECO must address certain aspects of the OCA's discussion of prudent avoidance.

Most importantly, it must be kept firmly in mind that the design, routing, and field levels from this line all are consistent with the concept of prudent avoidance. *See* PECO Brief at 44-50. This was wholly uncontested. In fact, Dr. Rosenbaum and Mr. Turner both admitted that this was the case. T.S. at 315-16, 640.¹⁵

¹⁵ Protestants' Brief also claims that design and location were not properly considered by PECO:

"To the extent that PECO did offer any proof in this regard [the safety of the line], it only offered proof that there was a relative decrease in risks due to the Delta configuration of the

The OCA's argument is with the method that was used to achieve that result, not with the result itself. The OCA's Brief states that:

"Dr. Rosenbaum aptly described the approach used by PECO as follows:

"It is like driving on a long trip with a bad brakes and no seat belts and calling it prudent because you arrived safely."

OCA Brief at 46, 48.

Dr. Rosenbaum's analogy is actually not apt at all. PECO had "good brakes." The engineers who designed the line were aware of EMF when they chose the design and location of the line, T.S. at 11, 31-32, they did choose the route and design in their professional judgment at that time would result in the lowest field levels, T.S. at 11,18 and subsequent calculations confirmed that professional judgment to be correct. T.S. at 20. PECO suggests that Mr. Rosenbaum's automobile analogy would be more appropriately phrased as follows:

"It is like a professional automobile mechanic, well aware of the condition and equipment on his car, driving on a long trip and calling it prudent because he arrived safely and a subsequent check of his auto confirmed that it was in proper working order."

It also must be remembered that prudent avoidance evaluations, or indeed consistency with the concept of prudent avoidance, are not presently required by the

lines. However, it did not address this in a straightforward way, since the considerations were imposed only after the line was originally designed."

"In any event, in addition, there was no consideration of location as effected by safety considerations, and it was admitted that no such consideration was given. The Office of the Prosecutory Staff has, in another proceeding (Duquesne Light), argued that the doctrine of prudent avoidance entails siting as well as design."

Protestants' Brief at 2.

It is simply untrue to characterize the evidence as showing a "relative decrease in risks due to Delta configuration." Protestants' did not prove that there will be any risk from the line, and statements regarding "relative risk" are therefore meaningless. The record evidence also clearly demonstrated that alternative designs and alternative routes were considered by PECO before it decided to use the compact delta configuration on the Conrail right-of-way. T.S. at 11, 19-20,31.

Commission's regulations. The evaluation that was conducted by PECO was above and beyond what is required of it. It is clear from the OCA's Brief that its primary desire is to have the Commission consider implementing a wide range of public involvement programs as a formal element of the transmission line siting procedures. See OCA Brief at 44-45. But such regulations do not exist at the present time, nor is PECO aware of any previous request by OCA to implement such regulations. PECO respectfully submits that its actions should be judged according to the existing regulations. And given the fact that PECO's Letter of Notification was filed with the Commission in late November 1989 -- a mere six months after publication of the Office of Technology Assessment Report that first described the concept avoidance, Silva Rebuttal at 15 -- its actions should not be "discouraged," but rather viewed as a laudatory, and succesful, implementation of the concept.

The OCA Brief also claims that PECO attempted to "downplay" the significance of the fields from the line by providing data on fields that exist elsewhere, but that this "misses the point" that this line will provide "virtually constant exposure to EMFs to these residents." (Citing T.S. at 10 for this last statement). OCA Brief at 46-47.

It is the OCA that misses the point. As Mr. Silva explained: "[W]e do not know whether brief exposures or longer term exposures are important, if in fact either type of exposure is important." Silva Rebuttal at 15. That is one of the reasons why prudent avoidance suggests only modest efforts at changing exposure. Mr. Silva's data on magnetic fields were presented to "provide a context for understanding total magnetic field exposure and the relative contribution and variety of sources encountered in everyday activities," Silva Rebuttal at 15, and they showed that the fields from this line are in the same range as those typically encountered in everyday line. Silva Rebuttal at 19. ¹⁶

The OCA Brief also argues that the residents (Protestants) had "no

¹⁶ Moreover, the transcript citation referred to by the OCA (T.S. at 10) does not state that this line will result in constant exposure -- it does not even address that question.

opportunity to determine prior to the construction of the line whether the Company had employed all reasonable design alternatives," and that "[t]hese residents are being placed in the difficult position of being asked to believe that the utility happened to be right." OCA Brief at 47. Protestants, however, have now had a full hearing to explore those issues. The OCA's argument does not warrant further relief.

Finally, the OCA's Brief also states that:

"[T]he OCA submits that it is counter-intuitive to apply the concept of prudent avoidance after a line is constructed and no further design changes can be made. The OCA submits that it is not good public policy to determine after a line is built that it happened to be consistent with the concept of prudent avoidance."

OCA Brief at 46.

The OCA's submission misses the point of prudent avoidance. Prudent avoidance is "one possible framework for analyzing exposure to electric and magnetic fields, and for considering actions that might alter exposure." Silva Rebuttal at 15. (emphasis added.) The public policy questions of whether such changes in exposure are warranted and whether prudent avoidance should be the approach used for such changes are simply not answered by the existence of the concept. Mr. Silva explained that various approaches to prudent avoidance are possible:

"The concept of prudent avoidance is a general framework that has not been codified. It suggests modest efforts to reduce field exposure, and should be understood to be oriented toward that result, rather than toward any required method of achieving that result. The question of what is "modest" will vary depending upon the specific project. Where, as here, the design and routing of the transmission line result in lower fields at modest cost consistent with prudent avoidance, the concept of prudent avoidance does not require that any specific decisional or temporal process must be followed in achieving that result. "

Silva Rebuttal at 18. (emphasis added.)

Moreover, it should be remembered that the Woodbourne-Heaton line,

when evaluated under the regulations of the few states that have passed regulations implementing a statewide understanding of prudent avoidance (e.g., New York and Florida), meets those regulations. Silva Rebuttal at 18. The approach that the OCA describes as "bad public policy" thus would be good public policy in New York or Florida. PECO respectfully submits that, since the question of "what is good public policy" was not before the Commission in this proceeding, it should make no decisions on this record regarding what does or does not constitute "good public policy." It should simply decide the issue before it -- whether Protestants and the OCA have met their burden of proving an adverse effect -- and to the extent that that it finds it necessary to reach any determination regarding prudent avoidance in this proceeding, it limit that determination to the agreed upon conclusion of all witnesses, including Dr. Rosenbaum, that this line is consistent with prudent avoidance.

C. A Rulemaking on Notice, Determination of "Substantial Alteration" in the Right-of-Way, and Invalidation of the Commission's Approval of the Line Are Beyond the Scope of this Proceeding

The OCA also requested that the Commission institute a rulemaking on its notice procedures, OCA Brief at 57, find that the Woodbourne-Heaton line created a "substantial alteration" in the right-of-way under the Commission's existing notice regulations, *id.* at 53, and, finally, that it should invalidate its approval of the line and order full hearings regardless of any findings made on the record in this proceeding. *Id.* at 17. None of these requested forms of relief are within the scope of this proceeding; none are even presented as related to a finding of adverse effect.

The OCA Brief's request for a rulemaking on the Commission's notice regulations was stated as follows:

"[T]he OCA submits that the Commission should consider amending its regulations to provide adequate notice to all neighboring landowners in transmission line siting proceedings. The OCA urges the Commission to propose amendments to the regulations, publish them in the Pennsylvania Bulletin and receive public comment on these regulations. It is only in this

way that those affected by the construction, reconstruction, or reconductoring of transmission lines can be assured of adequate notice and an opportunity to be heard."

OCA Brief at 57 (emphasis added).

This request really speaks for itself. It is not a part of this proceeding, and the OCA explicitly recognizes that a separate proceeding would be necessary to grant this relief.

Moreover, the argument does not justify any relief in this proceeding. To the extent that the Commission regulations do not provide adequate notice, that problem has already been addressed as to Protestants. They have received their hearing. And they have failed to prove that they will be adversely affected by the line.

The OCA's argument that the right-of-way has been substantially altered is outside the scope of this proceeding and in fact is nothing more than a claim that the Commission's Letter regulations do not provide sufficient notice to neighboring landowners. That is the precisely the claim that Protestants made before Judge Palladino. They already received relief for that claim in the form of the instant hearings. The OCA is merely re-arguing that decision and claiming that the Court and Commission were wrong in limiting the scope of these hearings.

Finally, the OCA requests that the Commission should order additional hearings in this proceeding even if it finds that Protestants and the OCA failed to meet their burden of proof:

"Regardless of any other finding which is made by this Commission based upon the record created in this series of hearings, the Commission should reconsider and vacate the order approving the letter notification and speaking to the issue of the need for the line."

OCA Brief at 17.

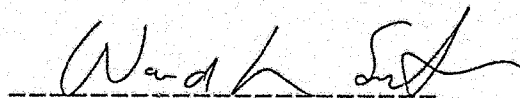
In this request the OCA is asking the Commission, quite explicitly, to ignore the record in this proceeding and start all over again. This request is quite revealing of the OCA's position in this proceeding. It wants more hearings regardless of what

the evidence shows. PECO submits that the Commission should reject that approach. Full hearings have now been held on the question of whether Protestants will be adversely sufficient to warrant disapproval of the line, and no such effects were shown to exist.

IV. Conclusion

Protestants have not met their burden of proving that the Woodbourne-Heaton line will cause adverse health or land use impacts. PECO requests that the Commission adopt the proposed Findings of Facts and Conclusions of Law included in PECO's Initial Brief, and adopt the proposed Order attached herein reconfirming its approval of PECO's Letter of Notification for the Woodbourne-Heaton line.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read "Paul Bonney", is written over a horizontal dashed line.

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May 12, 1992

PROPOSED ORDERING PARAGRAPHS

In consideration of the foregoing, IT IS ORDERED:

1. That the Commission Order of February 9, 1990, approving PECO's Letter of Notification for the 230 kV Woodbourne-Heaton line is hereby reapproved.
2. That the Emergency Petition of Non-Noticed Property Owners to Intervene for Reopening and to Suspend Approval is hereby denied.

1 PW

ORIGINAL

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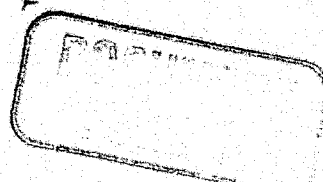
KEVIN M. STACK

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IN PENNSYLVANIA

May 12, 1992

John G. Alford, Secretary
PA Public Utility Commission
Room G-18, North Office Bldg.
Harrisburg, PA 17120



RLS

Re: Letter of Notification of Philadelphia Electric
Company Re: Proposed 230 KV Woodbourne to
Heaton Transmission Line,
Docket No. A-110550, F. 055

Dear Secretary Alford:

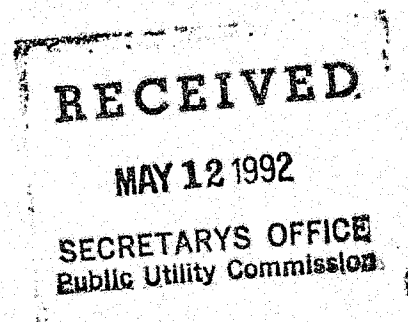
Enclosed please find for filing an original and nine (9)
copies of the Reply Brief of the Protestants in the above-captioned
proceeding.

Copies have been served upon all parties of record as
shown on the attached Certificate of Service.

Sincerely,

Robert J. Sugarman

RJS:er
Enclosure
cc: All parties of record
misc92.2\alfdrdtr.512



CERTIFICATE OF SERVICE

Re: Letter of notification
of Philadelphia Electric
Company Re: Proposed 230 KV
Woodbourne to Heaton
Transmission Line,
Docket No. A-110550, F. 055

I hereby certify that I have this day served a true copy of
the foregoing document, Protestants' Reply Brief, upon parties of
record in this proceeding in accordance with the requirements of 52
Pa. Code § 1.54 in the manner and upon the persons listed below:

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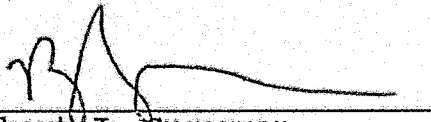
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DATED: May 12, 1992

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MAY 12 1992

SECRETARYS OFFICE
Public Utility Commission

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

IN RE: LETTER OF NOTIFICATION	:	DOCKET NO. A-110850-F055
OF PHILADELPHIA ELECTRIC	:	
COMPANY UNDER 52 PA	:	
CODE S 57.72(d) RE: PROPOSED	:	
230 KV WOODBOURNE	:	
TRANSMISSION LINE	:	

REPLY BRIEF OF THE PROTESTANTS

DOCKETED
MAY 19 1992

FILED

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DATED: MAY 12, 1992

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INTRODUCTION

In the Main Briefs of the parties opposing the Protestants, many arguments were made to rebut the extensive testimony as to adverse impacts of the Woodbourne-Heaton line. The Protestants herein respond to those arguments.

REPLY TO THE MAIN BRIEF ARGUMENTS

- I. PECO's position that the Woodbourne Heaton line meets NESC standards, "similarity-based" standards, and "everyday exposure considerations is misconceived and betrays a misappropriation of prudent avoidance.

PECO argues that the line meets all NESC standards. It also argues that the magnetic fields to be produced by the line are similar to those of existing lines; this idea is referred to herein as the "similarity-based" approach. Considerations of "everyday exposure" refer to comparisons of the fields to be produced by the line to fields one might encounter in the course of everyday activities.

- A. The NESC standards do not relate to EMF

PECO asserts that the Woodbourne-Heaton transmission line meets the National Electrical Safety Code ("NESC") standards for the safe construction, operation, and maintenance of a transmission line. Main Brief of PECO, p. 17. This point loses its weight when it is understood, as PECO witness Mr. Oedemann testified, that the NESC has no requirements relating to Electric and Magnetic Fields ("EMF") considerations. N.T. 35; see also N.T. 356. When EMF is properly viewed as a health risk and as causing adverse effects on land use, it becomes foolish to suggest that the safety criterion for a line are satisfied by adherence to standards that do not consider EMF. To say that the Protestants offered no evidence that

the line would be constructed, operated, or maintained in an unsafe manner is ignore virtually all of the testimony and arguments of both the Protestants and the Office of Consumer Advocate ("OCA").

B. "Similarity-based" and "everyday exposure" approaches fail to address the need to lower EMF levels or the practice of prudent avoidance.

1. Similarity-basing involves EMF levels from lines built years ago and is not a health based standard.

PECO argues in support of the prompt energization of the line that the magnetic fields to be produced are similar to those associated with already existing lines. Main Brief of PECO, p. 18. This novel argument seems to suggest that serious dangers should be ignored where they have been unknowingly incurred in the past. As such, the claim fails by its own weight. The proposed applications fare no better. The Law Bureau Prosecutory Staff also notes the value in comparing EMF levels of a proposed line to those of typical lines. Main Brief of the Prosecutory Staff, p. 40. The obvious fault in the similarity approach is that most existing lines were built before EMF was the major concern and issue that it has become. As PECO witness Mr. Silva testified, similarity-basing is a matter of voltage classification which does not make any judgment as to danger from existing lines; it is not a health based standard. He also acknowledged that some of the lines that are "similar" to the Woodbourne-Heaton line were designed and placed in service as long as fifty years ago. N.T. 1311, 1312.

Since PECO states in its "ABCs of EMFs" pamphlet (Protestants' Exhibit 1) that it "evaluates construction practices designed to reduce EMFs," but comes up with lines with levels similar to those of lines built even decades ago, one can only conclude that PECO is not seeking to "reduce" EMF. See Protestants' Exhibit 1, back page. If PECO is claiming that it hypothesizes with the highest possible levels that could be produced in mind and then brings them down in the design process to more typical levels, PECO's understanding of prudent avoidance is surely convoluted, and unworthy of the Commission's safety requirements.

2. "Everyday exposure" is not analagous to the exposure scenario to be created by the line.

In an argument related to the idea of similarity between lines, PECO advocated the testimony of Mr. Silva to the effect that the magnetic fields to be produced by the line are similar to those encountered in everyday life. Main Brief of PECO, p. 18. This argument fails because with respect to "everyday life" exposure, one may choose where one goes and how much time one spends there. The Protestants' practice of prudent avoidance is significant in this regard. See N.T. 138-139, 148, 162, 203-204, 234, 445-447, 471, 473, 476, 483-484, 489.

In addition, an individual may lead such a lifestyle as to be exposed only to low fields almost all of the time. In that case, everyday exposure would really be quite low. In any event, the fact of the matter is that the Woodbourne-Heaton line would expose people at a very close proximity to significant levels of EMF

whenever they are in their homes, yards, or neighborhoods. Short of leaving those homes, no one has suggested anything the Protestants can do to avoid or lower these fields. The Protestants themselves irrefutably discussed the difference between "everyday exposure" and what the line would expose them to, in their testimony regarding their practice of prudent avoidance within their homes. For representative statements of these points see N.T. 129, 141, 148, 278, 496. In addition, Protestant Robert Small testified

They're [PECO] going to put something that's going to blast my property 24 hours a day, 365 days a year. That is being put to me. There is no way I can exercise prudent avoidance on something that is being put to me in such a constant fixed fashion.
N.T. 278.

Such testimony was wholly un rebutted. To compare this situation which Mr. Small describes to normal "everyday exposure" to EMF is simply fatuous. Mr. Silva himself acknowledged that his analysis ignores the adverse effects of constancy.

Moreover, it is also important to note that with regard to the everyday exposure calculations made by Mr. Silva, there is no suggestion that prudent avoidance has been practiced in any form at the sites of his measurements. What is to be gained in the way of EMF avoidance if one continually compares proposed levels to already existing and unmitigated dangerous levels?

Of considerable note in this vein is that PECO has suggested publicly that consumers at least consider the prudent avoidance approach of lowering "exposure" to common sources of EMF. Protestants' Exhibit 1, back page. It is inconsistent with this

position for PECO to continue to base its understanding of acceptable EMF levels on such "exposure" rather than on the sorts of exposure that would result from prudent avoidance. If, as PECO witness Mr. Boeggeman has stated, EMF exposure is a societal issue, and society is moving towards lower EMF levels as a goal, then future levels should be accordingly considered with a view to society's unfolding present and future approach to EMF levels and not its past 'non-approach'.

II. The Law Bureau Prosecutory Staff's argument against consideration of a transmission line's impact on market values does not rebut the Protestants' position on the issue of land use.

A. The Prosecutory Staff seeks incorrectly to narrow the discussion to market value effects.

In the Prosecutory Staff's Main Brief, it argues that the Commission has no authority to consider the impact of transmission lines on market values; it claims that the Commission therefore should not "undertake an unnecessary evaluation which has no legal significance." Main Brief of the Prosecutory Staff, pp. 15, 22. This reasoning is in line with the Prosecutory Staff's consistent confusion of property values and adverse land use effects. Rather, what the Prosecutory Staff seeks to do is convert land use discussions, the decisions of Protestants to abandon homes owing to an inability to sell and a desire to escape EMF, and the effects on those who remain as well, into the terms of monetary loss so that the Commission need not address the legitimate and pressing land use effects.

The Protestants have consistently maintained that the

Commission must consider the adverse effects of the Woodbourne-Heaton line on land use in the areas adjacent to and in close proximity to the line and has rebuffed the Prosecutory Staff's attempt to blur and conflate the issues involved. See Main Brief of Protestants, pp. 11-13 for a synopsis of Protestants' position.

At no point in its Brief does the Prosecutory Staff deal with Mr. Turner's testimony for the Protestants, for example, as to effects on land use. Instead, it chooses to treat his testimony erroneously as testimony concerning market value of affected properties. When it appears that the Prosecutory Staff is at least addressing the Commission's regulations regarding effects on the environment and land use in the same breath as Mr. Turner's testimony, it again reduces "damages" to "decrease in market value" in a paranthetical gesture. Main Brief of the Prosecutory Staff, p. 33.

- B. The prosecutory Staff's argument actually supports the Protestants' view that the Commission must consider effects on land use.**

The Prosecutory Staff undertakes an extensive review of the legislative history of the Commission's siting regulations. It quotes the Commission in part as follows:

...in every siting proceeding the environmental impact of the proposed line will be an issue which the applicant must address affirmatively and completely in order to be granted a siting certificate. Main Brief of the Prosecutory Staff, p. 30.

A significant function of regulations such as these is to bring about, through the administrative process, a definition or valuation of features of

our environment which may be diminished by the development of overhead electric transmission systems. ID, p. 31.

The Prosecutory Staff fails to understand that these sorts of statements are indeed at issue and support the Protestants' claims that the Commission must consider adverse impacts on land use. "Environmental impact" and "a definition or valuation of features of our environment which may be diminished" are precisely the issues that Mr. Turner set out to address. In Turner's Direct Statement, he testified to "changes in land use patterns." He was speaking of "environmental impact" and undertaking "a definition or valuation of features of our environment which may be diminished by the development" of transmission lines. See Id, p. 6. What Mr. Turner's testimony, both written and oral, made clear, is that owing to the EMF issue, the concept of prudent avoidance, the fear and alarm of EMF, and the emerging picture of how local governments are responding to these factors, there are going to be significant effects on land use patterns in areas where transmission lines are built.

In light of this testimony, the Prosecutory Staff's assertion that "it stretches credibility to contend that the inclusion of the terms "land use" and "landscape" in the siting regulations allows the Commission to consider a purely private concerns [sic] like the market value of an individual property" misses widely the mark. Main Brief of the Prosecutory Staff, p. 33. It also flies in the face of the purpose of laying out the Commission's stance regarding the evaluation of impacts on land use. It is only the Prosecutory

Staff's stubborn insistence on treating land use impacts as a question of property values that prevents the Protestants from simply paraphrasing its argument to support their argument that adverse land use impacts must be considered.

III. The Protestants have established that the line will have adverse impacts on land use despite PECO's argument to the contrary.

PECO presented a witness, Carter Van Dyke, who tried to rebut Mr. Turner's testimony. The thrust of Mr. Van Dyke's testimony was to discuss the current development and zoning features of the area adjacent to the Woodbourne-Heaton line and in close proximity. He wanted to suggest that because the Conrail corridor and its impact were long ago factored into the development, zoning regulations, and market values of the area, the land use patterns in the area and its property values should not be expected to change owing to the construction and energization of a powerline. Van Dyke Rebuttal, pp. 8-10, 13-14.

Mr. Van Dyke's testimony misses the mark. First, as the OCA noted in its Main Brief, the Conrail corridor, prior to construction of the Woodbourne-Heaton line, was used primarily as a railroad corridor. The effects on market value and--the Protestants would add--land use, would have formerly resulted from being near a railroad corridor. Main Brief of OCA, pp. 49-50.

Moreover, and more importantly, the old valuation and zoning are from a time when EMF and the fear and alarm it causes were not a consideration either on the part of planners, local government,

or citizens or businesses choosing to locate where they did. It is for these reasons that it is necessary, as Mr. Turner did, to discuss the effects that the EMF issue is having on the planning profession, zoning approaches, and individual decisions as to where people feel they may safely live.

Mr. Van Dyke did not interview the Protestants PAUSE in preparing his testimony, nor was he familiar with PECO literature which recommends consideration of prudent avoidance and addresses the issue of fear of EMF. N.T. 1284. Mr. Van Dyke's testimony was based largely on a detailed analysis of the past in the same sense that "similarity-based" approaches are backward looking. Again, when Mr. Van Dyke extrapolated from the existing and past zoning and land use of the Woodbourne-Heaton corridor vicinity, he did so without considering the new and important factor of fear of EMF and land use and zoning reactions to that fear.

Mr. Turner, on the other hand, did address the changing framework of land-use planning, zoning, nuisance regulations, etc... with a careful eye to the EMF issue. See Turner Direct Statement; in particular, pp. 2-5. Mr. Turner also interviewed PAUSE members as to their fear. Though PECO would try to downplay the significance or weight of the Protestants' message to Mr. Turner by claiming that it is no evidence of decreased property values, it misses the real point which is fear and a desire to avoid EMF or at least lower one's exposure. Main Brief of PECO, p. 22. And as to that latter point, his interviews with the Protestants did not create but only confirmed Mr. Turner's understanding of the

seriousness of the issue of fear of EMF which he had already come across in literature and experiences in other townships. N.T. 564.

The whole discussion laid out above counters both PECO's argument that there will be no adverse impacts on land use, and the Prosecutory Staff's attempt to have the Commission ignore the important testimony as to environmental and land use impacts of energizing the Woodbourne-Heaton line.

IV. Protestants have demonstrated adverse health and biological effects of exposure to EMF while PECO has failed to rebut Protestants' testimony.

A. Dr. Liboff was the most qualified expert to speak to the issue of EMF health and biological effects and the status of EMF research to date.

1. Dr. Liboff is an expert in bio-electromagnetism.

The attempts of PECO and other parties to discredit Protestants' witness Dr. Abraham Liboff betray a lack of understanding of the science of bio-electromagnetism. Dr. Liboff is an expert, perhaps the expert in the field of bio-electromagnetics.

Dr. Liboff has been active in biophysics and medical physics research for almost twenty-five years. He alone, out of all the experts who testified in this proceeding, is involved in research concerning the interaction of magnetic fields and living systems, and the physical mechanism underlying that interaction. Dr. Liboff organized the first conference specifically to examine the evidence for bio-electromagnetic interactions. As evidence of the effects of EMF on biological systems has mounted, the field of bio-

electromagnetics has flourished, with several conferences, international conferences, held yearly, professional groups and journals being formed, and a World Congress on the subject soon to meet. Liboff Direct Statement, p. 1.

Dr. Liboff also testified that bio-electromagnetism

is a classification of an area of science that has not heretofore existed, because it depends upon a number of scientific disciplines, each of which is not sufficient to describe the effects and the interactions in total. N.T. 882. Emphasis added.

No witness was offered to rebut this testimony.

He further testified that in the bio-electromagnetic community various inputs

are weighted to the point where if enough biological studies are available, and enough material which may be in a totally different area is available, then conclusions are drawn which, although not proving, say, potential hazard, certainly tend to provide a basis on which discussions concerning hazard might be more detailed in terms of taking these as real possibilities. N.T. 884.

...when a biologist, for example, gets up and delivers a paper at the Bio-electromagnetics Society, it's uncommon for anybody to get up and question that person's ability to talk about engineering matters. Because what has happened is that the discipline itself has formed a sort of molding together...of so many different disciplines from other areas that it becomes a discipline in its own right. N.T. 885.

Of all the witnesses who testified, only Dr. Liboff is actively engaged in bio-electromagnetism and the bio-electromagnetic scientific groups. Such a position gives him access to information regarding the emerging picture of EMF induced health and biological effects which is not available within the confines

of special scientific disciplines which only offer a small part of the overall data used in bio-electromagnetism.

Further, PECO expert witnesses displayed their lack of willingness or ability to consider input from fields other than their own, showing that they do not yet understand bio-electromagnetism as a phenomenon. Many of their comments with respect to epidemiological research, for example, betray this characteristic. N.T. 1042, 1045, 1048, 1051, 1052, 1056, 1179.

2. Each PECO witness narrowed his testimony to very specific fields, limiting the scope of their contributions to an examination of the issues properly residing in the field of bio-electromagnetism, and leaving Dr. Liboff un rebutted.

Each PECO witness attempted to "bite off" a tiny piece of the conglomeration of spheres showing adverse effects of EMF on health and biological systems and counter it within his own specialty. Leaving aside the issue of what makes one qualified to discuss bio-electromagnetic questions as touched upon above, those witnesses showed that they were not qualified to broad conclusions and that their testimony must be viewed as limited and inconclusive at best.

PECO presented Dr. Murray Rosenberg for instance, and argued in its Main Brief that he had shown that Dr. Liboff relied upon studies that used different fields from those associated with the line. Main Brief of PECO, p. 28; also, Rosenberg Rebuttal, p. 16. Dr. Gelmann also presented such testimony. Main Brief of PECO, p. 28; Gelmann Rebuttal, pp. 19, 12.

Neither Dr. Rosenberg or Dr. Gelmann claimed to be qualified to state that different fields would have produced different

results in the studies. They try to limit the application of the important questions being studied in the Woodbourne-Heaton line and its fields while the important discussion concerns EMF. Neither has the expertise necessary to discuss the biological and health implications of different fields.

Dr. Gelmann testified under cross examination that his opinions in his written testimony were limited to oncology, and molecular and cellular biology. N.T. 1142. He has published no articles on EMF and cancer beyond a review of the literature. N.T. 1147-1148. Yet, as discussed above, he offered opinions as to the use of particular types of magnetic fields in research on the interaction of EMF and biological and health effects.

Dr. Rosenberg did not reconcile his testimony with the medical use of EMF, nor did he refer to any research in this vein. His testimony in this regard was unsubstantiated and without weight. N.T. 1225, 1227, 1235. Yet he was willing to exceed his area of expertise to conclude that exposure to EMF will not result in adverse health effects in humans.

Dr. Rosenberg was also quite liberal in his opinions on the Ion Cyclotron Resonance ("ICR") hypothesis. Though he began with a detailed critique from the physical standpoint, he also opined that the ICR hypothesis has no implications for human health. Rosenberg Rebuttal, p. 20. He made this statement although different groups, for instance, have found results in calcium efflux studies. N.T. 1223. He also made the statement while refusing to comment on whether ICR works in bone healing. N.T. 1225. Dr. Rosenberg offered

no rebuttal of Dr. Liboff's testimony as to the successful results that Dr. Liboff's team has found using the ICR hypothesis. Nor did he challenge the fact that Dr. Liboff has obtained a number of patents involving both the basic ICR concept and a number of medical applications. Liboff Direct Statement, p. 5.

The same type of criticisms rebuts Drs. Bockman and Cole. Dr. Bockman limited himself to endocrinology and immunology. Bockman Rebuttal, p. 1. Dr. Bockman suggested that many of the Calcium efflux studies used fields different from 60Hz fields. He gave as his opinion that 60Hz fields do affect calcium metabolism in living organisms and said that EMF does not cause changes in biologically important calcium in whole animals. Bockman Rebuttal, pp. 12, 13. Dr. Bockman criticized the conflation of different fields and then did the same thing. The point is, though, that Dr. Bockman is not an expert in EMF and therefore does not have the expertise to make sweeping judgments as to a lack of EMF effects due to different fields being used in different studies.

A review of the Protestants' summary of Dr. Bockman's testimony makes it clear that he commented on a number of different studies and different areas and often noted positive results of EMF effects and qualified them as weak or inconsistent or insignificant. He extrapolated from narrowly focused studies to conclusions such as EMF having no effect on reproduction and development. Main Brief of Protestants, pp. s-60 to s-67.

Dr. Bockman felt qualified, despite many inconsistent results and disagreements among researchers, to state that adequate

experiments have been done in the area of EMF effects on reproduction and development. Nor does any additional research need to be done in the area of the calcium efflux studies he said. N.T. 974. Yet he testified that not everyone agrees on whether or not EMF aids in bone healing and that the mechanism by which it might aid is not known. N.T. 978-979.

Dr. Bockman has not conducted research into the biological effects of power frequency fields such as those associated with transmission lines, nor has he published papers about the subject. He began to look into biological effects of EMF about six years ago. N.T. 980. Thus while Dr. Bockman may be qualified in the areas of immunology and endocrinology and the sorts of questions we might and explore with regard to EMF effects, he is not qualified to discuss the application of different types of EMF, or to reach the conclusion that EMF from a power line will not adversely affect health. Nor is he qualified to posit as he does that there is no basis to conclude that power frequency fields have adverse effects on the health and function of the endocrine or immune functions. Bockman Rebuttal, p. 27.

3. PECO's testimony on epidemiological studies did not refute Dr. Liboff's use of epidemiological data or OCA witness Dr. Rosenbaum's testimony.

PECO witness Dr. Cole very selectively used parts of the results of epidemiological work to make his argument that no connection has been made between EMF and cancer, particularly childhood cancer. In its Main Brief, PECO laboriously recapitulates

Dr. Cole's criticisms of the epidemiologic studies which have reported positive associations between EMF and cancer. For the details of Dr. Cole's testimony, reference is made to PECO's Main Brief and Protestants' summary of Dr. Cole's testimony at s-67 to s-73 of their Main Brief.

Dr. Cole's testimony is not a refutation of Dr. Liboff's use of epidemiological results as one source of data yielding the conclusion that EMF adversely affects health and biological systems. Dr. Liboff's use of the epidemiologic studies is one of the methods used in bio-electromagnetism, a field in which PECO presented no witnesses. Aware that different studies show different things, Dr. Liboff testified that he sees positive results with respect to EMF and biological interaction coming in from diverse areas of science and medicine. Positive results together form the collection of data that concerns experts in bio-electromagnetic research. In this context, the positive epidemiological results support and are supported by other findings. See Main Brief of the Protestants, p. s-58; N.T. 896-897.

Dr. Cole did not deny positive associations; he downplayed and qualified positive associations. He explained that weak associations had been found and that he expected that these associations would disappear as better studies were done. Cole Rebuttal, p. 18. As the OCA points out in its Main Brief, Dr. Rosenbaum testified that there is another quite plausible scenario which holds that as more carefully done studies are conducted, the removal of technical problems might lead to weaker results even if

there is a real and consistent effect. Main Brief of OCA, p. 33. Further, Dr. Cole's testimony to the effect that the EMF-cancer associations will fade away in further studies is limited. His opinion is drawn, admittedly, from an expertise in epidemiology, but it is drawn amidst a mass of conflicting studies and results within the field of epidemiology caused to a great degree by confusion as to how to measure exposure to EMF. Dr. Cole is not an expert in electromagnetism or powerfields or power lines and his dependence on the question of how fields were determined in deciding which studies are the most reliable must be viewed in this light.

While Dr. Cole's reasons for concluding that the EMF-cancer associations will disappear are based on confusing and contradictory results within the field of epidemiology, Dr. Liboff's support for the claim that there are associations comes from various disciplines all contributing to the field of bio-electromagnetics. Dr. Cole's position, to the degree it is supported, is not a refutation of Dr. Liboff's assertion that some epidemiological work is confirmatory of and confirmed by data from other fields.

Dr. Rosenbaum's testimony that the epidemiologic data was "confused" must be understood in the context of prudent public policy planning. Based on his understanding of his field, the confused state of the data and research and his experience in public policy, Dr. Rosenbaum testified that certain measures in the way of prudent policy are in order when the state of research is

inconclusive as it is now with respect to EMF-cancer associations.

Even Dr. Cole advised that the evidence in the area of epidemiology is inconclusive or evenly divided between positive results and negative results. N.T. 1097, 1523. He also stated that he is only 70% convinced that EMF does not cause cancer. N.T. 1101-1102.

Nothing in Dr. Cole's testimony argues against the position taken by Dr. Liboff. The only argument he could bring to bear against Dr. Liboff is that he ought not to be 100% sure that EMF causes cancer based on epidemiological work alone. But the epidemiologic results are only a contributing factor to the wealth of data from many scientific and medical areas of research. Further, the fact that an expert like Dr. Cole says that right now the epidemiologic results are inconclusive only lends support to the expert public policy position taken by Dr. Rosenbaum regarding what to do in the face of such uncertainty. Even Dr. Cole himself is undertaking an epidemiologic study that will consider in part exposure to EMF. N.T. 1120-1121.

V. The testimony and arguments to date support the conclusion that prudent avoidance calls for a delay in the energization of the Woodbourne-Heaton line.

A. The Prosecutory Staff's understanding of prudent avoidance is flawed and should not guide the Commission

The Prosecutory Staff adopts PECO's definition of prudent avoidance as the strategy of making minimal cost modifications in the design and siting of transmission lines that will help reduce

EMF exposure to the public. Main Brief of the Prosecutory Staff, p. 37. A prudent avoidance approach is based on the recognition that adverse health effects have not been demonstrated and that changes in EMF levels may have little or no effect on health. Id. This conceptualization by the :Prosecutory Staff seems twisted. The Protestants argue that the relevant recognition is that EMF has been shown to have adverse health and biological effects and that that recognition dictates that stepss be taken to cut down exposure and that the very nature of "reasonable cost" must be reassessed. See Rosenbaum Direct Statement, p. 8.

"Great confusion and disagreement" within the scientific community is not an argument against prudent avoidance. While the Prosecutory Staff does not deny this point, it suggests that we should err on the side of too little reduction of exposure rather than too much cost. There is no prudence in that outlook, when the cost of prudent avoidance is not known.

The Prosecutory Staff encourages the Commission to adopt its understanding of prudent avoidance. The Staff's Main Brief quotes a Carnegie-Mellon brochure: "Don't do anything drastic or expensive until research provides a clearer picture of whether there is any risk and, if there is, how big it is." Main Brief of the Prosecutory Staff, p. 38. The Prosecutory Staff plainly fails to see that this advice dictates against spending millions of dollars to use a narrow existing right-of-way in a residential area without seriously evaluating alternatives to build a transsmission line that will have decades of use. If we are waiting for research to

provide a clearer picture, it is not drastic or expensive to delay such a project when one considers the issue from all angles.

The Prosecutory Staff also argues that since PECO's design for the Woodbourne-Heaton line results in lower EMF levels than other designs, it doesn't matter when PECO made the calculations. That is, prudent avoidance--if PECO has in fact exercised it--need not be done before siting, design, and construction decisions are made. The Protestants take serious issue with the assertion that prudent avoidance may be achieved in such a happenstance manner and will present appropriate arguments in response to PECO's Main Brief claim that it exercised prudent avoidance.

Finally, it is argued by the Prosecutory Staff that the application of prudent avoidance or referencing of the concept in publicly distributed materials by a company like PECO does not translate into an admission that EMF is an established safety risk. Main Brief of the Prosecutory Staff, p. 44. This assertion seems an odd bit of sophistry. As the Protestants argue in their Main Brief, the precise character of an unsafe condition need not be proved in order for the condition to be characterized as unsafe. Suggesting prudent avoidance is an admission of an established safety risk. Main Brief of Protestants, pp. 8-9. What is is not is an admission that EMF causes adverse health effects. We must understand "established safety risk" as meaning that there is enough evidence to warrant treating a certain condition as dangerous, i.e., potentially harmful. PECO, despite the evasiveness of its witnesses in this regard, has acknowledged a potentially unsafe condition in

its advice that customers "consider" prudent avoidance. See N.T. 35, 36, 68-69. PECO has acknowledged a risk in that existing conditions may in fact prove to be unsafe when more conclusive evidence comes in from the scientific community. Thus the Prosecutory Staff's attempt to mitigate what amounts to an admission of at least some adverse impact of the line on PECO's part must be discounted.

B. PECO did not practice prudent avoidance in the siting, construction, and design of the Woodbourne-Heaton line.

1. Prudent avoidance requires that certain actions and considerations be undertaken before a line is planned and built.

PECO relies upon the testimony of Mr. Silva to the effect that "the concept of prudent avoidance does not require that any specific decisional or temporal process must be followed..." Silva Rebuttal, p. 18; and Main Brief of PECO, p. 49. The emphasis, he argued, is on the "result." Mr. Silva's position is misguided and unsupported by any argument or understanding of prudent public policy. PECO's argument is also premature at this stage of this hearing, for once effect is shown, further hearings are required.

OCA witness Dr. Rosenbaum, an expert in the analysis of policy implications and risk assessment, testified that prudent policy involves research, public information, and the involvement of the public in decision-making before the critical decisions are made. Rosenbaum Direct Statement, pp. 6-7. This opinion is clearly much better rooted in an understanding of how public policy ought to proceed in light of uncertainty. Since EMF, as Mr. Boeggeman put

it, is a societal issue, the very notions of what is to be considered a "risk," what measures will be "modest" in reducing the risk, and what is "too costly" are by no means established facts. When such an informed understanding is brought to bear on the concept of prudent avoidance, it becomes obvious that part of the consideration of prudent avoidance is deciding what it is to be prudently avoided. Are we going to prudently avoid EMF scenarios and levels created before EMF fear and risk became issues? Or are we going to prudently avoid getting ourselves into situations that currently available evidence tells us might be very costly down the line in terms of both economics and human lives and health?

With an eye to these and other very relevant and pressing questions, Dr. Rosenbaum suggested measures such as more research, public information, public involvement in decision-making before critical decisions are made, consideration of costs and effects of possible mitigative measures by utility companies, and erring on the side of safety while discussing the notion of "too costly." Rosenbaum Direct Statement, pp. 7-8.

Protestants' witness Mr. Turner expressed this coherent way of looking at prudent avoidance as an approach and indentified several reasons for adopting that approach in this case. Turner Direct Statement, pp. 7-8. Mr. Turner's testimony in this regard is important because as a land use planner he has important input with regard to cost. In this case, the "cost" is adverse land use effects owing to fear, loss of enjoyment of land, and disinvestment on the part of individual homeowners, and importantly, the

possibility of great costs incurred when existing facilities must relocate or take measures to reduce exposure down the line. Id., p. 7.

Drawing on his knowledge of the reasonable state of fear on the part of the public and its relation to land use, development, and zoning regulations, Mr. Turner testified:

...the original corridor, or right-of-way, was established for a rail line and the geometry and width of that right-of-way was conditioned by that function. The overlay of this new use with apparently no significant modifications of that right-of-way is, on the face of it, not responsive to public concerns regarding public health without substantial evidence regarding EMF levels. Turner Direct Statement, p. 6.

In contrast to the well formulated understanding of prudent avoidance discussed above, both PECO and the Prosecutory Staff rely on PECO's conceptualization of the approach as articulated by Mr. Silva. But Mr. Silva's testimony was unsupported and often confused.

As discussed earlier, the concept of "similarity-basing" has serious limitations and flaws as part of a prudent avoidance strategy.

When asked how prudent avoidance could alter field levels if implemented after design and construction, Mr. Silva responded

...if I can give an analogy from the OTA [Office of Technology Assessment] report itself, they suggest that prudent avoidance might be buying an appliance if it was available that had very low field levels. But the prudent part of prudent avoidance, the OTA report goes on to explain, would not indicate using that appliance until your old one wore out. So even if there is a field-free appliance on the market and you may want to buy it, they suggest waiting until your other one wore out before you would buy

it. N.T. 1319-1320.

Mr. Silva testified that the average life of a power line must be thirty or forty years. N.T. 1320. Mr. Silva consistently demonstrated that his was not a view of prudent avoidance formed in the context of wise public policy or a coherent understanding of what the costs might be of rushing ahead with a project because it seemed no worse in its features than ones constructed years ago.

2. PECO did not employ prudent avoidance in the siting, design, and construction of the Woodbourne-Heaton line.

For all the reasons discussed in the preceding paragraphs concerning prudent avoidance, it is patently obvious that PECO did not employ that approach as it claims in its Main Brief.

PECO chose to site the line on the existing Conrail right-of-way because it wouldn't have to purchase a new right-of-way, it is a direct route between the Woodbourne and Heaton substations, and because it had existing catenary structures. These facts can be culled from all of the testimony of Messrs. Boeggeman and Oedemann. See Specifically Oedemann Direct Statement, pp. 5, 11-12; N.T. 32.

Despite the fact that it is not the preferred design method of PECO, the compact delta design was chosen because of the features of the right-of-way and its catenary structures. Oedemann Direct Statement, pp. 5, 11, 12. Other possible line designs that could have been employed are horizontal, vertical and longer span delta. These designs were not compatible with the existing right-of-way and structures. Id., pp. 11, 12.

Mr. Oedemann testified that at the time of choosing the line design, no formal calculations were made of EMF levels but that he knew through experience that the compact delta would result in lower fields. He did not discuss the issue with anyone else at PECO. N.T. 20-21. Mr. Boeggeman calculated the EMF levels associated with the chosen line design and the alternatives after the line was 90% constructed and determined that the chosen design would result in the lowest EMF exposure. Boeggeman Direct Statement, pp. 11-12; N.T. 50.

The only reason that the existing corridor was chosen was that it was conveniently located and spared PECO the trouble and cost of buying a new right-of-way in what Mr. Oedemann described as being an area "so built up that buying a new route would be unheard of." N.T. 32. He also testified that if PECO had had an unconstrained right-of-way, then it would have kept the line as far from possible from "to keep EMF levels at the edge of the right-of-way as low as we can." N.T. 31. Since alternative rights of way were not priced, no comparison of EMF exposure and land use and health impact versus dollars was made.

This scenario was not one of using prudent avoidance to select the best site for the line. For the conceptual reasons set forth above, and because even PECO could see that it was using a right-of-way exceptionally narrow and close to homes, it is clear that PECO failed to practice prudent avoidance in siting the line. In fact, the one consideration mentioned by Mr. Oedemann that sounds like one small part of a prudent avoidance approach--keeping lines

away from the edge of the right-of-way to keep levels down at the edge--wasn't even given more than passing thought.

PECO also failed to practice prudent avoidance in choosing the line design. As Mr. Boeggeman testified, the chosen design for the line "just fell in our [PECO's] laps" as being optimum for reducing EMF; "We didn't have to do anything extra to reduce the fields." N.T. 75. Additionally, Mr. Boeggeman testified that there is another alternative line design similar to the double circuit vertical that could achieve lower EMF levels. He thought of this design but did not "evaluate" it because PECO "could not use the existing structures to do that." N.T. 58-59. Not only did the chosen design fall into PECO's laps as being "optimum," but because another design did not fall into its laps it was not even given formal consideration.

Once again, any coherent and logically formulated concept of prudent avoidance clearly was not employed by PECO in choosing its line design--thus it fails the result test and the process test.

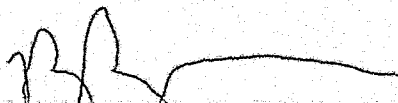
Obviously connected to the siting and designing of the line was the decision to construct it. The public was not involved in this decision nor was it even notified. To proceed with construction of such a line, involving a "societal issue" like EMF, in an atmosphere of growing concern and fear regarding EMF, displayed either a failure to exercise prudent avoidance or a blatant lack of understanding of prudent avoidance's contextualization in public policy formulation.

The only opportunity remaining for prudent avoidance to be

employed in light of the health risks, adverse land use impacts, and lack to date of public input, is to deny approval of the line.

The Protestants have also just become aware of a collaborative report by California Utilities and citizens groups recommending to the California Public Utility Commission interim steps to reducing health risks from magnetic fields. The binding notes that "society can no longer ignore the warnings that EMF is a potential problem which could affect everyone."

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Robert J. Sugarman', written over a horizontal line.

Robert J. Sugarman
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Dated: May 12, 1992

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MAY 13 1992

May 11, 1992

RECEIVED

MAY 13 1992

Mr. John G. Alford, Secretary
Pennsylvania Public Utility Commission
P.O. Box 3265
Harrisburg, Pennsylvania 17105-3265

SECRETARYS OFFICE
Public Utility Commission

Re: Letter of Notification of Philadelphia
Electric Company Relative to Reconductoring
and Rebuilding the Existing Line to Operate as
a Woodbourne-Heaton 230 kV Line in Bucks and
Montgomery Counties; Docket No. A-110500F055

5

Dear Secretary Alford:

By filing an original and two (2) copies of this letter, Pennsylvania Power & Light Company notifies the Administrative Law Judge and the parties to the above-referenced proceeding that it will not be filing a reply brief in the above-referenced proceeding. The fact that PP&L will not be filing a reply brief in this case should not be interpreted as agreement or disagreement with any of the positions advocated by any of the other parties in any of their Main Briefs. PP&L reserves the right to file exceptions and reply exceptions as may be necessary.

Respectfully submitted,

Jesse A. Dillon



BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Letter of Notification of :
Philadelphia Electric Company :
Relative to Reconductoring :
and Rebuilding the Existing : Docket No.
Line to Operate as a : A-110500F055
Woodbourne-Heaton 230 kV Line :
in Bucks and Montgomery :
Counties :

CERTIFICATE OF SERVICE

I hereby certify that I have this date served a
true copy of the foregoing on the following in accordance
with the requirements of 52 Pa. Code § 1.54:

The Honorable Herbert S. Smolen
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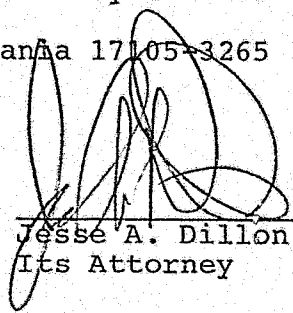
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Jesse A. Dillon
Its Attorney

Dated: May 11, 1992
at Allentown, Pennsylvania

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Public Utility Commission
SECRETARY'S BUREAU
Information Control Division

HAND DELIVERED

John G. Alford, Secretary
Pennsylvania Public Utility Commission
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Harrisburg, PA 17105-3265

DOCKETED

JUL 10 1992

Re: Letter of Notification of Philadelphia Electric Company Relative to Reconstructing and Rebuilding of the Existing 138 KV Line to Operate as a Woodbourne-Heaton 230 KV Line in Montgomery and Bucks Counties; Docket No. A-110550, F.055

Dear Secretary Alford:

The purpose of this letter is to inform the Commission, Administrative Law Judge Smolen and the parties of several points regarding the Philadelphia Electric Company Woodbourne-Heaton 230 KV line that is the subject of this proceeding:

1. The Company has completed the reconstruction of the Woodbourne-Heaton 230 KV line.
2. The Company plans to test the line during the week of July 13th. The Company expects that this will involve testing with no electrical load on the line for approximately 2 hours and testing with load on the line for approximately 6 hours.
3. After the testing is completed, the Company will temporarily place the line in a "standby" mode for use only during emergency situations, which would include, for example, the loss of another transmission facility.

July 2, 1992
Page 2

4. The Company will promptly inform the Commission, Administrative Law Judge Smolen and the parties if it has used the line during an emergency situation.

Please call me if the Commission has any questions regarding the above.

Sincerely yours,


Paul R. Bonney

PRB/meb

cc: Administrative Law Judge Herbert Smolen
Parties of Record

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the following parties and in the manner indicated below in accordance with the requirements of 52 Pa. Code § 1.54:

BY FIRST CLASS MAIL

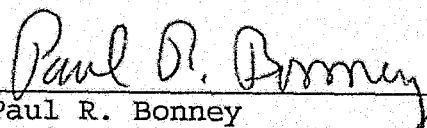
Honorable Herbert Smolen
Administrative Law Judge
Pennsylvania Public Utility
Commission
1302 Philadelphia State Office
Building
Broad & Spring Garden Streets
Philadelphia, PA 19130

Robert J. Sugarman, Esquire
Sugarman & Associates
16th Floor, City Place
101 North Broad Street
Philadelphia, PA 19107
(Counsel for Intervenors)

Jesse Dillon, Esquire
Pennsylvania Power & Light Co.
Two North Ninth Street
Allentown, PA 19101

Patricia Krise Burket, Esquire
Pennsylvania Public Utility
Commission
G-28, North Office Building
P.O. Box 3265
Harrisburg, PA 17120

Tanya J. McCloskey, Esquire
Assistant Consumer Advocate
Office of Consumer Advocate
1425 Strawberry Square
Harrisburg, PA 17120


Paul R. Bonney
Assistant General Counsel
Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101
(215) 841-4252

Dated: July 2, 1992

SUBJECT:

TO:

File Room

FROM:

John Frazier, Pub. Info. Office (7-5722)

Please put the attached letters in the
correspondence file of case A-110550F055.

Thank you,

RECEIVED

JUL 30 1992

Public Utility Commission
SECRETARY'S OFFICE
Information Control Division

July 29 1992
COMMONWEALTH OF PENNSYLVANIA
ANAH

A-110550, F.055

July 13, 1992

Mr. John Frazier
Public Utility Commission
P. O. Box 3265
Harrisburg, PA 17020

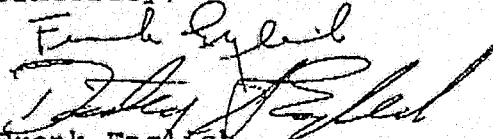
Dear Mr. Frazier:

In response to your comment reported in the Courier Times in which you state that "no one has complained" to the PUC about PECO's testing of the 230 kv Woodbourne-Heaton line:

Residents of Bucks and Montgomery Counties had to go to court to get the PUC to hear their concerns. The PUC did not inform residents that a line was being constructed nor did it inform residents about a test on a line that is still in litigation (what better way to receive no complaints?)

We are angry and this letter voices our opposition to the test and our complaint toward an insensitive PUC. Our anger is heightened by the fact that PECO publicly announced that it would not energize the line prior to a decision by Administrative Law Judge Smolen.

Sincerely,


Frank English
Dorothy A. English

cc: Judge Herbert Smolen
Chairman David Rolka
Robert J. Sugarman

FAX COVER SHEET

TO:

JOHN FRAZIER

FAX #:

717-787-6641

COMPANY:

PA PUC

DATE:

7/13/92

FROM:

FRANK + DOROTHY ENGLISH

FAX #:

215-357-4927

NUMBER OF PAGES:

2

(INCLUDING THIS COVER PAGE)

FAX COMMUNICATOR

2 sheets

717-787-6641

PLEASE DELIVER TO: Mr. John Frazier

Mr. John Frazier
Spokesman
Public Utility Commission
P.O. Box 3265
Harrisburg, Pennsylvania 17120

July 13, 1992

Subject: PECO 230,000 Volt Woodburne Transmission Line
Reference: Testing Of Line - Week Of July 13, 1992
Per Attached Article

Dear Mr. Frazier;

In reference to your statement contained in the Bucks County Courier article which appeared Sunday, July 12th, you stated that the PUC had received no complaints to the upcoming tests related to the Woodburne Transmission lines.

Please accept this FAX as our opposition to the above mention tests. We know of many other persons that disapprove and believe it is premature of PECO to energize this line, even for a test, in advance of Judge Smolen's decision.

Encl.

Sincerely,

William & Barbara Harley
Barbara D. Harley
William & Barbara Harley
1660 Bonnie Brae Drive
Huntingdon Valley, Pa.
19006-1304
Phone: 215-355-2989

Activists want the buzz on P.E. transmission line test

By David Josar
Courier Times Staff Writer
BUCKS COUNTY

The Philadelphia Electric Co. has declined to disclose exactly when next week it will test the Woodbourne-Heaton transmission line, which has some local residents concerned.

"I would like to know when the test is being conducted because there's a good possibility I would leave my house," said Karen Dalrymple, a Langhorne

resident whose Valley View Road property abuts the transmission line route. "I don't want to take the health risk."

P.E. spokesman Bill Jones would only say Friday that the electric company will test the line for six hours some time next week. "There are no specifics," he said.

Even though court action claiming health concerns has delayed the startup of the line, Jones said the test will not be a hazard. "We have over 3,000 miles of transmission lines, and

no one has ever reported a problem," Jones said.

The \$20.1 million line runs from a substation in Lower Moreland to one in Middletown.

Feasterville area residents, united as Parents Against an Unsafe Environment, have halted the long-term activation of the 12.8-mile, 230,000-volt transmission line by forcing an administrative court judge to hear arguments that it may be a health hazard.

The decision from that judge

expected in August, would be one of the first in the United States to address the issue of how public policy should address the effects of electromagnetic fields, which are caused by electric current and surround power lines and appliances. Some studies have determined that magnetic fields, harder to shield than electric fields, may promote the growth of cancer cells.

Dalrymple, a member of PAUSE, said at least one neighbor and other PAUSE members

are considering leaving their homes during the test.

"I don't even know how they can consider starting it up, when there's a court order halting them from doing it," said Dalrymple. "I just don't trust (P.E.)."

According to John Frazier, spokesman for the Public Utilities Commission, P.E. has contacted both the administrative judge and Robert Sugarman, PAUSE's attorney, about the test startup.

"No one has complained that we have heard," Frazier said.

Frazier said there are no regulations forcing P.E. to disclose exactly when it will test the line.

P.E. said the line will be "de-energized" following the test. "The test is needed so the power line could be used in emergencies, something Dalrymple criticizes."

"I've lived here 20 years, and there's never been an emergency," she said.