COMMONWEALTH OF PENNSYLVANIA

PUBLIC UTILITY COMMISSION

ORIGINAL

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-110550F055
Further hearing.	

Pages 1208 through 1305

Hearing Room No. 1
State Office Building
Broad and Spring Garden Streets
Philadelphia, Pennsylvania

Monday, December 16, 1991

Met, pursuant to notice, at 10:00 a.m.

BEFORE:

HERBERT SMOLEN, Administrative Law Judge

APPEARANCES:

PATRICIA KRISE BURKET, Esquire
P. O. Box 3265
Harrisburg, Pennsylvania 17120
(For the Commission's Law Bureau)

PAUL BONNEY, Esquire
2301 Market Street
Philadelphia, Pennsylvania 19101
(For Philadelphia Electric Company)

APPEARANCES (Continued):

THOMAS WATSON, Esquire
WARD L. SMITH, Esquire
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D. C. 20009
(For Philadelphia Electric Company)

ROBERT J. SUGARMAN, Esquire
Sugarman & Associates
16th Floor, City Place
101 North Broad Street
Philadelphia, Pennsylvania 19107
(For PAUSE)

TANYA J. McCLOSKEY, Esquire
1425 Strawberry Square
Harrisburg, Pennsylvania 17120
(For the Office of Consumer Advocate)

JESSE A. DILLON, Esquire
Two North Ninth Street
Allentown, Pennsylvania 18101
(For Pennsylvania Power & Light Company)

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C O N T E N T S

E X H I B I T S

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P R O C E E D I N G S

ADMINISTRATIVE LAW JUDGE HERBERT SMOLEN: Good morning. This is the further hearing in the matter of the Philadelphia Electric Company existing 138 kV line to be reconstructed as a Woodbourne-Heaton 230 kV line.

This morning's hearing has been reserved for further rebuttal testimony of the company, Philadelphia Electric Company.

Counsel.

MR. WATSON: Thank you, Your Honor. I have one preliminary matter.

JUDGE SMOLEN: Go ahead.

MR. WATSON: I believe we failed to move into evidence the testimony of Dr. Gelmann last week. So subject to Mr. Sugarman's objection and -- any objection or argument he may have, I would like to go ahead and get on the record a motion to admit that testimony.

JUDGE SMOLEN: Any objections by other Counsel?

MS. McCLOSKEY: No objection, Your Honor.

JUDGE SMOLEN: It's received subject to your qualification. I suggest that you renew this motion when Mr. Sugarman arrives so that he will have an opportunity to speak to it if he has any objections.

MR. WATSON: Yes, Your Honor.

(Whereupon, the document marked as PECo Rebuttal Statement No. 3 was received in evidence.)

JUDGE SMOLEN: With that preliminary aside, let's proceed with the witness.

MR. WATSON: I call Dr. Murray Rosenberg.

Whereupon,

MURRAY D. ROSENBERG

having been duly sworn, testified as follows:

JUDGE SMOLEN: Please state your full name and business address for the record.

THE WITNESS: Dr. Murray D. Rosenberg. It's 1445 Gortner Avenue, St. Paul, Minnesota 55108.

JUDGE SMOLEN: Counsel.

DIRECT EXAMINATION

BY MR. WATSON:

Q. Dr. Rosenberg, do you have before you a document entitled Rebuttal Testimony of Dr. Murray Rosenberg, Philadelphia Electric Company Rebuttal Statement No. 4?

A. Yes, sir.

Q. If I were to ask you each of the questions set forth in that document while you were now on the stand under oath would your answers be as set forth in that document?

A. Yes.

MR. WATSON: Your Honor, I move that the testimony of Dr. Rosenberg be admitted into evidence subject to timely objections.

JUDGE SMOLEN: It is received subject to that qualification.

(Whereupon, the document was marked as PECo Rebuttal Statement No. 4 for identification, and was received in evidence.)

JUDGE SMOLEN: Is the witness available for cross-examination?

MR. WATSON: He is available for cross, Your Honor.

JUDGE SMOLEN: Mr. Burket.

MS. BURKET: No questions, Your Honor.

JUDGE SMOLEN: Mr. Dillon.

MR. DILLON: No questions, Your Honor.

JUDGE SMOLEN: Ms. McCloskey.

MS. McCLOSKEY: Thank you, Your Honor.

CROSS-EXAMINATION

BY MS. McCLOSKEY:

Q. Good morning, Dr. Rosenberg. My name is Tanya McCloskey and I represent the Office of Consumer Advocate.

I would like to start on page nine of your testimony, lines one through seven, where you discuss the classification of the electromagnetic spectrum. Do you

have that reference?

A. Yes.

Q. Now, on line seven you refer to matter. When you are referring there to matter you are not referring to biological matter, is that correct?

A. That includes biological matter.

Q. And would you agree that the electromagnetic spectrum was classified into regions on the basis of its interaction with other matter, such as X-rays, and their interaction with the electron shells around the atoms?

A. They have been classified in various ways, including their interaction with inert matter, their interaction with biological materials and so forth.

Q. Could you give us an example of a classification based on its interaction with biological matter?

A. Well, a good example you just mentioned has to do with gamma rays or X-rays or ionizing radiation, which can certainly alter the structure of certain molecules within cells.

Q. Now, I am going to give you three references here and try not to lose each one as we go through. At page ten of your testimony, the answer there at lines nine through 15, and again at page ten, lines 22 through 28, and then on page 13, lines one through five, you are

comparing the energy in ionizing radiation frequencies and microwave frequencies.

Would I be correct that in these references you are referring to the energy per photon?

A. Essentially the energy at these frequencies is a proportional to the frequency by a proportionality constant which is called Planck's constant. The higher the frequency the more energy you have in that type of radiation.

Q. And if you look at the reference on page ten, lines 22 through 26, where you say the energy in power frequency fields is much less than one-trillionth of that found in ionizing radiation, would you agree that one could transmit any amount of energy at any frequency?

A. I'm not clear. I don't understand the question. Could you repeat that, please?

Q. Okay. Would you agree that one could transmit any amount of energy at any frequency?

A. There are limitations to how much energy you can generate in terms of the intensity at a given frequency. We do have super-generators, for example, that we use in particle physics that generate enormous amounts of energy, but this is a difficult problem.

Q. And would you agree that it is easier to move large amounts of energy at power frequencies than at

either microwave or ionizing radiation frequencies?

A. You are talking here about power?

Q. Yes, the power frequency such as on a transmission line that we have been referring to.

A. It depends on what you want to transmit. If you want to transmit the usual electrical power that we have, say, in our homes and so forth, then you use powerline frequencies for that. They are totally different things. I mean, if you want to transmit very high energetic particles, ionizing particles, that's a different story.

Q. Turning to page 11 of your testimony, lines ten and 11, where you reference sunburn, would you agree that sunburn is due to a photochemical action?

A. Yes. It is a photochemical action.

Q. So one could easily get sunburned when the skin is very cold, such as in the Antarctic, is that correct?

A. You can get exposure to ultraviolet rays in the Antarctic and you can actually get sunburned. You can get excessive exposures that could lead to other damaging effects.

Q. When you refer to other damaging effects of ultraviolet rays, is one of those skin cancer?

A. Yes. That is well known among farmers and

other people.

Q. And can ultraviolet rays cause cataracts?

A. Very high intense ultraviolet rays have been known to affect the lens of the eye.

Q. Now, referring back to page six, lines 33 to 36, and then again on page 14, lines 15 through 17, you are characterizing the sinusoidal field.

A. On page six is the sinusoidal field, yes.

Q. And I believe at page six you characterize it as an infinitely repeating cycle known as an alternating current?

A. Yes. If it goes on. Actually, you can limit it if you wish.

Q. And then at page 14, lines 15 through 17, you describe the sinusoidal wave as one that curves uniformly up and down and back again in a smooth symmetrical line. Do you see that reference?

A. Yes.

Q. Isn't it true that actual powerlines have transients, that is spikes, in the current from a variety of causes?

A. I think it depends on the powerline. I'm not familiar with how they do their transmissions, but with any type of generation if you turn it on or turn it off you are going to get on and off cycles.

Q. If you have a disruption such as lightning?

A. That I don't know. You would have to ask the powerline people about that.

Q. So would you agree that a transmission line does not have this sinusoidal wave that you have described in your testimony?

A. As far as I know when the transmission is steady, you have a sinusoidal wave.

Q. But then when there would be transients such as turning on and off the generation you would not have that uniform sinusoidal wave that you described in your testimony?

A. In between you would. You would have a momentary turning off and on, if that is what is done.

Q. Now, on page 16, lines one to nine, you are discussing pulsed fields and describing that that contains a sinusoidal field but also has an irregular shape or a blend or a mix of many different frequencies. Is it possible for there to be a biological effect which depends upon turning on and off a certain magnitude of electric and magnetic field within a range of frequencies?

A. No. What I am saying here is when you have a pulsed wave you can demonstrate using what we call Fourier analysis that this pulsed wave is actually a

collection of a large number of sinusoidal waves, some of which cancel, some of which reinforce one another, and the net effect is the equivalent of a pulsed wave. In other words, you have a complete series of sinusoidal frequencies that make up that pulsed wave.

Q. Okay. I think my question might go a step beyond that, which is is it possible for there to be a biological effect which depends upon this turning on and turning off or this pulsing of a certain magnitude of electric or magnetic fields within a range of frequencies?

A. You are talking if you have a pulsed wave and you turn it off and on?

Q. You obtain that pulsed effect by turning off and on.

A. What you are producing then is a pulsed wave by turning it off and on.

Q. Yes.

A. Whether you have any biological effects is going to depend a great deal on the energy and intensity and the frequency. If you are working at very high frequencies, which you can get pulsed frequencies, say, microwave, ultraviolet, and so forth, then, yes.

Q. Would you agree that microwave heating is one of those effects?

A. Microwave heating is not so much the effect of turning it off and on. It comes from the fact that you are working at a frequency where you are moving the water molecules, bending them, causing their movement about such that you get a heating effect.

Q. Now, if you could turn to page 20 of your testimony -- actually, I believe it begins at the bottom of page 19 -- you discuss your assessment of the experiments that have been conducted to test the ICR or ion cyclotron resonance hypothesis.

Is it your testimony here that the use of the ion cyclotron resonance hypothesis negates the results that may have been seen in some of these experiments?

A. What I am saying here is that there is no reasonable physical basis for the ion cyclotron resonance hypothesis. It does not make sense from a physical point of view from my analysis of the concept.

Q. Now, if the ion cyclotron resonance hypothesis is flawed does that necessarily negate the results that would be seen in an experimental study based on the ion cyclotron resonance hypothesis?

A. You cannot explain something with a flawed hypothesis, first of all.

Secondly, the point I was trying to make here is attempts to experimentally confirm the results have been

very unsuccessful. There are a lot of results, experiments, that give contradictory results. And in the areas of research, as I mention here, if a hypothesis is correct we should be able to conduct the same experiments and reach the same results, and this has not been true.

Q. Dr. Rosenberg, do electrical currents inside the body have any physiological function?

A. Well, there are some very weak currents, of course, we pick up that has to do, say, with the electrocardiogram or the electroencephalogram. These are very, very low types of currents that go on having to do with the -- having to do, say, with the conduction along the surfaces of the nerve cells and certain muscle cells. These are very low currents.

Q. And do microwaves and radio waves induce currents inside the body?

A. The microwaves as we use them today essentially do not produce -- they are not going to get into the body. They do not produce currents. If you use a sufficiently intensive microwave you can get some heating in the body and that is being used now in therapy, using what we call hyperthermia therapy, to try to heat up certain types of tissues, especially tissues that have low oxygen content because you can then hopefully destroy them.

Radio waves are not going to induce currents in the body unless you are producing an enormously intense radio wave and you are right close to it. You might get some effect. But in general all the radio waves which we have in our atmosphere are not inducing currents in the body.

MS. McCLOSKEY: Thank you, Dr. Rosenberg.

I have no further questions, Your Honor.

JUDGE SMOLEN: Do you want -- do you have any redirect or do you want to wait --

MR. WATSON: I think I would rather wait until --

JUDGE SMOLEN: Until Mr. Sugarman?

MR. WATSON: Until Mr. Sugarman does his and then do it all at once.

JUDGE SMOLEN: It is now 10:25. Let's take a 15 minute break and see what happens, see if he arrives during that period of time. So we will stand in recess.

(Recess.)

JUDGE SMOLEN: Back on the record.

MR. WATSON: Your Honor, I had one point that I wanted to bring up again when Bob was here. That is, I think we forgot the task of putting Dr. Gelmann's testimony, direct and cross and the other testimony, into the record last week. So I moved, Bob, while you were gone -- I move again that we admit it into evidence.

MR. SUGARMAN: Okay.

JUDGE SMOLEN: No objections having been made, that is received.

MR. WATSON: Thank you, Your Honor.

I think the witness is now still on cross.

JUDGE SMOLEN: Yes. The witness has been cross-examined by the OCA and we are waiting for cross-examination by Mr. Sugarman

CROSS-EXAMINATION

BY MR. SUGARMAN:

Q. Dr. Rosenberg, as I understand your testimony, you are stating that there are some theoretical problems with the ICR hypothesis which create very good reasons for believing that the mechanism does not and cannot occur in actual biological tissue, is that correct?

A. That's correct.

Q. You are not saying that you are able to be conclusive about it at this time, is that correct?

A. I am conclusive about it.

Q. Well, then why do you say on page 19 of your testimony, lines 29 to 34, that research has proceeded in part on the hope that these problems can somehow be resolved in the future, and then you say at this point, however, the ion cyclotron resonance 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? Instead of very good reasons why didn't you say it cannot? Isn't it because that you don't want to take that categorical position?

A. No. I consider this a conclusive statement. It's a highly speculative attempt. It is one which we have no good physical basis.

Q. But that's not the same as saying it cannot happen, that it cannot be true. Do you agree with that? What you just said is not the same as saying --.

A. It has no physical basis.

Q. What?

A. We cannot develop a good physical basis for it.

Q. Right. That means that you can't explain it?

A. That means we cannot prove it.

Q. Now, on page 20 you say that many of the attempts outside of Dr. Liboff's group to experimental confirm his results have been unsuccessful. You then say that one of the experiments that has even found one group reporting an increase and another group reporting a decree on a third group reporting no effect at all.

Now, if I understand your testimony that means that two out of the three groups did find an effect.

A. Some groups have found effects; some have not. I don't know if it is exactly two out of three just one

got an efflux and the other got -- an increase in efflux -- and the other got a decrease.

Q. Doctor, have you any personal familiarity with the use of electromagnetic fields in orthopedics?

A. I have not personally used it in the field of orthopedics.

Q. Are you familiar with the fact that it is being used?

A. Yes. I have heard it is being used in the field of orthopedics.

Q. And have you heard it is being used with positive consequences?

A. There have been some reports of some positive results using pulsed-type electromagnetic fields.

Q. What is your theory as to the biophysical methodology by which the electromagnetic fields have that effect?

A. In the field of orthopedics I really can't answer that. That's not my field.

Q. Well, would you take the view as to orthopedics that collisions occur in the pulsed fields?

A. I don't know what you mean by collisions, sir.

Q. Well, your testimony at page 18, lines 31 through 34, 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.

Does that apply to pulsed electromagnetic fields also?

A. As far as the ion cyclotron resonance theory is concerned, it would apply. One of the difficulties in orthopedics, as I understand it, is that in some cases they have had some increased bone healing and in other cases they have not. Again, that is a very controversial issue. It is not my field of specialty.

Q. All I'm trying to get at -- so you don't have an explanation as to how it works?

A. If it does work, I don't think there is a good explanation.

Q. Well, do you dispute that it works?

A. I really can't comment on that area. I don't work in that area. It's not my area of expertise.

Q. Well, let's assume that those who are reporting that it works and those who are in fact using it in clinical work are telling the truth and are correct.

A. I really can't comment on that. It is a supposition. I don't want to make assumptions.

Q. Let's assume for a moment that the literature reporting their results is neither fabricated nor

erroneous. Would you agree that the problem is not whether it works, that is, whether electromagnetic fields have an effect, but the problem is how to explain it?

MR. WATSON: Objection, Your Honor. This assumes facts not in evidence. Counsel has --

MR. SUGARMAN: The facts are in evidence, though.

JUDGE SMOLEN: Wait. Let him finish.

MR. WATSON: Counsel has asked and assumed that it works and then basically the answer says, well, assuming it works, can you tell us why it works. And as the doctor has already stated, he doesn't make that assumption, he does not agree with that assumption and there is no basis for that assumption in the record. And in that sense, Your Honor, it really just calls for speculation here.

JUDGE SMOLEN: Let's hear Mr. Sugarman.

MR. SUGARMAN: The problem is that there is evidence of it in the record.

JUDGE SMOLEN: What is the question again?

MR. SUGARMAN: The question is if there is -- if one accepts the literature reports which were testified to by Dr. Liboff and acknowledged by the company's other witnesses and also testified to by the OCA witnesses that electromagnetic fields have been reported as being successfully used in orthopedic treatment, if you accept

that that occurred, then isn't the problem not one of whether electromagnetic fields have an effect but, rather, how to explain that.

MR. WATSON: Well, Your Honor, that's the very point, and that isn't the problem that they have effects, but the whole assumption is that they do have effects. That assumption certainly was not established in the record.

JUDGE SMOLEN: Well, there has been testimony. I will overrule the objection.

You may answer, if you have an answer, sir.

THE WITNESS: I am not quite clear on the questions.

JUDGE SMOLEN: Repeat it.

BY MR. SUGARMAN:

Q. The question is if the literature is accurate in reporting that electromagnetic fields have an effect in orthopedic treatment, then isn't the problem not whether electromagnetic fields have a biological effect but, rather, how to explain it?

A. In all honesty I don't feel qualified to answer that question.

Q. Very good.

Now, you say on pages 16 and 17 that -- well, let me stick with 16 for a moment. You say that studies

using pulsed fields -- the question is do they provide information relevant to determining the effects of sinusoidal power frequency fields.

MR. WATSON: Excuse me. Could we have a line reference?

MR. SUGARMAN: Yes. Page 16, line 12.

BY MR. SUGARMAN:

Q. And what I understand your answer after the word no is that -- I am going to read one sentence of your answer: "Given the differences in frequency mechanisms and the effects discussed previously in my testimony, it is inappropriate to draw conclusions about power frequency fields based on a study using many frequencies."

Now, isn't there a difference between drawing conclusions based on a study using many frequencies versus the relevance of the information? That is to say, even if you can't draw conclusions about power frequency using other fields, in other words about pulsed fields using sinusoidal fields, isn't it nevertheless of relevance? Isn't there some middle ground between being able to directly draw conclusions and total irrelevance?

A. The difficulty here is that you have a -- as your colleague asked me earlier -- you have a series of frequencies going up to fairly high frequencies when you

are using a pulsed frequency wave. So you are really trying to compare two different situations, that versus a simple sinusoidal frequency. And I am saying it is inappropriate to draw conclusions from one to the other.

Q. And I'm not questioning that statement. I'm only saying that isn't that a different statement than saying that it is irrelevant? Isn't there a middle ground between not drawing conclusions, in science, on the one hand and total irrelevance on the other hand? Which is that it may be a relevant piece of data even though you can't draw a conclusions from it in itself.

A. To me, that is highly speculative. You know, I don't have a crystal ball as to what is going to be done in future research, but I would say as of now I think it is appropriate for me to say that it is inappropriate to draw such conclusions.

Q. At page 18 of your testimony, line 20, you state that, "A channel approximately ten feet wide would be required to meet the theory's conditions for most ions." I would like to ask you what is your authority for that proposition?

A. There have been many calculations using the frequencies that have been suggested by Dr. Liboff.

Q. And what are those frequencies?

A. He is using the calcium one, which is ranging

from 16 hertz up to about 32, in that area. He has used a few others more recently, the potassium one. I --

Q. What are the ranges of those?

MR. WATSON: Excuse me, Your Honor. Could we let the witness finish?

MR. SUGARMAN: I'm sorry. I wanted to get that answer on the record.

A. I don't have his recent articles with me. If you want to bring them in we can look them up. They are of that order of magnitude.

Q. They are what?

A. They are of that order of magnitude but I don't have them here with me to give you the exact figures.

JUDGE SMOLEN: Have you completed your answer to the underlying question?

THE WITNESS: No.

BY MR. SUGARMAN:

Q. Okay. Well, stay with it, then.

A. If we take the equations based on those frequencies and based on the magnetic field strength that he is using and put them in, we can calculate the radius of the helical path or circular path of the ion.

Now, depending on who makes the calculation and exactly which one you use, you get a diameter ranging from about ten feet, some people get up to about 80 feet,

depending on how you do the calculation. But it is so many orders of magnitude, we are talking about pores and membranes on the order of Angstroms. We are talking about something that is many, many orders of magnitude smaller.

Q. What is the authority, if you have an authority, that you rely on for the application of those formulas?

A. I would have to look up the references. There were several articles.

Q. Are any of them cited in your bibliography?

A. There was one by Carstensen, page 23.

Q. And what is the Carstensen's research that is relevant to establishing the width of the channel that would be required?

A. He has done the calculations on these.

Q. What is the underlying theory underlying the computation of the channel, however? I am not asking about him doing the calculations. I am asking what is your authority for the proposition --

A. The size of the channel --

Q. Yes.

A. -- normally, within a membrane?

Q. Yes -- no, no, no. Sorry. What is your authority for the application of a formula to compute the

width of the channel for ions in human tissue as necessary to meet the conditions?

A. I have used Liboff's formula. Q over M times B.

Q. Let me rephrase my question. We're not meeting -- I beg your pardon?

A. It's equal to Q over M times B. I don't have it written down exactly. We can look it up.

Q. Where are you finding Liboff's formula?

A. He has it in a great many of his articles.

Q. And you are saying that the channel would have to be ten feet wide?

A. Of that order of magnitude, possibly larger.

Q. Again, I am trying to find out the underlying theory that takes you from his formula to the conclusion that a ten foot wide channel would be required, not to the number but to the very concept underlying your conclusion.

A. I tried to explain this in here when I mentioned about the concept of cyclotron resonance. If you turn to page 17, it's the same equation we use -- page 17, going on to page 18 -- it's the same theory that was used in the giant particle accelerators, where we make use of the whole concept of cyclotron resonance, and that is that a particle, a moving charged particle in a

magnetic field, based on what we call Q times E is going to undergo a change in its direction, adopt a circular path or helical path and that if we can give it a boost every so often we can get it to make that revolution at a very rapid rate. And it is possible to calculate, as I state here in the testimony, for a given ion and resonance frequency the size of the circular path. And that is a well known physical theory.

Q. What is your authority -- let me put it this way: what is your authority for the proposition that the cyclotron resonance phenomenon only occurs when a particle or ion is traveling in a circular path?

A. Circular or helical path.

Q. Oh, you're changing it to helical?

A. You can get it in a helical path. It depends on the angle of the magnetic field.

Q. And what is the calculation for the width of the channel required using a helical path?

A. It's similar.

Q. Have you made the calculation?

A. Yes. It comes out about the same.

Q. And what is the angle of the helical path that you are assuming?

A. That depends on the orientation of the magnetic field.

Q. And what is the orientation of the magnetic field that you use?

A. You can do different calculations for different orientations, but you are going to come out essentially with a similar diameter.

Q. Again, now, what is your authority for the proposition that the cyclotron resonance phenomenon only occurs when a particle or ion is traveling in a circular or now I will add, consistent with your testimony a moment ago, or a helical path? Page 18, lines five to seven.

A. This is a basically physical theory you can find in any basic textbook on physics. It follows the simple laws of physics in terms of -- if you want to get more complicated, it's just Maxwell's equations being applied to a charged particle.

Q. Have you seen any published literature stating your conclusion that the channel width required makes the cyclotron resonance theory for electromagnetic field effect on humans impossible?

A. Yes.

Q. And who are the authors that have expounded that in your analysis?

A. I am trying to remember. There was, I think, an article by Halle. There was an article by Adair.

There were several such articles.

Q. Have you read the rebuttal to those articles?

A. I have some of Liboff's comments. He himself admits that it is very difficult to...

Q. To do what?

A. To put it on a physical basis.

Q. And yet? And yet what does he say?

A. Well, he personally believes there is such a phenomenon. I don't.

Q. Do you have an explanation for the effects that he and others who have found effects are finding?

A. I have no explanation. He's working with very difficult systems. People have gotten opposite effects or no effects. It just doesn't satisfy physical theory and it doesn't satisfy reproduceability of experiments.

Q. Do the negative results satisfy requirements of reproduceability of results?

A. Well, several people have had negative results.

Q. Does that satisfy the requirement of reproduceability?

A. Reproduceability would have many laboratories conducting similar experiments and they should all come out with the same results.

Q. Now, in your testimony at page 21, lines 14 to 20, your last sentence, it says based on your knowledge

and understanding of physics, biophysics and medicine and the research publications on power frequency fields. Why are you drawing a distinction between your knowledge of biophysics and medicine on the one hand and the research publications on power frequency fields on the other hand?

A. I am not drawing a distinction. I'm just saying --

Q. Why don't you talk about your -- well, go ahead?

A. I mean, I personally do not work on power frequency fields. I have worked in the field of biophysics and I have worked in the field of medicine. I feel I'm quite knowledgeable in these areas, certain subspecial areas, and I can read the literature and interpret it.

Q. So your opinion is based on literature interpretation?

A. Correct. Plus my background.

Q. Right. Now, then, your opinion divides into two parts. One is there are very good reasons to believe that power frequency fields -- sorry -- that exposure to power frequency fields does not cause any significant biological effects. And then the second half is your opinion that exposure, et cetera, will not result in adverse health effects in humans.

Now, I see there a distinction between an opinion that you -- your first opinion, where you say there are very good reasons to believe that exposure does not cause any significant biological effects. I see the word significant in there and that implies to me that you are not ready to form the conclusion that it doesn't or that there are very good reasons to believe that it doesn't cause any effects. Is that right? You're not ready to draw that conclusion?

A. What I am saying here is that based on my study of the literature, based on my background, based on my knowledge, the exposure does not cause any significant biological effect.

Q. In your written testimony, however, you say only that there are very good reasons to believe that it does not cause any significant biological effect.

A. Right.

Q. Are you changing that opinion here now?

A. No.

Q. So all you are saying in your testimony here, in your written testimony here, is that there are very good reason to believe that it does not cause any significant biological effect. And there are two qualifiers in there that I see. One is the word significant and the other that there are very good

reasons as opposed to a conclusory statement. Am I correctly understanding your testimony?

A. I don't look upon these terms as qualifiers. To me it's a direct statement.

Q. As contrasted with the last half of that sentence in which it seems to me you make a statement without qualifiers: it is my opinion that exposure, et cetera, will not result in adverse health effects. It seems to me in reading that statement that you were making a stronger statement there because you are not qualifying it by the term very good reasons, you are not qualifying it by the word significant, and you're expressing an opinion that seems to be stronger. Am I finding something in those two clauses of that sentence that -- am I finding a difference that you didn't intend?

A. I think you are reading out of these phrases more than I was saying here. I have no qualifications here.

Q. Are you willing to say that it is your opinion that exposure to electromagnetic fields will not result in any health effects in humans?

A. Will not result in adverse health effects in humans.

Q. Well, now you are putting the word adverse in. I am asking you whether you are willing to give the

opinion that exposure to electromagnetic fields will not result in any effects, health effects in humans.

MR. WATSON: Your Honor, just for the record, he is not putting adverse in there. Adverse is already in there.

JUDGE SMOLEN: Mr. Sugarman, that is clear, I believe.

MR. SUGARMAN: Yes.

BY MR. SUGARMAN:

Q. I mean in response to my question you are putting the word adverse in?

A. Oh, no. I am just reading what I stated.

Q. Oh, okay. Let me try again.

I am asking you a question slightly different, now, from your written testimony. I'm asking you if you're willing to express the opinion that exposure to electromagnetic fields will not result in any health effects in humans.

A. We are talking here about 60 hertz type fields, correct?

Q. No. I am talking about any electromagnetic fields.

A. Any electromagnetic field?

Q. Right.

A. Of any frequency?

Q. Any frequency.

MR. WATSON: Your Honor, I object again --

A. That is an entirely different question.

MR. WATSON: In the scope of this proceeding we have a powerline here of 60 hertz.

MR. SUGARMAN: Okay. No problem.

JUDGE SMOLEN: I don't know where we are now. Has the witness answered the question?

THE WITNESS: I didn't realize he was asking about any frequency. I have already testified that other frequencies can have effects.

JUDGE SMOLEN: Okay.

MR. SUGARMAN: Okay. In that case I don't have any further questions. Thank you very much.

MR. WATSON: No questions.

JUDGE SMOLEN: No redirect?

MR. WATSON: No, Your Honor.

JUDGE SMOLEN: Anything else?

MS. McCLOSKEY: No, Your Honor.

JUDGE SMOLEN: The witness is excused. Thank you very much for appearing and testifying, sir.

THE WITNESS: Thank you, Your Honor.

(Witness excused.)

MR. WATSON: Your Honor, we need a break to set up the other exhibits.

JUDGE SMOLEN: All right. how much time do you need?

MR. WATSON: Ten minutes at the max.

JUDGE SMOLEN: All right. Ten minute break.

(Recess.)

JUDGE SMOLEN: Back on the record.

Let the record show that there are a number of pictures, exhibits, plans, which are posted in the hearing room for the benefit of everyone who is present to view, that is, Counsel as well as members of the public who are present in the hearing room.

Let's proceed with the witness.

MR. WATSON: Thank you, Your Honor.

I call Carter Van Dyke.

Whereupon,

CARTER VAN DYKE

having been duly sworn, testified as follows:

JUDGE SMOLEN: Please keep your voice up. State your full name and business address for the record.

THE WITNESS: My name is Carter Van Dyke. My business address is Carter Van Dyke Associates, 40 Garden Alley, Doylestown, Pennsylvania.

JUDGE SMOLEN: Go ahead, please, Counsel.

MR. WATSON: Thank you, Your Honor.

DIRECT EXAMINATION

BY MR. WATSON:

Q. Mr. Van Dyke, do you have before you a copy of a document entitled Rebuttal Testimony of Carter Van Dyke, Philadelphia Electric Company Rebuttal Statement No. 5?

A. I do.

Q. Do you have any corrections or additions to that document?

A. Yes, I have three small corrections.

Q. Would you give us page and line and tell us what they are, please?

A. Page four, on lines 16 through 18, change the reference to CVD-2 to CVD-3.

The second one is on page 12. On line 14 there are two "of"s. Delete one of the "of"s.

And on page five, line 32, that should read "development and associated commercial facilities that serve the area."

Q. Now, taking into account these corrections, if I were to ask you --

JUDGE SMOLEN: Excuse me for a moment. We are taking out the word "service"?

THE WITNESS: That's correct.

JUDGE SMOLEN: So the end reads "associated

commercial facilities that serve the area"?

THE WITNESS: That's correct, Your Honor.

JUDGE SMOLEN: Go ahead.

BY MR. WATSON:

Q. Now, taking into account these corrections, if I were to ask you today each of the questions set forth in this document entitled Rebuttal Testimony of Carter Van Dyke, would your answers be the same as set forth therein?

A. Yes, they would.

MR. WATSON: Your Honor, in our letter of December 5 which accompanied the testimony of Mr. Van Dyke, along with the testimony of other witnesses as well, we stated that we would be asking for leave to allow Mr. Van Dyke to present the exhibits that he is sponsoring as part of his testimony. Full-sized copies of those exhibits are with us in the hearing room today. We have made them available for viewing by other Counsel. And we have provided smaller copies to Counsel for all parties.

At this point I would like to just ask Mr. Van Dyke a few questions about these particular exhibits to clarify the references to them in his testimony and to the smaller sizes.

JUDGE SMOLEN: Go ahead.

BY MR. WATSON:

Q. Mr. Van Dyke, does your testimony refer to any exhibits?

A. Yes, it does. Eight in total.

Q. Eight. Okay. Can you tell us basically what they consist of?

A. CVD-1 is my curriculum vitae.

CVD-2 is a composite of USGS quad maps.

CVD-3 is an overlay showing a utility overlay over those quad maps.

CVD-4 is an overlay showing streams.

CVD-5 is an overlay showing woodlands.

CVD-6 is an overlay showing urban development.

CVD-7 is an overlay showing zoning within the corridor study area.

And CVD-8 is a large aerial photograph composite with an overlay trace and attached photographs.

Q. Were those exhibits prepared by you or under your direct supervision?

A. Yes, they were.

Q. Could you just show us which one is CVD-2, which I believe is the first set of quad maps?

A. (Witness indicating.)

Q. Just to clarify how this was put together -- it may not show on the small photographs -- how many quad maps did you use to create this?

A. I used four.

Q. Can you tell us which ones you used?

A. The Hatboro, Langhorne, Frankford and Beverly.

Q. And could you show us the first overlay, CVD-3.

A. (Witness indicating.)

Q. What is the title of this, by the way, just for the record?

A. The title is existing utility facilities and corridors.

Q. Are the Woodbourne and Heaton substations shown on this exhibit?

A. Yes, they are shown very small. We are shown at scale. This is the Heaton and over here is Woodbourne.

JUDGE SMOLEN: The Heaton is to the left side?

THE WITNESS: That's correct, Your Honor.

JUDGE SMOLEN: And the Woodbourne to the very right side?

THE WITNESS: Correct.

BY MR. WATSON:

Q. Now, could you tell us where the regional study area is that you have referred to in your testimony when you were pointing to this exhibit? Show us where it is on this big one.

A. It is shown as the area which is outlined, the

extent of the corridors that we mapped, and it is approximately two-and-a-half miles to the north of the substations and two-and-a-half miles to the south.

Q. And on the map how far up does the study area go on CVD-3?

A. About two-and-a-half miles.

Q. But I mean how far on this piece? Does it go to the top, all the way up?

A. It goes all the way to the top and all the way down to the end of the extent of the colored-in area on the map.

Q. The colored-in lines?

A. That's correct.

Q. Can you just tell us -- it may be easier to tell from this thing than from the small pieces, from the smaller maps, about how much area is in the regional study area?

A. About 60 square miles.

Q. What do all these lines on this exhibit stand for. Can you just quickly tell us?

A. The red lines are existing railroads. The double lines are major expressways. The solid lines are arterials. The dashed lines are minor arterials.

Q. What color are all those?

A. Those are all black, with the exception of the

railroad which is shown in red. This is also another black line which says PL in the middle of it and that stands for pipeline. And finally the last ones that are shown are in blue and those are existing transmission lines, electric transmission lines.

Q. Could you flip over to CVD-4?

A. (Witness indicating.)

Q. For the record, what is the title of this CVD-4 overlay?

A. This is streams and waterways. And the legend refers to rivers, streams, lakes and ponds and intermittent streams.

Q. Where is the proposed Woodbourne-Heaton transmission line route on here?

A. Heaton is in this vicinity and it follows along this existing railroad corridor. It follows along stream corridors all the way up to the Woodbourne facility up here.

Q. Did you say stream?

A. Stream corridors.

Q. Now, could you turn to the next overlay, CVD-5?

A. (Witness indicating.)

Q. For the record, what is the title of this one?

A. The title of this is woodlands, and the key says woodlands. Woodlands are signified by the color

green.

Q. Could you again just show us where the proposed route is?

A. The Heaton substation is here. The route is along the corridor through this concentration of woodlands and terminates up to the Woodbourne substation, which is up in the upper left-hand corner -- right-hand corner. Excuse me.

MR. WATSON: Now, Your Honor, in the materials that were provided with Mr. Van Dyke's written rebuttal testimony Exhibits CVD-4 and CVD-5 were presented in a single photograph of this material. We now have them available in separate photographs and if anyone would like -- we had them sort of both together in one eight-and-a-half by 11 size but if Counsel wants another copy with those two parts separated out, Nos. 4 and 5, we would be happy to provide them.

BY MR. WATSON:

Q. Could you flip over to the next one, CVD-6?

A. (Witness gesturing.)

Q. For the record, would you give us the title of CVD-6?

A. Areas of urban development and ultimate alignments.

Q. And could you again just point out where the

proposed line is on this overlay?

A. The proposed line is shown in red, it starts on the left and continues across to the upper right-hand corner of the drawing.

Q. What are those other two lines on here?

A. There are two lines shown in dark green and those are two alternate alignments that we reviewed as part of our analysis. They follow along existing utility corridors for the most part.

Q. Could you now flip to CVD-7?

A. (Witness indicating.)

Q. What is the title of CVD-7 for the record?

A. This is corridor study area and existing zoning.

Q. What are all those orange areas -- show us where the line route is, first.

A. The line route is the red line. It continues from the right to the upper left-hand corner. The corridor studied, then, is bounded on either side by two white lines.

Q. And the line has a lot of colored-in areas on each side of it?

A. That's correct.

Q. Could you just tell us for the record what the orange areas represent?

A. The orange area is noted as moderate density residential zoning.

Q. What about yellow?

A. The yellow is low density residential zoning.

Q. And purple?

A. Purple is areas zoned industrial.

Q. Now, does this exhibit show the corridor study area and also the regional study area?

A. No. We have completed the regional study area with CVD-6. CVD-7 is the first analysis of the corridor study area.

Q. Can you just tell us what the difference is, what you look for in the regional study area and the corridor study area?

A. On the regional study area we are looking at -- actually, we are looking at the same thing but a difference in scale. We are looking at the natural features, existing utility corridors, we are looking at urban development within the regional scale. Once having gone through the process of elimination and determining the best route, we then go through a two step process, the first part looking at the existing zoning and the second part looking at the existing land use.

Q. Just to make sure I understand, is that done in the corridor study area when you are looking at the land

use impacts of the route?

A. That's correct.

Q. And then the regional study area is when you are looking for the best route?

A. That's correct.

Q. Can you point out -- and maybe you ought to go up there just for this one time. Can you just go up to the front of the room for a minute so you can point out this one. Can you describe for us what Exhibit CVD-8 shows?

A. CVD-8 is a composite of 14 aerial photographs with a transparent overlay which illustrates the various land uses within the corridor study area. Attached to that overlay are a series of photographs which illustrate different portions within the corridor study area.

Q. What is the source of the aerial photographs?

A. These are developed by the Delaware Valley Regional Planning Commission. They have the entire Delaware Valley flown every five years. These maps here are the maps that were flown in 1990.

JUDGE SMOLEN: Nineteen when?

THE WITNESS: 1990. These are the most current.

BY MR. WATSON:

Q. Now, have you reviewed, just to make sure we get our bearings straight here, have you reviewed the

aerial photographs that Mr. Turner sponsored as exhibit in this proceeding?

A. Yes, I have.

Q. Are any of the photographs that Mr. Turner used the same as the ones you used, aerial photographs?

A. Yes.

Q. Could you show us which ones are?

A. It's the area in the middle of this presentation, and it consists of the two -- actually, the four maps, four aerial photographs in the center. And if you would like for the record, I could read off the numbers. It's A 36 B 45, A 37 B 45, and this one would be A 36 B 44, and A 37 B 44.

Q. So you have -- those four in the middle are the same four that Mr. Turner had in his exhibits?

A. That's correct.

Q. Now, what is the drawing and coloring on the transparent overlay you have on CVD-8?

A. As the legend states, this consists of woodlands, streams, open space and recreation, residential development, utilities, non-residential development, commercial lands and also shows in a red line the Trenton Cutoff and it shows in white the boundary of the corridor study area.

Q. You say the red line, the Trenton Cutoff, does

the red line show the proposed route?

A. That's correct.

Q. Now, there are some photographs attached to Exhibit CVD-8. Can you tell us what those are?

A. These are photographs that I took in my site inspection review of the corridor study area.

Q. When did you take those?

A. I took these the latter part of November, the early part of December.

Q. Of this year?

A. Of this year.

Q. Are these photographs representative of the actual areas that you have observed in the corridor study area?

A. That's correct.

Q. How many photographs, counting the ones that look like they are taped together as a series, how many total number of photographs do you have there?

A. I believe it was 35.

Q. I notice that these photographs have a line extending from the corner of the photograph down into the route area. There is one up there in the middle box, there is one with towers on it. Do you see a whole bunch of towers?

A. This one?

Q. Yes. I can see that line drawn down into the route area. Can you tell us what that line represents?

A. That line points to a circle, in this case in front of a new residential home, and then it has an arrow from that circle in the direction in which the picture is taken, in this case towards those electrical towers of the substation.

Q. So you're saying that that photograph was taken in the area of the new residences and it was taken at the angle that comes off the circle?

A. That's correct.

MR. WATSON: Your Honor, I guess -- I we are finished. I think Mr. Van Dyke can have a seat.

Your Honor, I would just move at this time that the testimony and exhibits of Mr. Van Dyke be admitted into evidence subject to timely and appropriate objections.

MS. McCLOSKEY: Your Honor, we have an objection and a motion to strike portions of Mr. Van Dyke's testimony, beginning at page six --

JUDGE SMOLEN: Wait just a minute, please.

MS. McCLOSKEY: Okay.

JUDGE SMOLEN: Go ahead.

MS. McCLOSKEY: Beginning with page six, line one, through page eight, line 11, where Mr. Van Dyke discusses

alternative routes. The OCA would submit that this violates Section 5.243(e) of 52 Pa. Code, which states that a participant will not be permitted to introduce evidence during the rebuttal phase which is repetitive or should have been included in the participant's case in chief. The OCA submits that the discussion of alternative routes is not responsive to any testimony that has been presented in the direct phase of the Protestant's or the OCA's case, and that PECo in its prehearing memo argued that the location of this line was not an issue in this proceeding, and thirdly, that Your Honor had held that PECo had the burden of proof as to all requirements under the regulations that it normally would have had and in that they would have presented evidence with their filing as to alternative routes and since they did not pursue that in their direct case it is not proper rebuttal at this time.

MR. SUGARMAN: I would like to join in that objection and that motion and state that we were precluded from presenting evidence as to anything other than, quote, need, end of quote -- I mean, other than, quote, effect, end of quote. And so while we would have had testimony as to alternatives had the company presented it or had Your Honor ruled that it was admissible, we were told that this was not possible or

proper at this stage of the proceedings. And so we did not have such testimony because we were precluded.

Your Honor's ruling specifically said that the company would have all of the burdens that it normally has under the rules, and the combination of those two rulings made it clear to us that we were not permitted to put in evidence as to alternatives. So there is nothing for the company to rebut because they failed to meet that basic part of their case to begin with.

The way I understood it, if I may go on just to bring us back to last summer, was that if the Commission concluded or if Your Honor concluded that there was an effect from the line on my clients then the other issues would be opened up. And I argued that it all ought to be decided together and it all ought to be heard together and that position was rejected. That is why we were precluded from our witness on need. That is why our interrogatories on need, which also would have gone to alternatives, our interrogatories were not answered and the objection to answering them was upheld.

MR. WATSON: Your Honor, this is in rebuttal to the material set out in Mr. Turner's testimony, page eight, the sixth bullet.

JUDGE SMOLEN: Let's give them a chance to look at it. Wait just a second. I don't have Mr. Turner's

testimony before me. Do you want to --

MR. WATSON: Maybe I should read that into the record. It says there, quote, are there alternatives using more established and wider rights-of-way that could be used in lieu of this intrusion into a rail corridor with mixed uses, question mark, close quote.

JUDGE SMOLEN: And what is the response?

MR. WATSON: The response is that they opened it up, they raised it. They presented testimony of this witness on it and it would be unfair not to allow us to respond to it.

MS. McCLOSKEY: Your Honor, I think that is reading Mr. Turner's testimony completely out of context. In that section he is stating a number of reasons why a prudent avoidance approaches is appropriate and there he lists seven conditions or seven criteria of prudent avoidance. He does not address any of those but raises those as questions that should be answered in a prudent avoidance context.

JUDGE SMOLEN: Does it discuss alternate routes?

MS. McCLOSKEY: No, it does not discuss any alternatives.

JUDGE SMOLEN: Just mentions the phrase alternate routes?

MS. McCLOSKEY: It mentions the question when one

is looking at prudent avoidance as to whether there are alternatives using more established and wider rights-of-way that can be used in lieu of this intrusion into a rail corridor with mixed uses. It does not answer that question.

JUDGE SMOLEN: That is a question. What answer does he give to that question?

MS. McCLOSKEY: There is no answer. That is a question one should ask -- maybe I should show it to you -- it's a question one should ask when looking at prudent avoidance or criteria, so to speak. It starts at the bottom of page seven and then on to eight.

JUDGE SMOLEN: I see. This is his testimony, not a question by Counsel.

MS. McCLOSKEY: Yes, Your Honor.

JUDGE SMOLEN: All right.

MR. WATSON: I would like to respond.

JUDGE SMOLEN: Yes, you may.

MR. WATSON: Your Honor, I think it is not only not out of context, it is precisely in context. Here is an example of a land use witness, Mr. Turner, testifying that the consideration of alternatives and the suggestion of having alternatives using more established and wider rights-of-way -- he didn't just say are there alternatives, he specified the conditions: alternatives

using more established and wider rights-of-way that could be used in lieu of an intrusion into a rail corridor with mixed uses. In this instance, Your Honor, Mr. Turner is using that as an argument for why a position ought to be taken as to prudent avoidance.

And he says, in other words, prudent avoidance may not justify costly and major rerouting of existing facilities, but it may justify the cost of regulating facilities to avoid potentially greater future costs, and that is to encourage the placement of facilities away from areas where people live and work. That is a paraphrase of his testimony on page seven. So they have put alternatives directly at issue as an argument by Mr. Turner to support his testimony. I don't see how we could be prevented from having an opportunity to respond to that.

MR. SUGARMAN: Your Honor, the point Mr. Turner was making was that the company's proof was inadequate because they didn't deal with that subject. That would be like a witness failing to bring in an expert -- the plaintiff failing to bring in an expert whereupon the defendant's expert makes a comment that there was no expert on such and such a subject and the plaintiff is then allowed to bring in an expert on such and such a subject when he should have brought him in in the first

place.

If it was appropriate for alternatives to be considered in this proceeding that we are in now, then Your Honor laid the burden directly on the company in Your Honor's order because Your Honor said the company has the burden that it has under the rules.

I thought and I thought Your Honor ruled, and it is clear to me and I think it is clear to OCA as well, that Your Honor ruled that that would not be appropriate at this stage of the proceeding. Therefore Mr. Turner was foreclosed from developing alternatives.

But if it was appropriate for it to be heard, then the company had the burden to bring it out in the first place, and Mr. Turner's comment on the things that the company didn't bring out can in no way be considered to be testimony on that subject. He didn't testify that there were or weren't feasible alternatives. There is nothing to rebut in that record. And Mr. Van Dyke's testimony does not rebut Mr. Turner anyway because all Mr. Turner said was you got to look at alternatives. But he was foreclosed from going any further than that.

But in any event, I go back to Ms. McCloskey's argument that I agree with that the company, to the extent that it was open in these proceedings it was the company's initial burden to do it because Your Honor

explicitly ruled that they have all of the burdens that they normally have in an application proceeding.

JUDGE SMOLEN: Anything more, Ms. McCloskey?

MS. McCLOSKEY: No, I have nothing to add, Your Honor.

JUDGE SMOLEN: All right.

Mr. Watson?

MR. WATSON: May we have a moment just to check something?

JUDGE SMOLEN: Yes.

(Pause.)

MR. WATSON: Your Honor, in response let me just point out that we did not present testimony on alternative routes earlier. The issue was raised as to alternative routes by the testimony of Mr. Turner where he made the point that to support his argument about prudent avoidance you would, as he said it, look for more established and wider rights-of-way that could be used in lieu of what is proposed here. He is urging that prudent avoidance would suggest doing something different and his rationale is to address alternatives, and he even sets the criteria for those.

JUDGE SMOLEN: I was going to ask did not that testimony refer to prudent avoidance and study of alternative routes before a route was selected rather

than after the route has been selected in an attempt to justify the selection of a route which was already selected?

MR. WATSON: Your Honor, I don't believe he did. I believe his testimony simply was that at this point in one of these proceedings is where prudent avoidance gets applied and that you would take a look and that if you found more established and wider rights-of-way that that was one factor to be considered in whether to adopt certain prudent avoidance measures. And we are simply responding to that point and that point alone and that point directly.

MR. SUGARMAN: Your Honor, I would again make the point that when Mr. Oedemann was testifying, and I asked, and Mr. Boeggeman, maybe both or maybe one or the other, and I don't have the testimony here, but I asked whether they had considered alternative routes and they said no, they had not.

MR. WATSON: Your Honor, I think that's not a fair characterization.

JUDGE SMOLEN: Well, it's a statement of Counsel. He's characterizing his correction of the testimony.

MR. SUGARMAN: I could stand corrected if somebody has the transcript here.

JUDGE SMOLEN: You can argue otherwise.

MR. SUGARMAN: But what I go back to is the facts that the Commission through Your Honor decided that this phase of the case was going to be limited to the issue of effects. And I don't know how many times in the course of my case I was told to limit it to effects and if we find effects then we will go on and deal with issues of need and alternatives. So Mr. Turner's testimony was exactly as Your Honor said, was limited to a critique of what the company had done and the nature of things that ought to be done rather than developing alternatives. So this does not rebut him in any way. There is nothing in his testimony that Mr. Van Dyke's testimony will rebut because he didn't express an opinion. Mr. Turner did not say there are three good alternatives, he didn't say there are four good alternatives, and he didn't say what the criteria are, except in a general way by which any particular alternative would be judged. So this isn't rebuttal.

JUDGE SMOLEN: Ms. McCloskey?

MS. McCLOSKEY: Your Honor, I would just state that I think you have accurately stated Mr. Turner's argument, which is what steps should have been done before a route was selected, and then he listed a prudent avoidance approach to that consideration and this testimony was done after the route was selected and has no relevance to

Mr. Turner's testimony. And again, it should have been presented in the company's direct case had they made such an analysis.

MR. WATSON: Subject to correction, Your Honor, I don't find that Mr. Turner said that at all. He didn't say this is what should have been done some time ago. He says there are a number of reasons why prudent avoidance approaches are appropriate to the case, and then he lists them. And one of the ones that he lists that is going to be an issue is alternatives using more established and wider rights-of-way that can be used in lieu of intrusion into a rail corridor with mixed uses. And we are simply responding to that statement.

I think, Your Honor, in fairness if we can't respond to this statement then references to alternatives in Mr. Turner's testimony ought to be stricken. Because that is sort of saying, well, we said it and guess what, we found some way to construe his testimony so you can't respond to it.

MS. McCLOSKEY: Your Honor, I think Mr. Turner's testimony presents a policy approach to prudent avoidance and in fact one that is reflected in Mr. Silva's testimony of tomorrow, which addresses certain criteria. That's all he said, this is a policy one should consider. He did not address alternatives.

JUDGE SMOLEN: Anything further? Anything further by any Counsel?

MR. WATSON: Yes. I don't think it represents a policy approach. He talks about it here. And obviously he is referring to this line. He is not referring to a theory. He refers to the Woodbourne-Heaton case, specifically this case that we are now in the process of trying, and this witness has testimony dealing directly with that in response to this.

JUDGE SMOLEN: Anybody want to say anything else before I rule?

(No audible response.)

JUDGE SMOLEN: Motion to strike is granted for the reasons set forth by Counsel for OCA and Counsel for PAUSE. That is pages six, seven and the top of page eight up to and including line 11.

MR. WATSON: Your Honor, I move to strike the references of Mr. Turner to alternatives in his testimony on the same grounds put forth by Counsel who argued the preceding motion.

JUDGE SMOLEN: Let's hear arguemnt on that.

MS. McCLOSKEY: Your Honor, I would state that, first of all, Mr. Turner's testimony has already been accepted into the record without previous motion to strike and the motion is untimely.

Secondly, one of my grounds was Section 5.243(e)(b) which dealt with the rebuttal phase testimony and Mr. Turner's testimony was directed in direct.

And third, as I have stated earlier, he dealt with considerations that should have been looked at before the line location was selected and did not deal with location which Your Honor had ruled --

JUDGE SMOLEN: I want to get that clear on the record. Does that witness' testimony deal with alternative locations?

MR. SUGARMAN: No, Your Honor.

JUDGE SMOLEN: Specific alternative locations?

MR. SUGARMAN: No, Your Honor.

MS. McCLOSKEY: No, it does not, Your Honor. Mr. Turner's testimony does not deal with specific alternative locations for the Woodbourne-Heaton transmission line. And therefore we would argue that the motion to strike should not be granted.

MR. WATSON: Can we have a reference to the claimed statement of Mr. Turner that all of this should be considered in advance and that it is not considered in the context of this case?

JUDGE SMOLEN: Let's see if Counsel can find such a specific statement or implication.

MR. SUGARMAN: Page six, six lines from the bottom:

"In addition, this matter is confounded by the fact that the original corridor or right-of-way as established for a rail line and that 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 E/MF levels. Generally, the regulation of potential hazard involves the establishment of limits based on scientific research and measures, a threshold beyond which detrimental effects are proven serves as the basis," et cetera, and he goes on to say what should be done.

MR. WATSON: I would again ask for a reference to the very point.

JUDGE SMOLEN: When Mr. Sugarman says and goes on to say what should have been done, is there such a sentence including that type of phraseology?

MR. SUGARMAN: "In the interim, it is important for local jurisdictions which have been given" -- well, he is talking about, "in defined cases such as these it becomes much more difficult to establish reasonable guidelines. The scientific evidence is not yet conclusive to form the basis of mandatory regulations. At some future time the evidence may be very clear and many existing facilities

may be forced to reduce exposure or perhaps even relocate at great expense to their owners and to the public at large. In the interim, it 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 E/MF issues in an equitable and reasonable manner. Prudent avoidance, a term introduced, is one such approach," et cetera. "That is, it looks systematically" --

JUDGE SMOLEN: Let me stop you. So you are saying that the testimony is that this witness stated, that witness from whom you are quoting, that a policy is to be developed in the future?

MR. SUGARMAN: Exactly. Should be developed.

JUDGE SMOLEN: Should be developed.

MR. SUGARMAN: And should be applied. Exactly.

It goes on to say, "The prudent avoidance strategy is implicit in statements by Mays Sweetcord, chief of the radiation biology branch of the FDA," et cetera.

JUDGE SMOLEN: Okay. We don't have to repeat the testimony. That's already in.

Mr. Watson.

MR. WATSON: Your Honor, I think it's clear from the reading by Counsel, they can't find that statement.

It's not there. It doesn't exist.

MR. SUGARMAN: It's all in there.

JUDGE SMOLEN: I am going to deny the motion, the motion to strike. Let's go ahead.

The witness has been offered for cross -- well, the testimony and exhibits have been moved and you were in the process of objecting to receipt of certain portions of this witness' testimony.

MS. McCLOSKEY: Right.

JUDGE SMOLEN: Have you completed?

MS. McCLOSKEY: I have completed, Your Honor, yes. I have only the objection that I have noted.

JUDGE SMOLEN: Then let's go ahead with your cross-examination. All other portions of the testimony and exhibits are received.

(Whereupon, the document was marked as PECo Rebuttal Statement No. 5 for identification, and was received in evidence.)

JUDGE SMOLEN: Go ahead.

MR. WATSON: Your Honor, I had one other thing.

JUDGE SMOLEN: I'm sorry. I thought you had moved --

MR. WATSON: I had one other thing as a procedural matter. I hadn't passed the witness yet.

Under rule 5.409 we are required to provide copies

of exhibits to all Your Honor, all parties and two additional copies to the Commission. Unless Your Honor directs otherwise, we have these large exhibits, as you can see here, and given the size of these we would propose to submit the original exhibit to Your Honor along with two photographic reproductions of each exhibit identical to the photographic reproductions that were already forwarded to Your Honor and the parties. And we ask that these photograph reductions be accepted by the other parties in lieu of full-sized reproductions.

JUDGE SMOLEN: Let's hear from the other parties.

MS. McCLOSKEY: I have no objection, Your Honor.

MR. SUGARMAN: No objection, Your Honor, as long as the full-sized exhibits are available for inspection during business hours at PECo in Philadelphia.

JUDGE SMOLEN: Well, for the record, the record copies, let's have the record copies go with the record, which eventually will be in Harrisburg, not with me.

MR. SUGARMAN: Fine.

JUDGE SMOLEN: Because what I have are the ordinary size photographs. But let the record copies go with the record to Harrisburg so it is part of the official documents so that when the Commission reviews this case it will have these blowups.

MR. WATSON: That is exactly what we were

suggesting. We will let everybody else have the copies we previously sent them, subject to anybody who wants this extra copy that had two things on one photograph. And you will keep these so if somebody wants to inspect them --

JUDGE SMOLEN: Well, I'm not keeping them. They are going to go with the record.

MR. WATSON: Ultimately they will go with the record.

JUDGE SMOLEN: That's right. Very good. Your suggestion is well taken and we're going to adopt it.

MR. WATSON: Your Honor, I now pass the witness.

JUDGE SMOLEN: Go ahead.

MS. McCLOSKEY: Thank you, Your Honor.

CROSS-EXAMINATION

BY MS. McCLOSKEY:

Q. Good morning, Mr. Van Dyke. My name is Tanya McCloskey and I am with the Office of Consumer Advocate.

I would like to start on page four of your testimony. At line eight you define the study area, the regional study area, as 2.5 miles on either side of the right-of-way for the Trenton Cutoff. Why did you select 2.5 miles?

A. It was really an average. When looking towards the north it was really bounded by the limit of east-west

oriented existing corridors or utility routes. To the south it was also bounded by utility corridors or utility routes, as well as the Delaware River. So it really did create a physical boundary line.

Q. And did you consider any other bounding other than the 2.5 miles, say, for example, a greater distance to the north but still the 2.5 to the south?

A. No, I did not.

Q. And did you consider any other areas other than an east-west alignment, for example, a non-linear alignment?

MR. WATSON: Excuse me, Your Honor. Consider for what purpose?

MS. McCLOSKEY: Consider in choosing a regional study area, in selecting.

A. We studied the area within the boundary which I described, two-and-a-half miles, approximately two-and-a-half miles to the north and two-and-a-half mile to the south and the extent of the distance between the two substations, which is approximately two-and-a-half miles, and that totaled about 60 square miles in area.

BY MS. McCLOSKEY:

Q. Now, at line ten on page four you define the corridor study area as 400 feet on either side of the right-of-way of the Trenton Cutoff. What was the basis

for selecting 400 feet?

A. The 400 feet was a width that we felt was necessary in order to get a good approximation of the adjacent land uses. It also coincided with some of the natural features within the corridor. And finally, with the large aerial photographs on the wall, coincidentally, was one inch is equal to 400 feet and one inch was a nice breakoff point.

Q. Now, on your exhibit, the large exhibit, is that CVD-8?

A. That's correct.

Q. Of the corridor study area, you have light tan shadings for residential areas, and there are some small light tan shading and some larger light tan shading. What is the difference between the two?

A. May I go up and inspect?

Q. Sure.

A. Some of the small tan shaded areas, both within and outside of the corridor study area, are single family detached residences. The large tan buildings are multi-family type units, such as townhouses or garden apartments.

Q. Now, at page 12 of your testimony, down at line 25, you talk about the railroad use of the corridor until the mid-1980's. And in your analysis did you determine

when the homes that fall within the corridor study area, whether single family or multi-family dwellings, were built along that corridor?

A. Yes, I did.

Q. And when were those homes built along the corridor?

A. It's variable. In some of the areas along the corridor study area I observed some homes which appear to have been around the turn of the century or perhaps older. These were generally in this case individual residences. There were very few of those.

There were a number of them which appear to have been built, I would say, after the second world war and up to, possibly, the early '60's, judging by the style of houses, split level homes and this nature, your standard single family detached development of that period. And you can also date the developments by the age and the size of the trees.

There were some, I believe two developments, which appear to be very recent, one which is a townhouse development which is still under construction. And there is a single family detached cul-de-sac, it was the one I referred to in the photograph earlier, where there is still, I believe, one lot available for sale. It is still in the process of construction. They are very

recent. You can tell that because there is no vegetation around the homes. The lawns have just been seeded.

Q. I believe you also referenced there the zoning for the area along the corridor. Do you know when the zoning was adopted for that corridor?

A. Well, that is hard to say. We are addressing in this case six municipalities and two adjacent boroughs. Most of the zoning that took place in these Montgomery County and Bucks County communities, to the best of my knowledge, was during the late '40's or early '50's, some communities as late as the early '60's. But I would have to check my records to see specifically for the dates for each of the existing municipalities within the corridor study area.

Q. Now, turning to page 14 of your testimony, lines one and two and then again on lines 22 through the end, 38, and onto the top of 15, you talk about market valuation effects from E/MFs. And I believe you conclude that market effects would already be included in the market price of the homes along that corridor. Is that a fair summary of your testimony?

A. Yes, that was the conclusion of my analysis.

Q. And have you reviewed or considered current public knowledge, information or awareness of transmission line projects in reaching your conclusion?

MR. WATSON: Objection, Your Honor. Beyond the scope. He has not testified as a public opinion expert.

MS. McCLOSKEY: Your Honor, he has testified that the effects or fears of E/MFs would have no effect on the market valuation of these homes. I am just asking --

JUDGE SMOLEN: What he considered?

MS. McCLOSKEY: Yes.

MR. WATSON: What he considered would be a different question. That I wouldn't object to.

MS. McCLOSKEY: I asked him if he specifically considered current public opinion in reaching his conclusion. And I think that goes to the basis of his conclusion that public fear would not change the valuations.

MR. WATSON: I think she has a good point. I will withdraw the objection.

JUDGE SMOLEN: There is nothing for me to rule upon. You may answer the question.

A. Yes, I am aware that there is public fear of E/MFs and did take that consideration into account.

BY MS. McCLOSKEY:

Q. And when you say you took that into account, what types of cases or public fear have you reviewed or considered?

A. I reviewed the testimony of Mr. Turner. I did

not explore any additional information other than that.

Q. So you did not review recent newspaper accounts of other transmission lines in Pennsylvania?

A. That's correct.

Q. And you spoke about reviewing the testimony of Mr. Turner. Did you review the testimony of what we have termed the Protestants, which are the people who live along the corridor area which you have studied in this proceeding?

A. No, I did not.

MS. McCLOSKEY: I have no further questions, Your Honor.

JUDGE SMOLEN: Mr. Sugarman.

MR. SUGARMAN: Just a few.

CROSS-EXAMINATION

BY MR. SUGARMAN:

Q. Good morning, Mr. Van Dyke.

A. Good morning.

Q. You testified that your pictures are representative of what you see on the corridor. You are not saying that each picture represents an average, are you, of anything?

A. To answer your first question, yes, these are representative of corridor. And they are representative of areas along the corridor that can be seen from the

roadway.

Q. Well, you testified that some 22 percent of the corridor is developed in medium density residential?

A. That's correct.

Q. And where in your photographs are you showing the medium density residential?

A. Medium density residential, as I defined it, is the density between one dwelling unit and eight dwelling unit per acre.

Q. And where are you showing that in your photographs?

A. If I could come up...

JUDGE SMOLEN: Yes, you can come up.

A. On the right-hand side there are --

BY MR. SUGARMAN:

Q. Wait. We're on the left-hand side, aren't we?

A. I'm sorry. On the left-hand side there are no residences within this third sector until you begin to get towards -- just about the third way point. We begin to see some residences here.

Q. Now, wait. Where is a picture of those typical residences?

A. I don't have -- what I have, Mr. Sugarman, is a picture of the closest building to the proposed line because I wanted to show the scale of one of the towers.

And it is a commercial building in this case. This is the closest building to the line. It is all industrial on the other side.

Q. Well, I'm not criticizing your pictures, it's just that you don't have any pictures of those medium residential developments.

A. We do right here in the middle of the display. It shows a picture actually taken from the center of the cul-de-sac between two of the single family detached residences so you can see the relationship between the building and the tower to the rear of that property.

Q. Where is the tower shown?

A. The tower is shown right here in the middle of the picture. It's hard to see because it blends in with the trees.

Q. Right.

A. And the house is shown to the left in the foreground.

Q. Now, is that condition that's shown in that photograph there representative of 22 percent of the corridor?

A. Not really because the house in question which I am showing is one of the closest houses to the corridor, and I did that for that purpose.

Q. Closest houses to the line, you mean?

A. One of the closest houses to the line.

Q. Where is the representative photograph that shows the 22 percent of low density residential in the corridor?

MR. WATSON: Objection, Your Honor. That's argumentative.

MR. SUGARMAN: It's just a question: where is the representative photograph.

JUDGE SMOLEN: He took out the 22 percent.

What's the question now?

BY MR. SUGARMAN:

Q. Where is the representative photograph of the 22 percent of the corridor?

JUDGE SMOLEN: I thought you had eliminated the 22 percent.

MR. WATSON: I object to that.

MR. SUGARMAN: No, no.

MR. WATSON: He didn't testify that a photograph was going to represent 22 percent, Your Honor.

MR. SUGARMAN: Where are the photographs. My question deals with the word representative. If the photographs as a whole are representative of the conditions, as I understand the word representative there ought to be a proportion of photographs equivalent to the proportion of uses.

BY MR. SUGARMAN:

Q. So my question is where are the photographs -- do 22 percent of the photographs contain examples of the medium and low density uses along the corridor?

A. I will try to count them off for you, Mr. Sugarman.

Q. Very good.

A. There is the one we just referred to with the transmission line behind it.

The second one is -- there are two here showing, again, this moderate density development. In this case they are townhomes. That shows the transmission line between the two sets of buildings, which blends in with the woods in the background,

The fourth one is the one that I referred to earlier in my testimony with the new house just opposite the existing substation.

The fifth picture is a new house with no landscaping around it, just showing a street which acts as a buffer to the transmission line. And you can see the tower just opposite with a vegetative buffer in between.

The sixth one, I believe it is six now, is an example of another single family detached development looking between two buildings with the tower between them

and hedgerow of trees.

And the seventh picture is shown just opposite that, which is working towards the right-hand side of the presentation sheet, showing a red house to the right and a white house to the left, and the transmission line in this case is much more difficult to see in the background because in this case the ground drops off to the rear.

Q. Do you think you've got another one?

A. This is open space. This is a golf course.

Q. Have you got one more at the end?

A. And this whole area here is industrial.

Q. Industrial. Okay.

A. Or vacant land.

Q. Now, you calculated that 22 percent of the right-of-way is occupied by low and medium density housing -- 22 percent of the corridor, I'm sorry, the 400 foot corridor. Are you including the streets in that 22 percent, or is that 22 percent a function of acreage or of uses or what?

A. The way I calculated that, Mr. Sugarman, is I took the linear frontage of those uses along the right-of-way.

Q. The what?

A. The linear frontage of those uses along the right-of-way.

Q. Along the right-of-way?

A. Along the right-of-way of the existing railroad line.

Q. So just to illustrate, if you took all the acreage in the 400 foot corridor the number might be higher or lower than 22 percent?

A. No, I don't think so. It represents a really good average of the best determination of how to --

Q. All right. And it's a linear foot average, it's not a number of uses. For example, if industrial lots, as we know, are often bigger than home lots there might be more than 22 percent of the lots that might be residential.

MR. WATSON: Objection, Your Honor. It's a compound question. If he could just break it up into two --

MR. SUGARMAN: I will break it up.

BY MR. SUGARMAN:

Q. More than 22 percent of the lots might be residential, is that right?

A. I can't answer that. I didn't count the number of industrial or commercial uses.

Q. Okay. Now, looking at those houses that show up in your exhibit as little red squares there inside the parallel white lines --

JUDGE SMOLEN: So the record is clear, they are tan. Go ahead.

BY MR. SUGARMAN:

Q. And therefore in the corridor. Which of those, Mr. Van Dyke, would you advise -- which of those families would you advise to remain there in their homes?

MR. WATSON: Objection, Your Honor. Argumentative.

JUDGE SMOLEN: I will sustain that. Go ahead.

BY MR. SUGARMAN:

Q. Well, Mr. Van Dyke, did you familiarize yourself with the concept of prudent avoidance?

A. Yes, I did.

Q. Did you familiarize yourself with the exhibits that we have of PECo recommending consideration of prudent avoidance?

A. No, I did not.

Q. Well, if you knew that PECo had recommended that people consider prudent avoidance would that change your testimony?

MR. WATSON: Your Honor, I object. This witness has not testified about prudent avoidance. He has testified strictly about land use.

BY MR. SUGARMAN:

Q. Oh, you are not testifying, then, there won't be any effect on my clients?

Q. Along the right-of-way?

A. Along the right-of-way of the existing railroad line.

Q. So just to illustrate, if you took all the acreage in the 400 foot corridor the number might be higher or lower than 22 percent?

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BY MR. SUGARMAN:

Q. Oh, you are not testifying, then, there won't be any effect on my clients?

MR. WATSON: Your Honor, that is argumentative.

JUDGE SMOLEN: Well, I am going to sustain the first objection. Let Mr. Sugarman repeat the next question.

BY MR. SUGARMAN:

Q. You're not testifying, then, there won't be any effect on my clients' enjoyment of their properties or the benefits that they realize from their properties, are you?

JUDGE SMOLEN: Wait. We have an objection. I am going to ask effect in what way? You are talking about health effect?

MR. SUGARMAN: No, not health effect. Effect on enjoyment of their properties. That is to say whether they can play in their backyards -- have their children play in the backyards -- whether they can --

JUDGE SMOLEN: Isn't that an alleged health effect?

MR. SUGARMAN: Well, Your Honor, I am talking about prudent avoidance, you see. I am talking about the effect of trying to be prudent and avoid the potential for health effects.

JUDGE SMOLEN: Well, what's your question?

MR. SUGARMAN: So I am not asking Mr. Van Dyke will they get sick. I am asking Mr. Van Dyke will they be affected in the way they use their properties if they try

prudent avoidance to avoid getting sick.

MR. WATSON: Your Honor, I object.

BY MR. SUGARMAN:

Q. My question, sir, was you are not testifying that that won't happen, are you? That they won't suffer in their abilities to use their properties?

MR. WATSON: Objection, Your Honor. This witness is a land use planning expert. This witness is not an expert on prudent avoidance. This witness has not testified about prudent avoidance. Prudent avoidance is a policy determination not to be made by a land use planner. Land use planning information is one element of that. This expert has provided that information. This expert has not purported to then go to the conclusion of whether prudent avoidance ought to or ought not be applied and if so how. And it goes beyond, therefore, this expert's testimony. There is no reference --

MR. SUGARMAN: It's cross-examination, Your Honor.

JUDGE SMOLEN: I am going to sustain the objection. Try it again.

BY MR. SUGARMAN:

Q. Mr. Van Dyke, in establishing market value, which you testified about, and in opining there would be little or no effect on market value did you consider the extent to which the utilization of the property might be

inhibited by the advice that people are given to prudently avoid exposure to E/MF?

A. As a follow-up to your question, Mr. Sugarman, I really see that, really, beyond my layer of expertise.

Q. So you did not consider the extent to which my clients and others might be inhibited in the use of their property?

A. I looked at it in terms of whether there would be any impact upon the existing land uses, whether there would be any changes and how it might affect property values.

Q. Do you agree that if people who buy houses because of their existing perceived benefits, such as the outdoors, are then prohibited or inhibited from utilizing the outdoors that that has an adverse effect on them?

MR. WATSON: Objection, Your Honor. It assumes facts not in evidence. There is no proof that these people are inhibited from using their houses.

MR. SUGARMAN: They are told by the company to practice prudent avoidance.

JUDGE SMOLEN: Overruled.

MR. WATSON: They are not, Your Honor, told by the company to practice prudent avoidance. They are told to give consideration --

JUDGE SMOLEN: That they might modify their

behavior.

BY MR. SUGARMAN:

Q. Do you agree that people who buy a real estate property from a land use perspective because of its perceived benefits, including the outdoors, are affected in the value that they have in that property by the inhibition from using those assets which have gone into their purchase decision?

A. My experience is there are so many variables in which people go into in deciding where to locate. My firsthand experience is that some people seek to locate next to a transmission corridor because it is an added open space, which in light of some testimony seems to be in direct contrast. They see it as a freebie in that respect. It is more open space, it is an amenity. To the point where we have even had a client who had 50 acres and located his three-and-a-half million dollar house right next to an electric utility tower because it was on a hill and afforded him the best view. So, you know, there are a number of values that go into deciding where people are going to locate.

I think the issue that you are talking about, is one on perceived fear, is one particular value. There are schools that people consider, location to commercial facilities. There is a host of values that go into the

decisionmaking process of where to locate.

Q. Thank you. Now, do you agree that when a value or a factor which is perceived as neutral from a health perspective such as a transmission line up until five or ten years ago --

MR. WATSON: Objection, Your Honor. It assumes facts not in evidence.

JUDGE SMOLEN: Yes.

BY MR. SUGARMAN:

Q. Well, do you agree, Mr. Van Dyke, that in the various siting proceedings that took place in Bucks County in this general area from 1965 to 1985 it was generally accepted that there was no issue of health effects associated with transmission lines? For example, the 500 kV line that the Commission approved from Whitpain to Branchburg.

MR. WATSON: Objection, Your Honor. This witness has not testified and is not qualified to testify on what were the issues in legal proceedings ranging over a 20 year period.

JUDGE SMOLEN: Sustained.

BY MR. SUGARMAN:

Q. All I'm driving at is don't you agree that the public perception and the literature has changed with respect to the potential health effects of transmission

lines over the past ten years?

MR. WATSCN: Objection, Your Honor. That is beyond the scope. He has testified --

MR. SUGARMAN: Oh, no. He said very specifically that --

MR. WATSON: He testified what he considered, but he did not testify to the state of overall public perception nor did he testify to the state of the literature.

MR. SUGARMAN: To the contrary --

MR. WATSON: And we didn't object when he was asked to testify --

JUDGE SMOLEN: I am going to sustain right now and ask Mr. Sugarman to rephrase.

BY MR. SUGARMAN:

Q. Do you agree that public opinion and the factors that the public takes into account are relevant in establishing market value?

A. Yes.

Q. Do you agree that public opinion with respect to the potential health effects of transmission lines has changed significantly in the past ten years?

MR. WATSON: Objection, Your Honor. He is not an expert on public opinion, where it stood ten years ago and where it stands now. He has no capacity to testify

as to that.

He did testify as to what he considered. We didn't object to that part of it. But he can't testify to the state of public opinion ranging over a ten year period. He's not an expert.

JUDGE SMOLEN: I agree. He can't testify as to the state of public opinion.

BY MR. SUGARMAN:

Q. I will ask this, then. In giving your testimony that some -- on page 15, line nine to 11, when you said some prospective purchasers in the corridor study area may consider the E/MF issue among many other issues in deciding whether to purchase in the area, do you agree that the more they might consider it the more likely it is that the market value will be affected?

A. I guess you have to draw a conclusion depending upon in which direction they come to a conclusion with respect to the E/MF issue.

Q. Right.

A. Whether or not that would affect their, you know, their desire to purchase in the area.

Q. Right.

A. And I can't speak for the values for everyone who is going to move into the area.

Q. Well, do you know of any basis for considering

E/MF as a reason -- as a positive reason to select a home? That is, is there any reason why anybody would want to cuddle up to an E/MF source?

MR. WATSON: Objection, Your Honor. He has not testified as to any possible or claimed adverse or beneficial effects of E/MF.

MR. SUGARMAN: He has said in his testimony the following: "Some prospective purchasers in the corridor study area may consider the E/MF issue among many other issues in deciding whether to purchase in the area. This does not suggest, however, that the market or market value will be affected but, rather, only that the issue might be considered and as I have indicated my analysis of this region does not reveal any effects on land use, zoning or property values that would suggest that any such consideration of the E/MF issue if it is occurring has had any affect on these land use factors."

JUDGE SMOLEN: What's the question?

MR. SUGARMAN: He's expressing an opinion on whether prospective purchasers are affected by E/MF and I'm testifying that opinion.

JUDGE SMOLEN: All right. And what is the question?

BY MR. SUGARMAN:

Q. My question is do you know of any reason why --

you indicated that you don't know which way the effect of E/MF would go if there was more consideration rather than less. And I am asking you do you know of any reason why consideration of E/MF would have a positive effect, that is, would attract buyers?

MR. WATSON: Your Honor, I renew my objection. The objection, Your Honor, is based on the witness' statements that prospective purchasers in the area may consider it and then he testifies that he hasn't seen any market impact of it. But he does not testify to whether there would be, as Mr. Sugarman is now asking, any beneficial effects from E/MF because that is not his expertise.

MR. SUGARMAN: But he testified in answer to my question two minutes ago --

MR. WATSON: He is just testifying as to the result that it might be considered by some and as to the result on property value.

JUDGE SMOLEN: Isn't he asking are there any positive results on property value? Whether this witness knows of any positive --

MR. SUGARMAN: That is what I asked.

MR. WATSON: He hasn't asked that. If he asked if there were any reasons why there would be positive benefits.

JUDGE SMOLEN: I'm not sure that's the meaning of the question.

MR. WATSON: If it's positive results on property value, that would be a different question.

MR. SUGARMAN: I'll ask that.

BY MR. SUGARMAN:

Q. Do you know of any positive results on property values that might flow from people giving more consideration to E/MF?

A. There's none that I can think of, Mr. Sugarman.

Q. Now, do you agree that if E/MF is given more consideration the effect on property values will be detrimental?

MR. WATSON: Asked and answered, Your Honor. He already testified he doesn't know. It depends upon the values of all the individuals --

JUDGE SMOLEN: Don't answer for him.

MR. WATSON: He already testified to it.

JUDGE SMOLEN: I know. Let him answer again. At the worst it's surplusage.

Go ahead. You can answer it again.

A. There are a number of values that go into the decisionmaking. I am no health professional but we don't know what additional research is going to have on E/MF. So they may discover that there is no effect, I mean,

conclusively that there is effect of E/MF. But I'm no expert on that. And that will resolve all concern for all parties.

BY MR. SUGARMAN:

Q. Did you see Diane Allen's series on E/MF?

A. No, I did not.

Q. Do you know about it?

A. No, I do not.

Q. Did you hear about the Texas school case where a line was relocated because of the proximity to a school?

MR. WATSON: Objection, Your Honor. This is beyond the scope of direct testimony.

MR. SUGARMAN: It goes to the issue of the effect on market value. If people hear that schools --

MR. WATSON: A school in Texas probably has little, if any, effect on market value here.

JUDGE SMOLEN: I will sustain the question. Go to the next question.

BY MR. SUGARMAN:

Q. Are you familiar with the New Yorker articles on E/MF?

MR. WATSON: Objection, Your Honor. The same thing. There is no showing that any of the possible purchasers read these articles. It has no bearing on

this.

JUDGE SMOLEN: This one I will overrule. You can answer.

Are you familiar with that article?

THE WITNESS: No, I am not.

Q. Do you agree that if there were a general awareness and fear of E/MF and a recommendation by the utility to consider prudent avoidance that a combination of those factors would have an impact on property value?

MR. WATSON: Objection, Your Honor. No evidence in the record that there is a general awareness and fear. It assumes facts not in evidence.

JUDGE SMOLEN: Well, the question may be a bit broad. You have testimony in the record at least as to the witnesses who did appear here. So to that extent I will sustain the objection and Mr. Sugarman can rephrase.

BY MR. SUGARMAN:

Q. Do you agree that a fear -- first of all, do you agree that a seller's fear of the property has an effect on market value or may have an effect on market value?

(Pause.)

Q. That is, it affects the extent to which the seller is a willing seller?

A. I'm not sure I understand that question.

Q. Do you understand the concept of market value as the price that a seller who is free to sell or not sell and a buyer who is free to buy or not buy would agree upon? Is that your definition of market value?

A. That's correct.

Q. And if a seller feels an unusual pressure will that in your view not affect the market value?

A. There are so many pressures that can affect the market value. The current economy is affecting it more than anything else.

Q. Whatever. If a seller is under pressure doesn't that affect the market value? Or doesn't that make the house sell for something other than market value, depending on which way you go with the semantics?

A. I think we are really entering into something beyond my expertise because I don't pretend to be a realtor in this regard.

Q. Then you would have no basis for either agreeing or disagreeing with my question, which is does not the fear of the sellers, the owners, as expressed in the record here affect the value or the price that they are likely to get for their properties?

MR. WATSON: Your Honor, with all due respect, that question contains at least one compound question if not a couple. It begins with you would have no basis to agree

or disagree with and then there is another question.

JUDGE SMOLEN: Let's try to break it down.

BY MR. SUGARMAN:

Q. You would have no basis for deciding whether the sellers perceived pressure to get out would affect the value they would get for their properties?

A. I have to look at this, again, in the context of the land uses within the corridor, which in my opinion are compatible with the electrification of this line. So, I don't perceive that there would be any impact in terms of either on the land uses or the value on any of the people there.

Q. Are you familiar with the concept of panic selling?

A. I have heard of that term.

Q. And if panic selling were to occur would you agree that the prices would drop?

A. Again, I think that is more of a real estate -- something that a realtor could answer better than myself.

Q. Now, you indicated that it's a principle of land use planning that utilities should be provided for in coordination of growth, looking at page 12, line 13, of your testimony.

A. Did you say page 12?

Q. Page 12, line 13. You are annunciating a

theory of land use planning or a principle of land use planning that defines the term compatibility as including the support services or infrastructure necessary for the population growth. Is that a correct paraphrase?

A. That's correct.

Q. Does that principle have any corollary or subset that says that the utility service should be provided in a way that does not detract from the health of the associated urban growth?

JUDGE SMOLEN: Let him answer one --

BY MR. SUGARMAN:

Q. Or does it allow utility services to be provided in any shape or form?

JUDGE SMOLEN: I'm sorry I interrupted because you were going on to a second question without getting an answer to the first question.

MR. SUGARMAN: I was trying to clarify the first question.

A. Could we go back?

BY MR. SUGARMAN:

Q. Does that principle, basic land use policy that utility services must be provided in coordination with urban growth, does that contain any component that requires or dictates that the utility services be provided in the least intrusive way?

A. With respect to the least intrusive way, I would concur with that.

Q. I'm sorry?

A. With respect to providing utility corridors in the least intrusive way, I would concur with that.

Q. Right. And is that why, for example, many distribution lines are put underground these days, so as to reduce the intrusion?

A. I don't have specific knowledge of underground utility lines other than the case where you have them within the urban context -- excuse me. I have to correct that. They are placed underground within your residential subdivisions.

Q. That is what I meant.

A. And we are really talking about essentially service lines in that regard.

Q. Right. I was talking about the general principle that you set forth and the application of it in one example.

So you would agree that the general policy to minimize intrusion would apply to transmission lines as well as to other utility services, would you not?

A. That's correct. That is one of the aspects you look at.

Q. Right.

A. There are a number of aspects that one must look at in terms of determining the location of utilities.

Q. Right.

Now, you indicated in that principle the basic land use policy that utility services must be provided in coordination with urban growth. Is that a principle of equity? That is to say, is the principle one that is based on achieving the most aesthetic urban land use? Or is it one that is based on the equitable principle that the growth must provide for it's necessary infrastructure?

A. It is really more the latter. Specifically, when municipalities zone as are empowered to under the Municipalities Planning Code they can't provide for zoning or the opportunity for people to have industrial or commercial or residential development and not provide the necessary utility infrastructures that support that zoning. And so the utility infrastructure is a necessary component of normal planned urban growth. You can't have one without the other.

Q. Then you will agree with me there is no equitable reason in that principle to put this transmission line in the CSA, since the CSA by your testimony shows a very limited growth potential whether

or not the line is energized, referring to page 15 of your testimony. So the principle does not apply in this area, is that right?

A. I think we have to look at what we refer to in terms of a service corridor and the need for something such as a Public Utility Commission. Service corridors do not necessarily serve the adjacent area. For example, the source of generated power is often in many, many counties away from the area that is being served. And so if you look at it in that context the people adjacent to that corridor for many, many counties or halfway across the state or through many states are not direct beneficiaries of that service.

Q. Then the equitable principle that you have to provide for your infrastructure along with your growth just does not apply. There have to be some other reasons justifying the transmission line, not that one, right?

A. I'm not sure I understand your question.

Q. I'm saying to you that if the reason for providing infrastructure to complement growth is an equitable principle which says if you are going to have the growth you have to also have the concomitant infrastructure, then that -- and you are now talking about growth miles away, as you say, then the principle of equity that you annunciated does not apply to that

situation. You have to find some other reason why the line should be built, isn't that true?

A. I'm still not exactly sure in terms of which context you're referring to. If you're talking about the context of within the CSA, first of all, as far as my analysis, I made no determination as to need. You're getting to the issue of whether or not there is a need. We did not begin to evaluate need.

Q. I'm not trying to get into it. You annunciated a general equitable principle of land use planning which is that if you are going to go into an area bring the necessaries with you or you have to bear the costs associated with developing an area. And I am just saying that principle has no application here, isn't that right?

A. Within this corridor, specifically, in my analysis, I showed that there is very little development potential.

Q. Right. So therefore that principle has no application to this situation as far as this corridor is concerned?

A. There is very limited application as far as this corridor is concerned, that is correct.

MR. SUGARMAN: Thank you very much.

I have no further questions.

JUDGE SMOLEN: I didn't ask, Ms. Burket, any

cross-examination of this witness.

MS. BURKET: No, Your Honor.

JUDGE SMOLEN: Mr. Dillon?

MR. DILLON: No, Your Honor. None.

JUDGE SMOLEN: Do you have any redirect?

MR. WATSON: No, Your Honor.

JUDGE SMOLEN: In that case the witness is excused. Thank you very much for appearing and testifying today.

(Witness excused.)

JUDGE SMOLEN: Anything further that we have to discuss today? Hearing no response we will adjourn today's session for tomorrow morning. The other witness is not here, is he? No, that's for tomorrow. Then we will see everyone tomorrow morning at 10 o'clock.

Thanks very much.

(Whereupon, at 1:02 p.m., the hearing was adjourned, to be reconvened at 10:00 a.m. on Tuesday, December 17, 1991, in Philadelphia, Pennsylvania.)

C E R T I F I C A T E

I hereby certify, as the stenographic reporter, that the foregoing proceedings were taken stenographically by me and thereafter reduced to typewriting by me or under my direction; and that this transcript is a true and accurate record to the best of my ability.

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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY
OF
DR. EDWARD GELMANN

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

November 1991

REBUTTAL TESTIMONY OF DR. EDWARD P. GELMANN

CONTENTS

I. Background and Qualifications

Q Please state your name and business address.

A. Edward Paul Gelmann, 3800 Reservoir Road, N.W., Washington, D.C.

Q What is your occupation?

A. I am a medical doctor, researcher, and teacher, specializing in medical oncology. I am also 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.

Q Dr. Gelmann, what is oncology?

A. It is a subspecialty of internal medicine that involves the study and treatment of cancer.

Q Are you testifying today on behalf of the Georgetown University School of Medicine?

A. No. This testimony reflects my opinions as a medical oncologist and cancer researcher, and is not presented on behalf of Georgetown University Medical School or any other institution with which I am affiliated.

Q What are your responsibilities as Chief of the Division of Medical Oncology at the Georgetown University Medical School?

A. My responsibilities include the direction of a clinical service where cancer patients are treated. The division has both an inpatient ward for oncology patients and an outpatient clinic. I direct and supervise a cancer research laboratory where technicians, graduate students,

and postdoctoral fellows conduct studies on the molecular and cellular biology of cancer. I also teach medical and graduate students, medical oncology fellows, and Department of Medicine house staff.

Q Please briefly describe your educational background.

A. I received a Bachelor of Science degree from Yale University in 1972, and an M.D. from Stanford University School of Medicine in 1976.

Q Did you receive any academic honors during your education at Yale?

A. Yes. I graduated magna cum laude and was a member of Phi Beta Kappa.

Q What did you do after graduating from medical school?

A. I was an intern and later a resident at the University of Chicago Hospitals and Clinics.

Q Are you licensed to practice medicine?

A. Yes. I am licensed in Maryland and the District of Columbia.

Q Are you board certified?

A. Yes. I am a board certified in Internal Medicine. I am also board certified in the subspecialty of medical oncology.

Q Do you personally treat cancer patients?

A. Yes, I have treated and cared for cancer patients since 1978.

Q Do you personally conduct research on cancer?

A. I have conducted research on cancer for about 15 years. After I finished my residency and fellowship training, I was a research fellow at the National Cancer Institute, and later a Senior Investigator at the National Cancer Institute. I also conduct cancer research as a faculty member at the Georgetown University Medical School.

Q What is the National Cancer Institute?

A The National Cancer Institute is part of the National Institutes of Health, the federal government's primary medical research institution. It is the world's largest biomedical center involved in cancer research. I conducted cancer research in the National Cancer Institute's Laboratory of Tumor Cell Biology.

Q What type of cancer research did you conduct at the National Cancer Institute's Laboratory of Tumor Cell Biology?

A. I investigated the process by which cells become cancerous. For example, I isolated and characterized several human cancer genes, and I worked with HTLV-1, which is a virus associated with a kind of human leukemia.

Q What did you do after leaving this laboratory?

A. I became Senior Investigator at the Medicine Branch of the National Cancer Institute, where I conducted research in the cellular and molecular biology of human cancer.

Q Did you receive any awards for your research during your time at the National Cancer Institute?

A. Yes. I received a Unit Commendation from the United States Public Health Service for my work in cancer research.

Q Have you published any of your research on cancer?

A. Yes. I've published over 100 papers, mainly on the molecular and cellular biology of cancer. In addition, I have co-authored several book chapters on cancer in medical and science textbooks.

Q Please name a few scientific journals that have published your cancer research.

A. My research has appeared in *Cancer Research, Science, American Journal of Medicine, Nature, Journal of Clinical Oncology*, and *Molecular and Cellular Biology*, among others.

Q As part of your professional responsibilities, do you ever review a body of scientific literature on a subject new to you?

A. Yes. I perform that function frequently. For example, I review grant proposals for NIH projects involving areas of research on which I do not personally conduct research. I also regularly review articles submitted for publication in scientific journals.

Q Could you name some of the scientific journals for which you review articles?

A. These include the *International Journal of Cancer, Cancer Research, Journal of the National Cancer Institute, Science, Journal of Clinical Oncology*, and *The New England Journal of Medicine.*

Q Please briefly discuss your involvement in professional organizations.

A. I am a member of the American Association for Cancer Research, the American Society of Clinical Investigation, the American College of Physicians, and other professional groups. I also serve as liaison between the American Society of Clinical Oncology and the National Cancer Advisory Board.

Q What is the National Cancer Advisory Board?

A. The National Cancer Advisory Board is a committee of scientists, physicians, and lay people appointed by the President to oversee cancer research in the United States.

Q Dr. Gelmann, what percent of your professional work is in the fields of molecular genetics, cellular biology, and cancer?

A. 100 percent.

Q What have you been asked to do in connection with this proceeding?

A. I was asked to conduct an independent search of the literature on biological and experimental research related to electric and magnetic fields. I was also asked to assess this scientific literature in the areas of cancer and molecular and cellular biology and to assess whether power frequency fields cause any adverse genetic, molecular, and/or cellular effects that could lead to cancer or other adverse health effects.

Q How did you approach this work?

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.

II. Backround on Cellular Biology, Molecular Genetics, and Cancer

Q Could you briefly describe the basic structure and function of the cell?

A. 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."

Q How can research in genetics and molecular and cellular biology help us to understand the causes and developement of cancer or other adverse health effects?

A. 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.

Q Is genetic change associated with cancer?

A. Yes. 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 <u>essential</u> for normal cells to be transformed into cancer cells.

Q Does all genetic change result in cancer?

A. Although 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.

Q Are there any other basic points about genetics and cancer that you would like to discuss?

A. It is important to understand that "cancer" is a generic term used to describe many different types of diseases. Cancers of different organs have unique characteristics. Different cancers also result from different causes. For example, ultraviolet light from the sun changes the DNA of skin cells and contributes to the cause of melanoma and other skin cancers; it does not cause lung cancer. Cigarette smoking, on the other hand, can deposit substances in the

cells of the lung which can change their DNA and thus lead to lung cancer, but smoking is not believed to cause skin cancer.

Q How do you determine whether an agent causes the type of genetic change that can lead to cancer and other adverse health effects?

A. 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 laboratory studies. Scientists conduct experiments on isolated cells and tissues under controlled laboratory conditions, as well as laboratory and field studies on whole animals. Studies of the first type, with cells growing in culture, e.g. in a petri dish, are called "in vitro" studies. This type of research allows scientists to look for a change in the DNA molecule itself. 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.

III. EMF Research on Molecular Genetics and Cellular Biology

Q Have laboratory studies on cells and tissues as well as studies on whole animals been conducted with power frequency electric and magnetic fields?

A. Yes.

Q Have you categorized these studies for purposes of discussion?

A. There are many ways of organizing the studies in this body of scientific literature. I have chosen to categorize them into four areas: 1) mutational analyses, 2) chromosome studies, 3) animal studies, and 4) tumor growth studies. These categories include the standard types of tests that are conducted to determine whether an

agent causes molecular or cellular change that can lead to cancer or other adverse health effects.

A. Mutational Analyses

Q Would you please explain what you mean by "mutational analyses?"

A. 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. A mutation is another name for a permanent change to a particular part of the DNA molecule. For example, in sickle cell anemia, a single mutation in the gene responsible for the production of hemoglobin, an essential component of red blood cells, causes changes in the hemoglobin such that it is not able to properly transport oxygen. 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.

Q What are the results of the mutational analyses involving power frequency electric and magnetic fields?

A. These studies indicate that exposure to 60 Hz fields have no effects on mutations. For example, Frazier et al. (1984) 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) also found no effect of power frequency fields in his work with human colon cancer cells. Others, such as Reese (1988, 1990), have similarly found no indications of DNA change after exposure to power frequency electric, magnetic, or combined electric and magnetic fields.

Q Are you familiar with the study by Liboff on DNA synthesis?

A. Yes, I am familiar with that work. I would note that, although the paper (Liboff, 1984) claims to have examined DNA synthesis, the

laboratory test, or "assay," that was used was not a measure of DNA synthesis. The Liboff research measured uptake of tritiated thymidine, which may have had no relationship to DNA synthesis in the model used by Liboff.

Q Was Liboff's work confirmed by the work of Takahashi?

A. No. Takahashi (1986) used pulsed electromagnetic fields, and not sinsuoidal fields like those used by Liboff. The two types of fields are very different. For example, pulsed fields include frequencies much higher than those used in the Liboff research. Because of these differences in the exposure agent used, Takahashi's work does not confirm Liboff's work.

Q Do you agree with the conclusion expressed in Liboff's publication that the observed effects may be mutational?

A. No. The change in tritiated thymidine that Liboff reported is unrelated to mutations, so that even if it is a valid result, it does not show a mutational effect of exposure to power frequency fields. To conclude that such changes are a mutational event exhibits a basic misunderstanding of the molecular biology involved in those events.

Q You said earlier that change in DNA is often repaired naturally by the cell. Have any studies examined the relationship between electric and magnetic field exposure and DNA repair?

A. Yes. A study by Whitson et al. (1986) looked at this issue. Whitson first exposed cells to ultraviolet radiation in order to cause change to the DNA. He then exposed the cells to power frequency fields during the time that the cells were undergoing DNA repair. This procedure allowed him to see if DNA repair processes were affected by exposure to power frequency fields. Whitson found that DNA

repair processes were not affected by exposure to power frequency fields.

Frazier (1990) looked at another DNA repair process in the cell. Frazier found no effect of power frequency electric and magnetic field exposure on the ability of cells to repair DNA damage.

B. Chromosome Studies

Q What are the studies you described as "chromosome" studies?

A. These studies evaluate whether there are breaks or other damage to the chromosome as a result of exposure to an agent.

Q What does damage to the chromosomes tell researchers about cancer and other adverse health effects?

A. 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. A number of cancers, including chronic myelogenous leukemia and lymphomas, have been shown to be linked to specific acquired abnormalities in chromosomes.

Q What do the chromosome studies with 60 Hz electric and/or magnetic fields show?

A. The studies show that power frequency electric and/or magnetic fields are not associated with damage to chromosomes. For example, Cohen (1986) conducted extensive studies with human blood lymphocytes and found no effects. Livingston (1986) studied cultured animal cells and human lymphocytes after exposure to 60-Hz fields of 2,200 mG and a range of electric field intensities. There was no effect of any field strength at exposure times up to 100 hours. Other researchers, such as Rosenthal and Obe (1989),

have found similar results with other cell lines using electric, magnetic, or combined electric and magnetic fields.

Q After reviewing the mutational analyses studies and the chromosome studies, what do you conclude about the possible relationship of power frequency electric and/or magnetic fields and cancer or other adverse health effects?

A. 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.

C. Animal Studies

Q What are the studies you described as the "animal" studies?

A. Animal studies examine the effects of an agent on whole organisms. Some of the animal studies are conducted under controlled laboratory conditions, while others look at animals living directly beneath transmission lines. In these studies, animals are exposed to electric and magnetic fields throughout critical stages of reproduction and/or development. The researchers then examine the parents and/or their offspring for adverse health effects.

Q What do the animal studies tell researchers about DNA change or other adverse effects on cellular or molecular biology?

A. 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. The animal studies look for effects on the whole organism, such as abnormalities in reproduction, growth, or development. These functions depend on the proper functioning of DNA. For example, during development from a single cell to a whole

organism, many millions of cell divisions occur. DNA changes that are not repaired may be manifested as abnormalities in reproduction, growth, or development.

Q Could you give us an example of one of the animal studies involving power frequency electric and/or magnetic fields?

A. Yes. One of the best designed studies of this type is by Benz & Carsten (1987). Benz and Carsten studied two strains of mice under two combined-exposure conditions: 10,000 mG + 50 kV/m and 3,000 mG + 15 kV/m. Thousands of mice were exposed over several generations. The researchers evaluated a number of health endpoints, including fertility, growth, development, and general health. This study consistently indicated no effects of electric and magnetic field exposure on any of the many health endpoints examined. Benz and Carsten conducted an additional test which examined whether electric and magnetic fields had a toxic effect on bone-marrow stem cells. Studies of effects on bone marrow are important with regard to the development of leukemia. The results of this test showed no significant effects on the stem cells of the bone marrow.

Q Have any other studies investigated the effects of power frequency fields on bone marrow cells involved in the development of leukemia?

A. Yes. A recent study by Lorimore et al. (1990) 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. If an agent causes leukemia, one would thus expect to see some effect on these cells.

Q Have other studies examined the effects of power frequency electric and magnetic fields on living animals?

A. Yes, there are a number of long-term multigenerational studies of avian, mammalian, and other species, such as those by Kowalczuk and Saunders (1990), Rommereim et al. (e.g., 1987, 1989, 1990), Walters and Carstensen (1987), Algers and Hultgren (1986), and others. 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.

Q What do you conclude based upon your review of the animal studies?

A. 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.

D. Tumor Growth Studies

Q Please tell us about the studies described as "tumor growth" studies.

A. Tumor growth studies are a direct test of cancerous properties of cells. This type of research examines whether cancerous cells will form tumors when transplanted to an animal host. In these studies, 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. 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.

Q Have these types of studies been conducted with power frequency electric and magnetic fields?

A. Yes. For example, Chandra and Stefani (1979) examined the growth of transplantable mammary tumors of mice. 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. No effect on the growth of the tumor was observed as a result of exposure. Studies by Kronenberg and Tenforde (1979), Thomson (1988), and others have also found no significant differences in tumor incidence or animal survival.

Q What do you conclude based on your review of the tumor growth studies?

A. The tumor growth studies indicate that exposure that 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.

E. Other Cellular Research Discussed in the Testimony in This Proceeding

Q Dr. Gelmann, I'd like to ask you about some of the specific research reports that have been mentioned in the testimony for this proceeding. To begin with, are you familiar with the research by Goodman on protein synthesis and RNA transcription?

A. Yes. I have read her work carefully (e.g., Goodman, 1983, 1984, 1986, 1987, 1988, 1989, Wei and Goodman, 1990).

Q Are you familiar with the assays used in her experiments?

A. Yes, we use those assays regularly in the laboratory which I head.

Q Could you please describe Goodman's research?

A. 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. She has examined certain cellular processes in those cells after exposure to the fields.

Q Does the Goodman work fall within one of the categories of studies that you have described?

A. No. Goodman examined normal cell processes unrelated to the process of carcinogenesis.

Q What were the reported results of the Goodman research?

A. Goodman has reported that some subtle changes in the uptake of RNA precursers may occur after exposure.

Q Do the Goodman results indicate that exposure to power frequency fields will result in cancer or other adverse health effects?

A. No. As I noted earlier, Goodman's work deals with normal cell processes unrelated to carcinogenesis. In addition, her work was done on cells in vitro, and have not been shown to occur in humans. Even if the results that Goodman has observed do occur in humans, there would be no suggestion of an adverse health impact. The changes that she has reported are trivial compared with innocuous events that occur everyday. For example, Goodman's results are trivial compared to the normal processes that occur when hair grows.

Q Are you familiar with the research by Marron, et. al, on the cell cycle of slime mold?

A. Yes. Marron (e.g., Marron, 1975, 1978, Greenebaum and Marron, 1982) reported that, for certain slime molds, the length of the cell cycle was increased after exposure to power frequency fields.

Q Do the results of Marron indicate an adverse human health effect of exposure to power frequency fields?

A. No. 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.

Q Are you familiar with the work by Byus and Adey on ornithine decarboxylase ("ODC")?

A. Yes, I have analyzed the research on this issue (Byus and Adey, 1987, 1988). As with the Goodman work, this research does not fall within any of the categories of research previously discussed.

Q What is ODC?

A. ODC is an enzyme involved in cellular growth. Increased ODC activity exists in normal growing cells. It also exists, in much greater amounts, in cancer cells.

Q What were the results of the Byus and Adey research on ODC?

A. Byus and Adey reported that exposure to modulated microwaves, and to 60 Hz fields, resulted in a small, transient increase in ODC activity is some types of cultured cells, but not others.

Q Does the Byus and Adey research on ODC indicate a carcinogenic effect of exposure to power frequency fields?

A. No. The magnitude and timing of the ODC increases reported in this research are inconsistent with a carcinogenic effect. In fact, Byus and Adey themselves have concluded that any suggestion of a carcinogenic effect from this research is speculative. (Byus and Adey, 1988, Adey, 1990) I agree with that conclusion, and would note further 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.

Q Are you familiar with the calcium efflux work of Bawin & Adey and Blackman?

A. Yes. That research (e.g. Blackman, 1979, 1980, 1982, 1985, 1988, 1990, Adey and Bawin, 1982, Bawin and Adey, 1975, 1976, 1978) has looked at the question of whether exposure to modulated microwaves and to power frequency fields alters the amount of calcium that leaks out of slices of brain tissue.

Q What were the results of that research?

A. The results have been inconsistent. Some researchers have reported an increase in calcium, others have reported a decrease in calcium, while still others have reported no change in calcium. Because of this inconsistency of results, it is my evaluation that the researchers likely are reporting an experimental artifact, rather than an effect of exposure to fields.

Q Do the calcium efflux results have any implications for cancer?

A. No. The calcium endpoint that was assayed in these experiments is not related in any known way to the process of carcinogenesis.

Q Have you reviewed the research on bone repair?

A. Yes. Most of the bone repair research involves pulsed fields (e.g., Bassett, 1981, 1982, 1984), which will not be created by the transmission line at issue in this case. There is limited research on bone repair using power frequency fields.

Q What are the implications of the bone repair research for carcinogenesis?

A. Bone repair is a normal process unrelated to carcinogenesis. It is worth noting 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.

Q Have you reviewed the research by Wilson and others on melatonin?

A. Yes, I have reviewed that research (e.g., Lerchl, 1991, Reiter, 1990, Wilson, 1981, 1986, 1988, 1990).

Q Does that research provide a pathway by which exposure to EMF could cause cancer in humans?

A. No. There are no data connecting melatonin levels to breast cancer causation in humans.

Q Have you reviewed any EMF research on cell proliferation?

A. Yes, I have reviewed over 30 studies on cell proliferation, including the research discussed by other witnesses in this proceeding, such as the work by Ross, et. al. (1990), Parola (1988), and Liboff's recent abstract using lymphoma cells (Liboff, 1991).

Q What have been the results of the cell proliferation studies?

A. Some reported an increase in cell proliferation, some reported a decrease, while others reported no effect. 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.

Q What do you conclude with regard to the cell proliferation studies?

A. The cell proliferation studies as a whole do not report any consistent effect on cell proliferation. More importantly, however, the tumor growth studies described earlier in my testimony provide a much more direct measure of whether exposure to power frequency fields affects cell proliferation in intact animals. Those studies consistently report that no such effect occurs as a result of exposure to power frequency fields.

Q Have you reviewed the work of Winters and Phillips?

A. Yes, I have reviewed that research (e.g., Phillips, 1986, Phillips, Rutledge and Winters, 1986, Phillips, Winters and Rutledge, 1986, Phillips and Winters 1987).

Q In Dr. Liboff's written testimony (p.6), he indicates that the Winters and Phillips work involves cell proliferation. Does the Winters and Phillips work involve cell proliferation?

A. No. The assay used by Winters and Phillips is known as soft agar clonogenecity. This research is unrelated to cell proliferation, and also is unrelated to the process of carcinogenesis.

Q What is your evaluation of Winters and Phillips soft agar work?

A. This work was severely criticized by its sponsor, the Scientific Advisory Panel of the New York State Power Lines Project. (Ahlbom, et. al., 1987) Briefly, the most important of the criticisms are that

the 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. I agree 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.

F. Conclusions Regarding the EMF Research on Cancer and Other Adverse Health Effects

Q What is your overall evaluation of the body of literature you have discussed in your testimony today?

A. 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.

Q Does the fact that these studies involve a variety of biological endpoints provide support for the hypothesis that exposure to power frequency fields is related to cancer?

A. No. 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.

Q Dr. Gelmann, based on your education, training, and experience in the fields of cancer and molecular and cellular biology, do you have an opinion about whether there is a relationship between cancer and exposure to power frequency electric and/or magnetic fields?

A. Yes, I do.

Q. What is that opinion?

A. 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.

Q Are you familiar with the calculated electric and magnetic field levels associated with the Woodbourne-Heaton 230 kV line?

A. Yes, I have reviewed Mr. Boeggeman's testimony in this proceeding which contains that information.

Q As a medical doctor and specialist in medical oncology and molecular and cellular biology, is there any scientific basis to conclude that the power frequency fields associated with the Woodbourne-Heaton 230 kV transmission line would cause adverse health effects, including cancer?

A. No, there is not.

Q Does this conclude your testimony?

A. Yes.

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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

EXHIBIT EG-1
OF
DR. EDWARD GELMANN

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

November 1991

(August, 1991)

CURRICULUM VITAE

NAME	Edward Paul Gelmann
DATE & PLACE OF BIRTH	May 31, 1950; New York, New York
CITIZENSHIP	U.S.A.
PRESENT ADDRESS (and home telephone #)	5412 Waneta Road Bethesda, Maryland 20816 (301) 229-2847
OFFICE ADDRESS (and telephone #)	Division of Medical Oncology Lombardi Cancer Research Center Podium Level 3800 Reservoir Road, NW Washington, D.C. 20007 (202) 687-2198
SOCIAL SECURITY #	078-38-0376

EDUCATION

1972	B.S., Yale University, New Haven, Connecticut. Scholar of the House, magna cum laude.
1976	M.D., Stanford University School of Medicine, Stanford, California, Medical Scientist Training Program

SPECIALTY BOARD CERTIFICATION

1977	Diplomat, National Board of Medical Examiners
1980	Diplomat in Internal Medicine, American Board of Internal Medicine No. 070149
1982	Subspecialty Certification in Medical Oncology

LICENSURE

1977	Illinois State License No. 36-55120 (expired)
1978	Maryland State License No. D 22807
	California State License No. G 38939 (inactive)
1988	District of Columbia No. 17431

POSITIONS HELD

1976–1978	University of Chicago Hospitals and Clinics, Chicago, Illinois. Intern and Junior Assistant Resident, Department of Internal Medicine.
1978–1983	National Institute of Tumor Cell Biology, Bethesda, Maryland, Clinical Associate, USPHS.
1983–1988	National Institutes of Health, National Cancer Institute, Medicine Branch, Bethesda, Maryland. Senior Investigator.
1986–1988	Adjunct Associate Professor of Microbiology, Georgetown University School of Medicine and Dentistry, Washington, D.C.
1988–	Professor of Medicine, and Anatomy and Cell Biology; and Chief, Division of Medical Oncology, Georgetown University School of Medicine.

MILITARY SERVICE

1978–1988	USPHS; Senior Surgeon (O-5)

PROFESSIONAL SOCIETIES

American Society for Clinical Investigation
Fellow, American College of Physicians
American Society of Microbiology
American Association for the Advancement of Science
American Associaton for Cancer Research
American Society of Clinical Oncology
American Federation for Clinical Research

EDITORIAL BOARDS

1985–1990	Blood

AD HOC REVIEWER

Annals of Internal Medicine
Cancer Research
Journal of Clinical Oncology
Journal of the National Cancer Institute
Molecular Endocrinology
Journal of the National Cancer Institute

HONORS AND AWARDS

1970	Phi Beta Kappa
1988	Unit Commendation, United States Public Health Service

COMMITTEES AND APPOINTMENTS

1984-1986	National Cancer Institute Clinical Research Subpanel
1985-1987	National Cancer Institute Technical Review Committee for Contracts
1988, 1989	Program Committee - American Society of Clinical Oncology
1989-	ASCO Liaison to National Cancer Advisory Board
1989-1993	Microbiology and Infectious Diseases Research Committee, NIAID, NIH

GRANTS

4/1/90 - 3/31/93	National Cancer Institute Molecular Mechanisms for Prostate Cancer Cell Growth, R01 - CA 50355, PI - Edward Gelmann, 10% effort
7/1/90 - 6/30/93	National Cancer Institute Cancer Center Support Grant P30 - CA51008 PI - Marc Lippman 15% effort, Director, Urologic Oncology Program, Co-Director AIDS Program.

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Philadelphia Electric Company Rebuttal Statement No. 4

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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY OF DR. MURRAY ROSENBERG

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

REBUTTAL TESTIMONY OF DR. MURRAY ROSENBERG

CONTENTS

I. Background and Qualifications

Q Please state your name and business address.

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

Q What is your occupation?

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

Q What is biophysics?

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

Q Where are you employed?

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

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

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

Q Please briefly describe your educational background.

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

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

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

Q Are you licensed to practice medicine?

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

Q Please describe your medical training.

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

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

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

Q Do you also conduct research?

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

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

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

Q Have you personally conducted biophysics research?

A. Yes.

Q Could you give us an example?

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

Q Did that research involve 60-Hertz frequencies?

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

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

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

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

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

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

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

Q Are you a member of any professional organizations?

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

Q What is the Association of American Volunteer Physicians?

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

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

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

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

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

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

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

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

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

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

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

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

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

II. Background on the Electromagnetic Spectrum

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

A. 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. This infinitely repeating cycle is known as "alternating current." The number of times that a field alternates in one second is its "frequency." Frequency is measured in Hertz ("Hz"). For example, power frequency fields, such as those that will

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

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

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

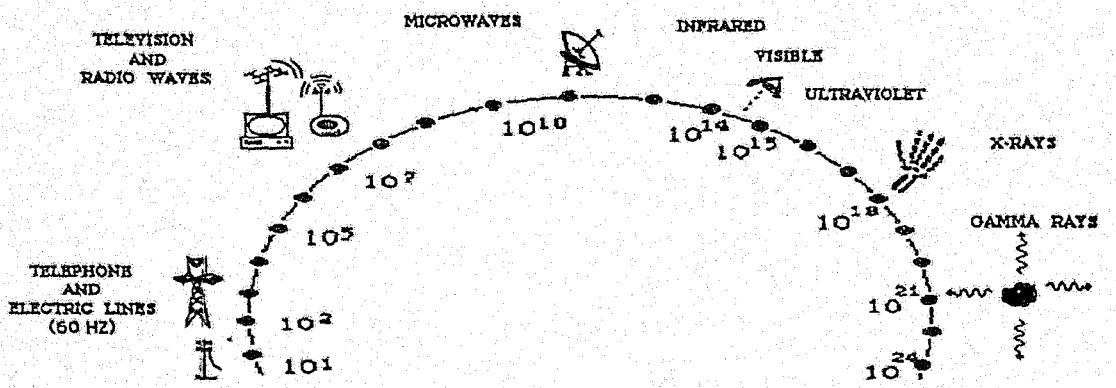
Q What is the electromagnetic spectrum?

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

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

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

THE ELECTROMAGNETIC SPECTRUM



FREQUENCY IN CYCLES PER SECOND

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

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

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

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

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

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

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

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

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

A.Ionizing Radiation

Q Please explain the biological effects of ionizing radiation.

A. 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 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.

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

A. No, 60 Hz fields are vastly different than ionizing radiation. 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. The mechanism of interaction by which ionizing radiation causes damage to tissues is dependent upon frequency and cannot be effected by power frequency fields.

Q What is meant by the term "mechanism"?

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

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.

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

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

D. Infrared/Microwaves

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

A. This region of the spectrum spans from about a billion Hz to a trillion Hz.

Q What are its characteristic mechanisms of interaction?

A. Energy from microwave fields cannot disrupt chemical bonds, like X-rays, nor can they excite electrons in the eye, like visible light. 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. At sufficient intensities of microwaves, the practical effect is that the biological tissue is heated.

Q Is this the principle by which microwave ovens cook?

A. Yes. 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. This increased movement leads to an increase in temperature.

Q Can power frequency fields interact with biological tissue in the manner of microwaves?

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

E. Radio and Television

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

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

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

A. There are no generally accepted effects from exposure to radio and television waves at environmental levels. 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"). Radiofrequency and television waves do not cause the biological effects associated with higher frequencies, such as microwaves and ionizing radiation.

F. Power Frequency Fields

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

A. No. 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. 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.

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

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

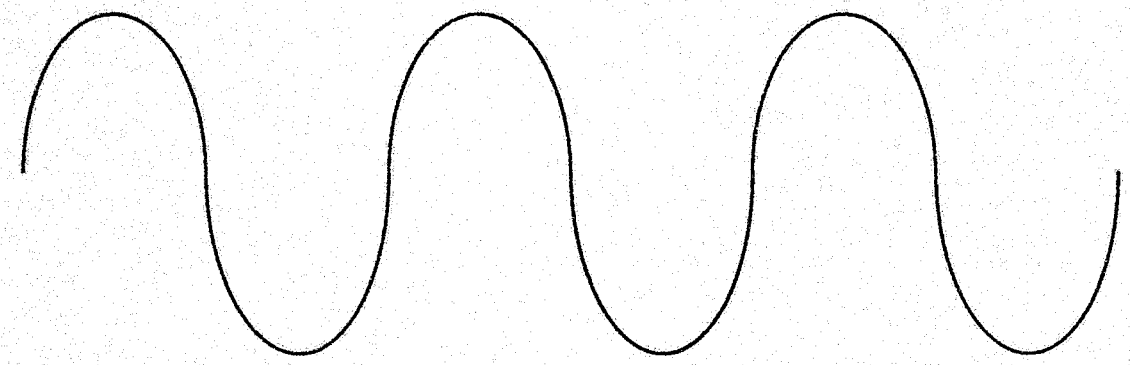
III. Waveform and Shape of Fields

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

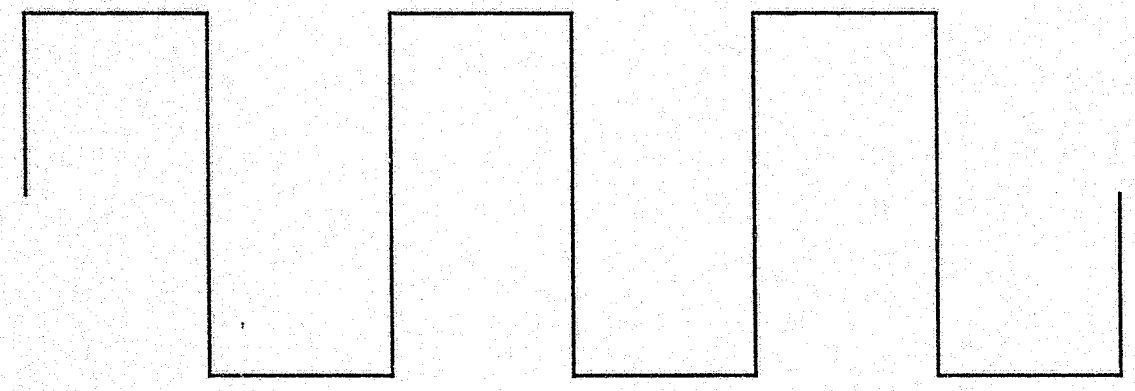
A. Yes. I mentioned earlier in my testimony that these fields are "sinusoidal." This term refers to the shape of the fields as they alternate from positive to negative and back to positive. The sinusoidal wave curves uniformly up, down, and back again in a smooth, symmetrical line.

Q Are there other types of fields besides sinusoidal fields?

A. Yes, there are a number of different types of fields other than sinusoidal fields. One type of field is generally known as a "pulsed" field. There are many types of pulsed fields, but each has a very different shape than the sinusoidal field associated with power transmission. The diagram on the next page of this testimony demonstrates the difference in shape of these two types of fields.



SINUSOIDAL FIELD



PULSED FIELD

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

A. 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. These fields can range as high as several thousand Hz. A field that is "pulsed" 60 times a second will contain 60 Hz sinusoidal fields, but it also will contain many other sinusoidal fields of very different frequencies.

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

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

Q What is a "modulated" field?

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

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

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

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

IV. Ion Cyclotron Resonance

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

A. Yes. ICR is a hypothesis which suggests that very low magnetic fields enhance the movement of charged particles, called ions, through channels in the cell membrane. 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. (E.g., Adey 1981, Liboff 1985, Lednev 1991).

Q Does ion cyclotron resonance provide an understanding of interactions between power frequency fields and biological tissue?

A. No. Dr. Liboff and his colleagues, in their writings, have suggested that it might provide such an understanding. (E.g., Liboff 1985, Liboff, McLeod, and Smith 1990). 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.

Q Please give an example of a problem with the ICR theory.

A. 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 travelling 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.

The first problem with the ICR theory has to do with the size of the circular path that would be necessary for a 60 Hz 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. The actual cell wall channels, however, are much smaller than that -- they are submicroscopic. In an opening of that size, the cyclotron resonance effect postulated by Dr. Liboff simply could not take place. In fact, you would need a frequency of about 6,000,000 Hz to meet the theoretical cyclotron resonance conditions in the actual channels in cell membranes, which is quite different from 60 Hz.

Q Are there any other problems with the ICR hypothesis?

A. Yes. 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. This is why the giant particle accelerators mentioned previously are carefully constructed to ensure that no such collisions occur. 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. Any theoretical, or calculated,

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.

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. One element of the resonance calculation is the mass of the ion. If an incorrect mass of the ion is used in the calculation, the results of that calculation will be incorrect. The ICR hypothesis is based on just such an incorrect calculation. The calculations that have formed the basis for the ICR hypothesis use an ionic mass that assumes that no other molecules are surrounding the ion when it travels through the channel in the cell membrane. In fact, however, ions in the body are surrounded by a shell of water molecules which remain around the ion as it passes through the fluid-filled channel in the cell membrane. The presence of these water molecules substantially alters the effective mass of the ion, and this change in mass undermines the theoretical calculations that form the basis of the ICR hypothesis.

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.

These and other problems with the ICR hypothesis have been recognized by Dr. 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). Research on the ICR hypothesis has proceeded in part on the hope that these problems can somehow be resolved in the future. At this point, however, the 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.

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

A. 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.

Q What are the implications for human health of the ion cyclotron resonance hypothesis?

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

V. Conclusions

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

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

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

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

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

A. Yes. At the molecular level, the theories such as ion cyclotron resonance that attempt to explain a mechanism for such an interaction are highly speculative at best. Based on 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 230 kV line will not result in adverse health effects in humans.

Q Does this conclude your testimony?

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

NAME: Murray D. Rosenberg

MARITAL STATUS: Married, 3 Children

DATE AND PLACE OF BIRTH:
January 7, 1925
Boston, Massachusetts

SOCIAL SECURITY NUMBER:
026-16-4680

CITIZEN/RESIDENT STATUS:
USA Citizen

EDUCATION

1942	Harvard University
1946-1956	Harvard University A.B., M.A., M.E.S., Ph.D., M.D.

PROFESSIONAL EXPERIENCE

1956-1957	Internal Medicine - Beth Israel Hospital, Boston
1957-1958	Biophysical Study Program, N.I.H. and M.I.T. Washington D.C. and Cambridge, Mass.
1958-1965	Rockefeller Institute for Medical Research, NYC Fellow and Assistant Professor
1965-Present	Department of Genetics and Cell Biology 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 purotransmitters. 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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ABSTRACTS

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Philadelphia Electric Company Rebuttal Statement No. 5 w/ Exhibit CVD-1

12/16/91 A-110550F055

Phila, PD

R/S

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY OF CARTER VAN DYKE

ON BEHALF OF
PHILADELPHIA ELECTRIC COMPANY

December 1991

REBUTTAL TESTIMONY OF CARTER VAN DYKE

CONTENTS

I. Background and Qualifications

Q Please state your name and business address.

A. Carter Van Dyke, 40 Garden Alley, Doylestown, Pa., 18901

Q What is your occupation?

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

Q What is land use planning?

A. Land use planning is the discipline involved with the orderly growth and development of cities, suburban areas, and rural areas. 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.

Q Where are you employed?

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

Q What is your educational background?

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

Q Are you a member of any professional organizations?

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

Q Are you a Licensed Professional Planner?

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

Q Are you a registered landscape architect?

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

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

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

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

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

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

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

A. My 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. I also have 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.

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

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

A. Identification of the Geographic Study Areas

Q What geographic study areas did you include in your land use assessment?

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

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

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

B. Inventory of Existing Land Uses Within the Regional Study Area

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

A. I conducted an inventory of three general types of land uses: (1) utility facilities and corridors, (2) natural features, and (3) urban development.

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

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

Q Please describe your inventory of the natural features within the Regional Study Area.

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

Q Please describe your inventory of the urban development within the Regional Study Area.

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

C. Analysis of Alternative Routes

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

A. Yes. The question of whether alternative routes are available is an important factor in evaluating the land use implications of a utility facility such as a transmission line. As I noted earlier in my testimony, 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. This coordination of utility services with urban growth forms the fundamental basis for sound land planning and development.

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

Q What were the results of your analysis of whether alternative routes are available to interconnect the Woodbourne and Heaton substations?

A. No reasonable alternative routes are available in the Regional Study Area.

Q What is the basis for that conclusion?

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

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

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

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

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

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

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

D. Inventory of Existing Land Uses Within the Corridor Study Area

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

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

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

A. Existing zoning in the Corridor Study Area was identified by reviewing local zoning maps of the jurisdictions in the Corridor Study Area. That review reveals the following breakdown of current zoning in the CSA:

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.

Q Were you able to estimate potential future poulation and residential density growth in the Corridor Study Area?

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

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. Therefore, 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.

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

E. Impact Assessment of the Woodbourne-Heaton 230 kV Transmission LIne

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

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

1. Impact Assessment of Existing Land Uses

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

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

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

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

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

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

Analysis indicates that the Residential zoned areas of the Corridor Study Area are also compatible with an adjacent utility use. 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. 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 with electrical facilities. 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.

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

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

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

While compatability 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. In this case, I would like to address of whether energization of the transmission line will affect residential property values.

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

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

The land use inventory demonstrates that approximately 22% of the Corridor Study Area is presently used for residences, almost exclusively low density residences. 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.

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

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.

Q It has been suggested in this proceeding 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. Can you comment on this suggestion?

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

The Regional Study area already contains numerous utility functions and corridors, including electric facilities. (These utility functions and corridors can be seen by reference to Exhibit CVD-3.) My 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. 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. I therefore would not expect any unique or unusual impacts, such as a decrease in property values, to occur after energization of the Woodbourne-Heaton line.

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. And as I have indicated, my 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 occuring, has had any effect on these land use factors.

2. Impact Assessment of Potential Future Land Uses

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

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

III. Conclusions

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

A. Yes. There is a fundamental relationship between growth and development, and the need for providing essential utility services. Electric service has historically, and continues to be, a fundamental "quality of life" element in the United States and the Commonwealth. Sections 301(2) and 301(4) fo the Pennsylvania Municipalities Planning Code establish the obligation for municipalities that develop Comprehensive Plans and associated land use regulations to coordinate land use activities with the planned delivery of utility service. That is, 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. This coordination of utility services with urban growth forms the fundamental basis for sound land planning and development.

The Woodbourne-Heaton 230 kV transmission line is an excellent example of a proper implementation of that coordination. 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. Due largely to this fundamental compatability with adjacent uses, I view the possibility of adverse land use impacts from energization of the transmission line to be minimal at most, and most likely to be 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)