

NEINER CONTENTION 1

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1 UNITED STATES OF AMERICA
2 NUCLEAR REGULATORY COMMISSION
3 BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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5 In the Matter of: :

6 COMMONWEALTH EDISON COMPANY :

7 (Braidwood Nuclear Power Station, :
Units 1 and 2) :

: Docket Nos. 50-456
: 50-457
8 -----X

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12 Nuclear Regulatory Commission
13 7920 Norfolk Avenue
Room P-114
Bethesda, Maryland

14 Thursday, May 16, 1985
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16 Deposition of EDWIN D. PENTECOST, called for
17 examination by counsel for the Intervenor, Commonwealth
18 Edison Company, taken before Sally V. Weeks, Court Reporter,
19 beginning at 9:38 a.m., pursuant to notice.
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22

1 APPEARANCES:

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I N D E X

WITNESS:

EXAMINATION BY:

EDWIN D. PENTECOST

MR. GALLO 5

MS. CHAN 94

E X H I B I T SNUMBERDESCRIPTIONPAGE

No. 1

Statement of Professional
Qualifications

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P R O C E E D I N G S

1
2 MR. GALLO: Let's go on the record. This is a
3 deposition established and scheduled by agreement of the parties
4 between Commonwealth Edison Company and the NRC staff. The
5 deposition concerns Mr. Pentecost, a representative of the
6 NRC staff and the subject of the deposition is the environmental
7 impact of 765 kV transmission lines.

8 The deposition was noticed and by agreement of the
9 parties it was scheduled and agreed that the deposition would
10 be taken today at the offices of the NRC in Bethesda.

11 A couple of preliminary matters. As I indicated
12 off the record to counsel, and with counsel's agreement for
13 the NRC staff, the deposition tomorrow will start at 10:00 a.m.

14 I wanted to put on the record and explain to counsel
15 for the NRC staff what our plan is with respect to complying
16 with the Licensing Board order that was recently issued with
17 respect to this case. In particular, I am thinking of that
18 part of the Licensing Board order concerning Neiner Farms
19 Contention Number 1 dealing with the issue of the impact of
20 the 765 kV lines.

21 That order, that is the Licensing Board order,
22 suggested and indeed required that applicant develop an

1 affidavit which would set forth its plan with respect to the
2 construction and operation of the 765 kV lines associated
3 with the Braidwood Station. And once that affidavit was
4 completed, it should be shared with the NRC staff and the
5 Neiner Farms representatives who are intervening in this
6 case.

7 The purpose of sharing this information is to attempt
8 to seek the resolution of the issue in some respect and the
9 Licensing Board, in its order, had indicated certain ground
10 rules or approaches that it thought might be indulged in by
11 the parties during that discussion. That affidavit should
12 be completed by the time of Ms. Creek's deposition which
13 is now set for 10:00 a.m., May 21st in Chicago.

14 It is our plan that once the deposition is complete,
15 that we will take the time, after the completion of the
16 deposition, to discuss with Mr. Bock and Ms. Creek and
17 representatives of the NRC staff the substance of the affidavit
18 and embark on negotiation discussion at that time to see if
19 it is possible to resolve the issue.

20 The reason I tell you all this now, Elaine, is so
21 that if you want to have Mr. Pentecost there, that it might
22 be useful to you.

1 MS. CHAN: Thank you. I appreciate that.

2 MR. GALLO: During the course of the deposition,
3 I will be referring to two types of transmission lines. One
4 is called 765 kV transmission lines and the other is 345 kV
5 transmission lines. My reference to 345 kV transmission lines
6 will really be very limited. So, if I ask any question
7 refer to just transmission lines, I am really referring to
8 765 kV transmission lines and that should be the interpretation
9 of my questions during the course of the deposition.

10 I think at this point it might be useful to swear
11 the witness.

12 Whereupon,

13 EDWIN D. PENTECOST,
14 a witness, called for examination, having been first duly
15 sworn, was examined and testified as follows:

16 EXAMINATION

17 BY MR. GALLO:

18 Q. Mr. Pentecost, am I pronouncing your name right?

19 A. Correct.

20 Q. If you don't understand any of the questions, please
21 feel free to indicate that. And while you may find some of
22 the questions unpleasant, the idea is to try to get at your

1 understanding of the issues and if you don't understand it,
2 say so, because I don't intend to try to trick you with any
3 question.

4 A. Okay.

5 Q. Would you state your full name and address for
6 the record.

7 A. Edwin Dean Pentecost, U.S. Nuclear Regulatory
8 Commission, Washington, D.C. 20555.

9 Q. What is your position with the NRC?

10 A. I am an environmental scientist in the Division
11 of Engineering in the office of Nuclear Reactor Regulation.

12 Q. And what are your duties as an environmental
13 scientist?

14 A. Mr. Gallo, I have a professional qualification
15 statement that summarizes that, if that would be sufficient.

16 Q. Well, let me take a look at it.

17 A. I am asked to review materials in the terrestrial
18 ecology area, area's land use as related to power plant
19 licensing cases. Other duties consist of preparing environ-
20 mental monitoring requirements, technical specifications a
21 little further down the line prior to the granting of the
22 full power license and the onset of operations.

1 Q. I want to take a moment to read the statement of
2 professional qualifications.

3 A. Sure.

4 Q. This statement of professional qualifications is
5 helpful. Do you have an extra copy?

6 A. Yes, I do.

7 MR. GALLO: I think we will mark it as Pentecost
8 Deposition Exhibit Number 1 and bind it into the transcript.
9 I will give it to the reporter for that purpose.

10 (Pentecost Deposition Exhibit No. 1
11 Marked for Identification.)

12 BY MR. GALLO:

13 Q. I see from your statement of professional qualifica-
14 tions that it is really Dr. Pentecost. You have a Master
15 and a Bachelor degree in biology from Ball State University
16 in 1967 and 1963 respectively; is that right?

17 A. Correct.

18 Q. And a Ph.D. degree in zoology from the University
19 of Illinois in 1972?

20 A. Correct.

21 Q. Now, your statement of professional qualifications
22 indicates that you have written a number of articles about,

1 I guess it would be terrestrial ecology; is that correct?

2 A. Yes. While I was at Argonne National Laboratory,
3 we did some contracting work for the Nuclear Regulatory
4 Commission and part of this was to prepare portions of the
5 environmental impact statements. And the terrestrial ecology
6 section also encompassed the human element and any impacts
7 to man from transmission line effects, for example.

8 Q. Let's clarify this. After you received your Ph.D.
9 degree in 1972 from the University of Illinois, what work
10 did you perform, or where did you work?

11 A. For the academic school years of 1972-1973 and
12 1973-1974, I was on the faculty at the University of Wisconsin
13 in Stevens Point as an Assistant Professor of Biology. I
14 taught introductory courses in zoology and biology.

15 Q. And when did you leave the University?

16 A. In June of 1974. And I joined Argon National
17 Laboratory July 1 of 1974.

18 Q. What position did you assume in 1974 with Argon?

19 A. I was entitled Assistant Biologist in the group
20 called the Environmental Statement Project that later gained
21 divisional status. The bulk of the work at that time was
22 for the construction stage of environmental review for a number

1 of proposed nuclear plants.

2 Q. Were you in a group headed up by Dr. Gusterson?

3 A. Yes, I was.

4 Q. Essentially that group provided assistance to,
5 I guess it would be AEC in those days?

6 A. Yes, it was the AEC. Maybe you can help me, Elaine.
7 I'm not sure when AEC became ERDA. That was a very short
8 little group.

9 Q. January of 1974.

10 A. And so it was ERDA at that time.

11 Q. The federal agency that we are referring to as
12 ERDA, what does that acronym stand for?

13 A. Energy Research and Development Agency.

14 Q. And what was the relationship between Argonne
15 National Laboratory and ERDA?

16 A. Well, through an agreement with the Department
17 of Energy, in this case the Chicago operations office of DOE,
18 certain Argonne staff were made available to assist the ERDA
19 staff in preparing the environmental documents supporting
20 the construction licensing for nuclear power plants.

21 Q. Were they supporting the ERDA staff or were they
22 supporting the staff of the Nuclear Regulatory Commission?

1 A. There was no Nuclear Regulatory Commission at that
2 time.

3 Q. I think you will find that when ERDA was created,
4 the NRC was created at the same time.

5 A. Okay, that's correct. Excuse me.

6 Q. I guess what I am trying to establish is whether
7 or not the environmental statements that you worked on were
8 in connection with applications filed by utilities for construc-
9 tion permits and operating licenses before the Nuclear Regulatory
10 Commission.

11 A. For a short period of time there, and I can't recall
12 the exact months, but I believe it was a portion of 1974, NRC
13 had not been created yet. By coming in July, I don't recall
14 the exact timing. It may have been -- well, we were ERDA
15 at the time.

16 Q. Do you remember the names of any of the power plants
17 that you worked on?

18 A. Oh, yes, quite a few. Palo Verde was going through
19 its construction review at that time. The Koshkonong plant
20 proposed by Wisconsin Electric and a number of other utilities
21 in Wisconsin, it was one of the few that got to that stage
22 and was later canceled.

1 I think the Braidwood construction permit review
2 work had just been completed prior to my coming. I am listing
3 plants that I didn't necessarily work on per se.

4 Q. Well, I am interested in the ones you worked on.

5 A. Well, I did work on Palo Verde and Koshkonong.

6 Q. And with respect to those two applications, what
7 were your duties?

8 A. We take the latter first. In the case of Koshkonong,
9 I was responsible for the terrestrial and ecology sections
10 which included a review of the impacts of constructing the
11 transmission line network and at that time the anticipated
12 operational impacts, assessing those. I also looked at the
13 impacts to the fishery of Lake Koshkonong, which was going
14 to be the water supply source for that plant.

15 Q. Let me stop you there.

16 A. Okay.

17 Q. Were any 765 kV transmission lines proposed in
18 connection with the Koshkonong application?

19 A. No, they were not.

20 Q. Do you remember what the largest size that was
21 proposed was?

22 A. 345 kilovolt lines.

1 Q. When you say you evaluated the terrestrial impacts
2 of the transmission lines, was this simply the land use impacts
3 or was it more than that?

4 A. It was more than that. Land use impacts to wildlife,
5 how the line might be maintained during the lifetime of the
6 plant and how this would affect use of the corridor and
7 adjacent areas by wildlife.

8 Q. Did you evaluate the potential impacts to humans
9 from noise generated by the transmission line, and in this
10 instance I am referring to the 345 kV lines at Koshkonong?

11 A. I don't recall assessing that. I believe at that
12 point it was not considered in most of our EIS's. We have
13 matured during the process. During the early days, certain
14 items were not addressed.

15 Q. Did you evaluate the potential for biological effects
16 to humans from the electrical fields from 345 kV lines?

17 A. I evaluated them from the standpoint of shock hazards.
18 There was one particular line segment where there was like
19 a 230 kilovolt line that was going to be upgraded to a 345
20 line as part of the project. And a private individual had
21 a recreational park, it was like an overnight camping, there
22 was a lake there, and the applicant provided photographs that

1 showed large metal objects, i.e., recreational vehicles, campers
2 of various sorts, parked under this line. So, we did look
3 into it. I looked at it. My supervisor looked at my analysis
4 and we tried to estimate if there was going to be a hazard,
5 a shock hazard by touching a metal object parked in this
6 particular section. And that was about the extent of it.
7 I don't recall. It has been a number of years since I have
8 written this. I would have to look precisely. The state of
9 the research knowledge at that time was such that we didn't
10 have a real good handle on the electrical field of facts.

11 Q. Do you mean what is called long-term effects?

12 A. Yes. But I did analyze the potential for shock
13 hazards.

14 Q. Did you analyze the potential impact as a result
15 of the generation of ozone?

16 A. I recall considering it, but I don't recall that
17 I had it in the testimony. I don't believe it was.

18 Q. Did you evaluate the biological effects, if any,
19 from magnetic fields?

20 A. No, I did not.

21 Q. Did you evaluate the effects of the electrical
22 field on animals or insects?

1 A. No.

2 Q. How about special effects like the effect on pace-
3 makers?

4 A. I don't recall doing that either. This was in
5 1974. Again, the state of our knowledge was not good.

6 Q. I understand. Now, this evaluation that you
7 performed with respect to Koshkonong, was that incorporated
8 into an environmental assessment report?

9 A. Yes, a draft environmental impact statement was
10 issued by the NRC in 1974, and that's as far as it went.
11 A final was never issued and the application was withdrawn.

12 Q. Do you recall whether or not the comments were
13 received with respect to the draft environmental statement
14 for Koshkonong, and in particular with respect to your area
15 of responsibility?

16 A. No, I can't recall just what comments came in.

17 Q. Now, what were your duties with respect to the
18 environmental assessment of Palo Verde?

19 A. The Palo Verde, I was in charge of the aquatic
20 ecology assessment in a desert environment. You certainly
21 don't have the same concerns that you have in central Wisconsin,
22 for example, but their major concern was that of diverting

1 sewage waste water effluent from the City of Phoenix from
2 a waterway to be used to cool the nuclear power plant. And
3 I had to assess what the impacts would be of diverting that
4 water from the salt of the rivers.

5 Q. Did you make any assessment in that case concerning
6 transmission lines?

7 A. No, I didn't.

8 Q. How long did you work in this capacity at Argonne?

9 A. I was at Argonne from July 1974 until September
10 1979. I continued to be a reviewer, doing this type of work
11 throughout the five years plus I was there; but part of my
12 duties were also as a section leader, which I guess would
13 be comparable to an NRC branch chief. I had a number of
14 technical people working directly for me doing various terres-
15 trial environmental studies.

16 Q. Do you recall ever having participated in an
17 environmental review of a nuclear reactor application during
18 that period of time involving 765 kV lines?

19 A. No, I did not. I can't recall any other consider-
20 ation at that time that we worked on.

21 Q. Did you participate in any review during that same
22 period of time involving 345 kV lines besides Koshkonong?

1 A. No. The other duties I had did not involve that.

2 Q. What job did you take after you left Argonne in
3 1979?

4 A. I joined the Department of Interior in Kansas City,
5 Missouri as a supervisor of biological scientists in the
6 Division of Technical Services and Research in the Office
7 of Surface Mining. It is one of five regional offices of
8 that agency.

9 Q. What did you do for the Department of Interior?

10 A. I had six employees working for me most of the
11 time. My job was to supervise their input to reviewing portions
12 of federal mining reclamation plans. We reviewed a lot of
13 state laws and regulatory programs that were being established
14 for coal mining reclamation. We had a seven-state area
15 responsibility.

16 Q. Did your responsibility in any way involve the
17 evaluation of the impacts of transmission lines?

18 A. No.

19 Q. What kind of environmental assessment were you
20 involved in?

21 A. Keep in mind, I was in a supervisory capacity,
22 so the people who were working for me were reviewing bylaw

1 and regulations on federal lands in Oklahoma and Texas in
2 our region. Applicants, coal miners, were required to submit
3 a mining plan, and we had to look at how it would affect the
4 vegetation that was there, the agricultural use of the land,
5 the hydrology of the area, potential impacts to streams and
6 other water bodies in the area.

7 And then they were also required to submit a
8 reclamation plan, that is how are you going to put it back
9 once the coal has been removed. Again, we had regulations
10 that required certain inputs and we were asked to review those.

11 The other large facet work involved reviewing seven-
12 states programs. They had to submit regulation and laws that
13 were as or more stringent than the federal surface mining
14 reclamation law.

15 Q. According to your resume, you joined the NRC in
16 January of 1982?

17 A. That's correct.

18 Q. And were you assigned to the group within the NRC
19 that deals with environmental matters at that time?

20 A. Yes, the Environmental and Hydrologic Engineering
21 Branch.

22 Q. Since that time, have you reviewed various license

1 applications from the standpoint of the effects of transmission
2 lines?

3 A. Yes. I did look at the Shearon Harris project
4 in North Carolina.

5 Q. Any others?

6 A. And I have looked at the Limerick Power Plant in
7 Pennsylvania. Those were the two that I evaluated that aspect.
8 As you probably know, the number of applications and review
9 assignments has diminished from what it was in the 1970s,
10 so I am sure I don't have as varied an assignment package
11 as I would have had ten years ago.

12 Q. With respect to Shearon Harris, did your participa-
13 tion in that environmental review involve the impacts of
14 transmission lines?

15 A. Yes, it did.

16 Q. I am going to ask you to explain the nature of
17 your review, but I should have asked a preliminary question
18 before that. Are we talking about the Shearon Harris construc-
19 tion permit, the application, or the operating license
20 application?

21 A. The operating license application.

22 Q. What did your review with respect to transmission

1 lines entail there?

2 A. Well, it was very similar to what was done at
3 Koshkonong, although we did review the literature for electric
4 field effects, what is known now. This was done in 1982.
5 And then when the final statement came out, another reviewer
6 took over for me because I had taken a different position
7 here, but I did look at transmission line operational effects.

8 Q. Did the Shearon Harris application involve the
9 proposed or the installation of 765 kV lines?

10 A. Not that I recall, no.

11 Q. Do you recall what the largest size was proposed
12 for Shearon Harris?

13 A. There was a 500 kilovolt line that was proposed
14 at one time and another staff member, Mr. Gears, did a review
15 of a particular segment. That was later canceled. And I
16 believe 345 was the largest. I would have to double check.

17 Q. Who was the person who did the review that you
18 referred to?

19 A. Mr. Gerald Gears.

20 Q. How do you spell his name?

21 A. G-E-A-R-S. That was prior to my joining the NRC.

22 Q. So, is it fair to say that your review on Shearon

1 Harris was limited to 345 kV lines?

2 A. Certainly nothing more than that.

3 Q. Did you analyze the potential effects of what you
4 called earlier shock effects?

5 A. As I recall, I considered that in my analysis and
6 did not identify any areas where there would be use, such as
7 a trailer park or other areas where there would be intensive
8 use where it would be a major concern.

9 Q. And you indicated earlier that you reviewed the
10 literature for biological effects as well?

11 A. Yes.

12 Q. Are we talking now about long-term biological
13 effects?

14 A. Yes.

15 Q. What conclusion did you draw from that review?

16 A. That the -- again, I am paraphrasing here. I am
17 not giving you exact words -- that the field strength levels,
18 the electric field strength levels at ground level, that being
19 defined as about a meter above the ground surface, would not
20 be extensive enough to cause health effects, adverse health
21 effects to any humans being in the area.

22 Q. Did you examine, for that application, the

1 potential effect of ozone?

2 A. Yes, I did.

3 Q. What did you conclude with respect to that
4 examination?

5 A. I felt that the periods of time that ozone would be
6 produced and the diffusion properties in the air and the
7 clearance above vegetation, that there would not be any adverse
8 effect to the vegetation from ozone production.

9 Q. Did you examine the potential effects to animals
10 or insects from the effects of the electrical field?

11 A. No, I didn't.

12 Q. Did you examine the potential effects from magnetic
13 fields to either humans or animals or insects?

14 A. Let me stop a minute and ask what you mean by
15 examine.

16 Q. Evaluate. Does that help you if I change examine
17 and say evaluate?

18 A. If you mean evaluated as a potential impact on
19 a long segment of line --

20 Q. Yes.

21 A. No, I did not.

22 Q. Did you consider it in any way?

1 A. Well, again, I was somewhat familiar with the
2 literature and I felt that levels would be so low at ground
3 level, under that size line, that there would not be a problem,
4 so I didn't really address it.

5 Q. Would it be fair to say that based on your knowledge
6 of the field of the impacts from magnetic effects under
7 transmission line that you didn't think it was a problem in
8 the Shearon Harris application, so you just dismissed it on
9 that basis?

10 A. That's correct.

11 Q. Did you consider special effects like the effect
12 on pacemakers?

13 A. I don't recall in that case. I have to check the
14 record.

15 Q. Let's talk a little bit about Limerick. Did the
16 applicant in Limerick propose the construction of 765 kV line?

17 A. No.

18 Q. What was the largest size line that was involved
19 in that size application?

20 A. 500 kilovolt. 500 kV lines.

21 Q. Did you assess the impact from those lines in that
22 application?

1 A. Yes, I did. I took information provided in the
2 environmental report submitted by the applicant, reviewed
3 the literature and concluded that there would not be a problem.

4 Q. When was this review made by you?

5 A. I started work on the project in the summer and
6 fall of 1982 and continued on with it until, I think we had
7 a draft ready to go out in March or so of 1983. The dates
8 may not be exact on that, Elaine, but that's roughly the time
9 period we were doing the review.

10 MS. CHAN: That's close, as I recall.

11 BY MR. GALLO:

12 Q. Well, let me ask you the same list of questions.
13 Did you evaluate the long-term biological impacts, if any,
14 of the 500 kV lines to people, bugs and animals?

15 A. I didn't look at insects or animals. I did review
16 the literature for potential human health effects from exposure
17 to electric fields and essentially drew the same conclusions
18 that I did with the Shearon Harris project, that there would
19 not be long-term effects.

20 Q. Did you evaluate the effects of shock?

21 A. Yes, I did. There was one segment of line that
22 was of concern to me. It paralleled a common corridor

1 of a railroad track and a major highway, all close together,
2 so I did look for a potential to have ungrounded objects,
3 metal objects where you might get a large voltage built up
4 and a potential for shock. After talking with the applicant,
5 finding out what their plan was to ground any objects where
6 there was a question, I concluded that there would not be
7 a problem.

8 Q. Did you assess the impact or the potential impacts
9 from ozone from these 500 kV lines?

10 A. It was considered. It is an item that I considered
11 in Shearon Harris. I know I looked at it. I think I again
12 dismissed it as not likely to cause impact to vegetation.

13 Q. Did you examine the effects of noise at the Limerick
14 application from the operation of these 500 kV lines?

15 A. I did not. Another staff member looked at noise
16 of the cooling tower operation at the plant and I am not sure
17 whether we -- pardon me?

18 (Counsel Chan and the witness conferring.)

19 THE WITNESS: Oh, yes. The other staff member
20 addressed this also. In the auxiliary, I guess you would
21 call it, water supply source was from the Delaware River some
22 30 miles away from the nuclear power plant, and there was

1 a large pump house that had been constructed there. There was
2 a national historic site nearby, a number of homes nearby,
3 so a noise analysis was done. I believe that was done under
4 contract for us of that facility, but if any noise work was
5 done as far as transmission line noise, it would have been
6 done by this individual. I don't recall on that project
7 whether we did or not.

8 Q. So you don't recall whether or not a noise analysis
9 of the transmission line operation was done in Limerick?

10 A. No.

11 Q. All right. Do you recall whether or not an analysis
12 of the potential noise impact was made in connection with
13 your work on the Shearon Harris application?

14 A. No. I don't recall doing it myself. And, again,
15 as far as the power plant itself, there may have been a noise
16 analysis there, but I don't think we did a special analysis
17 for the transmission lines.

18 Q. Returning to the Limerick application, do you recall
19 whether or not any comments were received on the draft
20 environmental statement with respect to your area of responsi-
21 bility, that is the transmission line assessments?

22 A. I don't recall. It was about that time I was

1 reassigned and took the position of program assistant, so
2 the responses to the comments were handled by another staff
3 member, but I don't recall anything. He did consult with
4 me on a few items, but I don't believe there was anything
5 on transmission lines.

6 Q. When did you become program assistant?

7 A. That was in May of 1983.

8 Q. What were your duties as program assistant?

9 A. I worked directly for Mr. Richard Vollmer, the
10 Director of the Division of Engineering and helped with tracking
11 work products in the division. There were roughly 130 people
12 in the division, so we were tracking work progress, preparation
13 of budget input, sort of a conduit of information to our office
14 director and his staff. So, it was predominantly administrative.

15 Q. Are you still the program assistant?

16 A. No.

17 Q. What is your position now?

18 A. In March of this year, March of 1985, I became
19 environmental scientist and was reassigned back to the group
20 I had joined in 1972.

21 Q. When did you say you became the environmental
22 scientist again, January of what year?

1 A. No, March of this year.

2 Q. March of 1985. I see. And was your first assignment
3 the Braidwood case?

4 A. No. As a matter of fact, that came along near
5 the end of March, early April, so I have not really had the
6 time to dig into all the facts in the case.

7 Q. Well, have you worked on another application during
8 this short period of time that you have been an environmental
9 scientist?

10 A. Yes. During the time I was program assistant,
11 I continued to work on the Palo Verde plant, again, the operating
12 license stage. And as Elaine knows, I have just finished
13 preparing testimony for hearings in June for that case. The
14 decision was made to allow me to continue with working on
15 that case because I had already expended so much effort with
16 it. So, I have spent considerable time on that contention.

17 Q. If I have understood your prior testimony, that
18 particular case, that is the Palo Verde case, does not involve
19 the impacts of transmission lines; is that correct?

20 A. That's correct?

21 Q. And you have also been assigned to the Braidwood
22 case for the purpose of addressing this issue, which I will

1 call Neiner Farms Contention 1?

2 A. Yes, I have.

3 Q. Have you ever testified in an NRC proceeding before,
4 licensing proceeding?

5 A. Yes, I have.

6 Q. Where did you testify?

7 A. In Phoenix, Arizona on the Palo Verde in the CP
8 stage environmental hearings, construction permit stage.

9 Q. Any other case?

10 A. Yes. The Indian Point hearings in April of 1983.
11 There was a contention that involved the consideration of
12 the impacts of shutting down Indian Point Units 2 and/or Unit
13 3, and I was part of a panel that examined the economic and
14 ecologic effects from converting from nuclear to a replacement
15 power source.

16 Q. Did that assessment in any way involve transmission
17 lines?

18 A. No, it didn't.

19 Q. Did your testimony at the construction permit stage
20 of the Palo Verde case involve transmission lines?

21 A. No.

22 Q. In the Palo Verde case, did you actually take the

1 witness stand?

2 A. Yes, I did.

3 Q. And were you subject to cross-examination?

4 A. Very little. We had no interveners in that case.

5 As a result, the hearing board probably delved a little deeper
6 than possibly they would have. I think I was asked to clarify
7 a few items by the applicant's counsel.

8 Q. In the Indian Point case, did you actually take
9 the stand and testify there?

10 A. As part of a panel, which consisted of reading
11 my name into the record and that this was my testimony. And
12 two members of our five-member panel, two other members received
13 all the questions in their area and I was not cross examined
14 on mine.

15 Q. In all your experience, whether it was at Argonne
16 or the NRC or elsewhere, have you ever been involved or
17 participated in an evaluation of the impacts of 765 kV lines?

18 A. No, I haven't.

19 Q. During your schooling, did that involve any type
20 of study that would be relevant to 765 kV lines?

21 A. No.

22 Q. Am I correct in my understanding that the impacts

1 of the construction and operation of the 765 kV line is an
2 environmental issue as opposed to a health and safety issue?
3 Is that how you see the issue?

4 A. Well, it depends, sir, on how you define environ-
5 mental. If you are considering environment to be everything
6 except man, then as I see the contention before us, it is
7 largely human health and safety.

8 Q. All right. It wasn't clear in my question. I
9 am defining environmental in the same manner that the NRC
10 defines environmental. And when I compare it to health and
11 safety, I am thinking of radiological health and safety issues
12 that the NRC normally considers. Which one of those two camps
13 does this issue fall in, as you understand it?

14 A. I would say environmental.

15 Q. All right.

16 A. Could I clarify a response that I just gave you
17 about my schooling?

18 Q. Yes.

19 A. As an ecologist, being trained in the late 1960s
20 and early 1970s, we were beginning to look at disturbances
21 to the environment of various types and, of course, one of
22 these being the clearing of vegetation for a variety of reasons,

1 one of which was transmission lines. So while I couldn't
2 say it was affiliated with the 765 kV line per se, I did have
3 some training that prepared me in knowing what kinds of things
4 to look at in preparing an assessment.

5 Q. All right. Does NRC have any regulations or guidance
6 of any sort that provide insight to an environmental scientist
7 on the review of transmission lines?

8 A. Yes. We have a document entitled "Environmental
9 Standard Review Plans for the Environmental Review of
10 Construction Permit Applications for Nuclear Power Plants."
11 And this was dated May 1979. If you recall the process at
12 the construction permit stage, we address both the anticipated
13 impacts of construction and operation, as we knew it at that
14 time.

15 And I have here the two sections of the Standard
16 Review Plan that pertain to transmission line systems, they
17 being 3.7 and 5.6.3. I can provide you a copy, if you
18 would like.

19 Q. Is this Standard Review Plan still in use today?

20 A. Yes, it still -- when you say in use, I would
21 like to qualify that a bit by saying if we had construction
22 permits to be considered, it would be in use. Certainly those

1 portions of the Standard Review Plan that pertain to operating
2 the impacts and how we should address the concerns are still
3 appropriate.

4 Q. Well, let me understand this. This Standard Review
5 Plan document that you handed to me, which is dated May 1979
6 and is designated by a number NUREG-0555, does that apply
7 to operating license applications as well?

8 A. Yes.

9 Q. And is this guidance for use of NRC reviewers,
10 or is it guidance for applicants in the preparation of
11 environmental reports?

12 A. It is guidance predominantly for the staff reviewer.
13 I think the applicant could get some insight by looking at
14 it, but it is more for our use.

15 When you said is it -- if I could ask to have your
16 question repeated about is it also used for operating --

17 Q. Tell me what it is.

18 A. Is it used for operating license applications?

19 Q. Yes, I had asked that question.

20 A. We have no comparable document in effect, but it
21 is entitled "Operating License Reviews." Some review plans
22 were proposed but they have not made it through the system,

1 for whatever reason.

2 Q. In your experience, is there a difference in the
3 approach to a transmission line evaluation depending on whether
4 it is construction permit or operating license?

5 A. Yes, there is. At the construction stage, we were
6 addressing both the impacts of construction, that is getting
7 to the proposed corridor, putting the towers in place, distur-
8 bance to the environment to that. We identified land use
9 by acreage type along the proposed corridors and provided
10 maps of the corridors. Once we get to the operating license
11 stage, the construction impacts are no longer addressed and
12 we are looking solely at operational effects.

13 Q. Are the operational effects considered at the
14 construction permit stage?

15 A. Yes, but not in the same depth that they are in
16 the operating stage.

17 Q. What do you mean by the term operating effects?
18 Describe the effects.

19 A. Okay. The audible noise created by operating the
20 high voltage line; the potential impacts of electric fields
21 produced by operating lines; magnetic fields and their impacts
22 on the environment; ozone production created by the operation

1 of the lines and, again, the associated impacts.

2 Q. Is there a comparable document to NUREG-0555 that
3 is made available to applicants to guide them in the preparation
4 of environmental reports?

5 A. Hold on a second.

6 Q. If you know.

7 A. I know something but I am not sure.

8 MS. CHAN: Off the record, please.

9 (Discussion off the record.)

10 THE WITNESS: We do have a regulatory guide,
11 Mr. Gallo, on what should be included in the environmental
12 report.

13 BY MR. GALLO:

14 Q. Do you remember what the number is?

15 A. No, I don't.

16 Q. Do you have it with you?

17 A. No.

18 MR. GALLO: Counsel could you get me that information?

19 MS. CHAN: Yes, I will provide it.

20 MR. GALLO: Thank you.

21 BY MR. GALLO:

22 Q. I think I know the answer to this question, but

1 I will ask it. Were you involved in any way in the preparation
2 of the section on transmission lines in the Braidwood FES?

3 A. No, I wasn't.

4 Q. And is that the same answer with respect to the
5 draft environmental statement on Braidwood?

6 A. On the operating license?

7 Q. Yes.

8 A. Yes, that's correct.

9 Q. Were you involved in any way, perhaps during your
10 tenure at Argonne, in the work on the Braidwood construction
11 permit draft environmental statement, final environmental
12 statement?

13 A. No, I wasn't.

14 Q. Were you aware that that evaluation was being
15 conducted at Argonne?

16 A. As I look at -- no, I didn't know that it was being
17 done there. I think Oak Ridge National Laboratory was also
18 doing a number of these reviews for the NRC as well, so I
19 couldn't tell you for sure that it was done.

20 Q. All right, fine. Now, I have looked at the
21 environmental statement for Braidwood. It is called NUREG-1026
22 and in particular there is an assessment of the transmission

1 line impacts appearing on pages 5-10 and 5-11 of the final
2 environmental statement. And then there are references to
3 the matters of transmission lines in other sections of the
4 final environmental statement. Have you had the opportunity
5 to review this material that I have just referred to?

6 A. Yes. I have read through it one time. If you
7 are meaning have I reviewed all the references cited here,
8 I have not.

9 Q. But have you reviewed the narrative material that
10 is in the FES?

11 A. Yes, I have.

12 Q. There is a list of authors of the final environmental
13 statement on page 7-1. Do you have that page?

14 A. Yes, I do.

15 Q. And I see that the list goes onto the next page.
16 Would you identify for me which individual was involved with
17 the assessment on the transmission line issue.

18 A. I believe most of this statement, the entire
19 statement was prepared by Argonne National Laboratory, Oak
20 Ridge and a few other -- well, let me just leave it at most.
21 I believe Mr. Webb from Oak Ridge National Laboratory, who
22 is mentioned on page 7-2, was involved in preparing input

1 and Mr. Germane LaRoche on page 7-1 was the staff reviewer
2 that reviewed the input, made modifications to it prior to
3 its incorporation in this document.

4 Q. What is the input that you are referring to? It
5 is not clear in the record that we are talking about the same
6 thing. What input are we talking about?

7 A. The input on pages 5-10 and 5-11 that you referred
8 to on transmission line system, 5.5.1.2.

9 Q. You have indicated to me that you have at least
10 read the write-up of the transmission line analysis in the
11 FES. Have you looked at the input provided by the individual
12 from Oak Ridge?

13 A. No, I haven't.

14 Q. Have you drawn any opinion with respect to the
15 adequacy of the evaluation on transmission lines as set forth
16 in the final environmental statement?

17 A. No, I haven't. To do that, I would need to --
18 at least I would feel most comfortable in going back through
19 and digging out some of the facts myself, looking at the route
20 in detail.

21 Q. Is there anything in the analysis at this point
22 that you specifically disagree with?

1 A. No. I see nothing there that I disagree with.

2 Q. Is it fair to say that at this point your review
3 is preliminary and therefore you need to do more analysis
4 before you can decide whether or not the write-up is adequate?

5 A. Yes.

6 Q. Have you had the opportunity to read the material
7 that the applicant submitted in the environmental report on
8 the transmission line issue?

9 A. No, I haven't.

10 Q. Do you know whether or not the analysis on
11 transmission lines in the final environmental statement covers
12 765 kV lines?

13 A. I have the feeling it does not because there was
14 some question, when I read the statement, whether or not the
15 765 kV line would be constructed as part of this project.
16 And it may have been the same feeling of the staff in preparing
17 this. I notice the analysis is based heavily on the review
18 article by Mr. Lee from Bonneville Power Administration, and
19 much of that work was based on 500 kilovolt line. I think
20 there was a bit of uncertainty here on whether the 765 line
21 would really be built and if it was more a question of the
22 345 line, assessing the impacts of that.

1 Q. Have you inquired of Mr. LaRoche -- is that the
2 man's name?

3 A. Yes.

4 Q. -- as to whether or not when he approved the write-up
5 for the transmission line section intended to cover 765 kV
6 line?

7 A. No, I haven't.

8 Q. Let me direct your attention to page 5-11 and in
9 particular the incomplete paragraph at the top of the page.
10 There seems to be some sort of evaluation there of both the
11 345 kV effects and the 765 kV line effects. Having a chance
12 to refresh your memory by looking at that section, does that
13 in any way alter the answer that you have given on my question
14 as to whether or not 765 kV lines are covered by the FBS?

15 A. That's the only place I recall seeing 765 mentioned
16 in the analysis section, in this particular section. No,
17 it doesn't really help me in deciding whether or not we did
18 address it.

19 Q. In your experience, what kind of, let me use the
20 term work papers, would exist with respect to supporting the
21 formal analysis that is in the FES on transmission lines?

22 A. In this case, we would have a rough draft that

1 was submitted by the contract of Mr. LaRoche's review. Most
2 likely, then, a second version would be sent in based on his
3 comments. He would then make any changes he saw fit and submit
4 it to management here for review. And there would probably
5 be a number of drafts up through the management chain.

6 Q. And as I understand it, you have not had an
7 opportunity to look at those papers?

8 A. No, I haven't.

9 MR. GALLO: Ms. Chan, is it possible that we could
10 be provided copies of those papers?

11 MS. CHAN: If they are available. I think the
12 problem may be that if a draft is submitted, the drafts are
13 thrown out after the finals are developed. But if it is
14 available, we shall try to obtain --

15 MR. GALLO: You mean if the documents exist, you
16 will provide them?

17 MS. CHAN: Yes.

18 MR. GALLO: Well, for Dr. Pentecost's benefit,
19 I hope that they exist.

20 BY MR. GALLO:

21 Q. I was going to ask you a series of questions as
22 to what type of design was assumed for purposes of evaluation

1 in the final environmental statement, and in particular the
2 design I am referring to is the 765 kV line design. I guess,
3 since you are not sure it is covered, you can't answer those
4 questions.

5 A. No, I can't.

6 Q. Are you familiar with the design of 765 kV lines?

7 A. Well, somewhat. I am not an electrical engineer,
8 so I am very limited in my understanding.

9 Q. That was really a broad question. Let me be a
10 little more specific. Do you have knowledge with respect
11 to what the width of a typical right of way would be?

12 A. Yes.

13 Q. What is that?

14 A. In the neighborhood of 250-300 feet. In this case,
15 I would have to look at what was said in the EROL in the case
16 of combining 345 and 765 in the same corridor as to whether
17 it would be exactly in that range.

18 Q. But I am just asking you general questions with
19 respect to 765 kV lines generally standing alone.

20 A. Yes.

21 Q. How tall would the towers be?

22 A. It seems to me like they are in the neighborhood

1 of 150-200 feet, if you are talking to the top of the tower.

2 Q. Is there, in your knowledge, some standard array
3 for the transmission line wires themselves? Are they just
4 a single strand of wires, or are there a number of levels?

5 A. Well, the conductor, in this 500 kV and above would
6 not be a single strand of wire, it would be a bundle of
7 individual wires. And they would be arranged -- 765 kV line
8 in a single circuit, I believe, as Mr. Lee has shown in his
9 document, shows there being three major bundle configurations
10 on that, one suspended from each side of the tower and then
11 one up at the next level in the middle of the tower. But
12 that can vary depending on the type of conductor and the design.
13 But, again, I am not an expert to go into that, the details.

14 Q. Do I understand that this bundle of wires is called
15 a conductor?

16 A. Yes.

17 Q. And the bundle is akin to a cable that contains
18 many wires?

19 A. You could say that in layman's terms.

20 Q. Or a fuel core that contains many fuel pins?

21 A. I wouldn't equate it quite the same, no.

22 Q. All right. Do you have any knowledge with respect

1 to what the peak current flow is with respect to 765 kV lines
2 generally?

3 A. No, I can't tell you off the top of my head.

4 Q. How about the average current flow?

5 A. No, sir.

6 Q. Can you tell me for purposes of an environmental
7 analysis what design parameters for transmission line, a 765
8 transmission line are important?

9 A. Okay, as far as assessing, let's say, electric
10 fields, if we use that as an example --

11 Q. All right, let's start with that one.

12 A. -- it would be the height above ground of the
13 conductors and that would be at the lowest point, comonly
14 referred to as the sag point, the lowest point between two
15 successive towers. The operating voltage current would need
16 to be known, or at least a range of them would need to be
17 known. For a worst case estimate, you would take the maximum
18 voltage of current. The receiving object, the position of
19 that object with respect to the conductors, whether they are
20 perpendicular or under the line or parallel, under or along
21 the edge of the outer most conductors. Electric fields, you
22 need to know that. I believe we have asked for your estimates

1 of electric field strengths.

2 Q. So you need the electric field strengths. Let's
3 assume a 765 kV line of a certain tower height, a certain
4 conductor sag point and a certain maximum voltage. We don't
5 know what those numbers are, but can you generally give me
6 some notion as to how far -- let me start again.

7 Clearly under the transmission line, this electrical
8 field can be noted and measured.

9 A. Yes, sir.

10 Q. Now, how far to either side of the transmission
11 lines does one need to go before that effect is not measurable?
12 Just in general terms. I don't want to hold you to any
13 particular dimension.

14 A. In the case of the 765 kV line, if we said that
15 we used 250 foot, the width of the corridor, the highest
16 electric field levels would be something like 40 to 50 feet
17 outside the edge of the corridor, which in this case, would
18 be about 200 feet from the center line of the corridor. And
19 I would guess out to 400 feet from that range you might still
20 be able to pick up the field. It would depend on a number
21 of variables, the topography and the vegetation along the
22 corridor would tend to mask or reduce the field strength that

1 you would measure out at that distance.

2 If we are talking central Illinois here, a nice
3 flat field, you wouldn't have those factors to reduce the
4 field strength.

5 Q. Is there some means that an environmental scientist
6 goes through to determine the reach or how far he would examine
7 the electrical field if he wasn't interested in the long-term
8 biological effect question? Do you understand my question?

9 A. I think so. We would not go out and take measurements.
10 I have not done that. I have seen examples of demonstration
11 projects where we measured it. And I have one reference that
12 I have looked at where the TVA has looked at field strengths
13 and the effects of topography and vegetation along a 500
14 kilovolt line. So, we would look at the terrain and the amount
15 of vegetation and I would try to glean from the literature
16 what measurements have been taken. I think that is one of
17 our questions to Commonwealth Edison, have there been
18 measurement studies taken. I have not seen any data yet on
19 765 kV lines.

20 Q. Would you identify the proximity of residences
21 to the lines?

22 A. Absolutely, yes.

1 Q. Then what would you do? Let's assume that you
2 obtained information that there is a residence within 260
3 feet of a center line of a 765 kV transmission line. Would
4 you examine that in particular, or how would you treat that
5 for your assessment purposes?

6 A. I would look at how the building was oriented towards
7 the line, whether it was parallel or not, perpendicular, if
8 it had large windows or was more of a solid building. Some
9 work has been done to measure electric field strengths inside
10 of homes and they find that electrical wiring, when the power
11 in the house is turned on, will add as much to the electric
12 field as any field strengths that have been measured, within
13 a distance we are talking about here, a couple hundred feet.
14 But I would look at that as well as looking at what was in
15 between the house and the transmission line where, again,
16 we had vegetative cover of trees or there was a hill, that
17 would certainly be different than if it were flat terrain.

18 Q. How would you determine at what point you could
19 simply dismiss consideration of a residence because it was
20 clearly far enough away that it wasn't a problem? How would
21 you determine where that line would be drawn?

22 A. I would have to look closely at the literature

1 to answer that. I would rely heavily on a couple of articles
2 that just recently have come out. But I think that once you
3 get down in the neighborhood of 1 to 2 kilvolts per meter,
4 which, for many of our 345 lines, the maximum kilovolts per
5 meter is estimated to be -- field strengths in kilovolts per
6 meter is estimated to be around 3.5. So once we got down
7 considerably below that, I think I would not be concerned.

8 Q. You made reference in answer to this question to
9 a couple of articles of literature. Could you identify those
10 for me.

11 A. There is a paper here by Mr. Caola regarding
12 measurements. The title of the paper is "Measurements of
13 Electric and Magnetic Fields in and Around Homes Near a 500
14 kV Transmission Line."

15 Q. Can I have this, or is this your only copy?

16 A. I can make a copy for you.

17 Q. I am not going to make these exhibits, I just want
18 them identified for the record.

19 A. I have another article by Mr. Sendaula and numerous
20 other authors entitled "Analysis of Electric and Magnetic
21 Fields Measured Near TVA's 500 kV Transmission Lines."

22 The first article was the one I referred to where

1 they actually measured electric field strengths inside of
2 homes, outside of homes fairly close to transmission lines.

3 The latter article has to do with the effects of
4 vegetation and topography on electric fields at various points
5 along the TVA 500 kV line.

6 Q. I noticed that the article by Mr. Caola involves
7 the measurements of electric and magnetic fields in and around
8 homes near a 500 kV transmission line. Are those magnetic
9 fields or electrical field information for a 500 kV line,
10 is that simply able to be extrapolated to a 765 kV line on
11 a linear basis?

12 A. I wouldn't do it, no. I would want to continue
13 my search and see if -- and that's why we asked the question
14 of Commonwealth Edison, were they aware of any studies where
15 field strengths were measured. It will vary with the voltage,
16 of course, so I wouldn't directly extrapolate.

17 Q. How would you use the conclusions reached in this
18 study in an application involving 765 kV lines?

19 A. I would look at the magnitude of change with distance
20 from the 500 kV line and get some idea of how much it is reduced,
21 and in that particular case, how much the normal electrical
22 field you would find in a house with the electricity turned

1 off, how it compares with that.

2 Q. I will give you these two studies back.

3 MR. GALLO: Counsel, could you provide copies,
4 please?

5 MS. CHAN: Yes.

6 MR. GALLO: I assume that whatever you are going
7 to send me, you are going to send to Mr. Bock?

8 MS. CHAN: Yes.

9 MR. GALLO: Great.

10 BY MR. GALLO:

11 Q. We were talking about what design parameters were
12 important for purposes of environmental evaluation with respect
13 to determining the size and intensity of an electrical field.
14 Are those same factors relevant for determining the size and
15 the intensity of a magnetic field as well, or is there something
16 more involved?

17 A. Magnetic field? Yes, those same factors I would
18 need to have.

19 Q. With respect to audible noise impacts, what design
20 parameters are important to you to make your evaluation?

21 A. Okay, there is a difference. I have searched the
22 literature enough to know that there is a difference, based

1 on the conductor bundle configuration as to the amount of
2 audible noise you would get.

3 I would need to know in addition the amount, the
4 percent of the year they would expect foul weather, such as
5 fog, rain or snow. With audible noise, any rough projections
6 on the metal wire conductor will cause corona discharge,
7 sparking corona, and it would create a humming noise. And
8 when there are water droplets on the conductors, the amount
9 of discharge and the intensity of the noise is greater. The
10 same with snow or fog.

11 So, I would use meteorological data in my assessment,
12 in this case for North Central Illinois, to try to come up
13 with some estimate as to numbers of days per year the audible
14 noise might be a certain level and also factoring distance
15 from the line.

16 Q. I am going to ask you some more questions about
17 noise matters as we get later into the deposition.

18 Again, returning to design parameters for 765 kV lines,
19 are there any parameters, other than the ones you mentioned,
20 of importance when one evaluates ozone?

21 A. Not that I can think of. Ozone is created when
22 there is ionization of the air at the conductor surface.

1 And, again, as with the noise created, you are going to get
2 the maximum ozone during foul weather conditions. And wind
3 dispersion would generally dilute the concentration quickly,
4 so it is just a few centimeters or a meter at most from the
5 conductors. I wouldn't expect ozone levels to be high enough
6 to cause effects on vegetation.

7 Q. And finally, are there any design parameters, other
8 than what you have mentioned, that are important in the evalu-
9 ation of the effects of 765 kV lines on the operation of pace-
10 makers?

11 A. I think, again, knowing the electric field strengths,
12 magnetic field strengths would be sufficient. But then in
13 conducting the assessment, you would obviously want to have
14 some idea of the type of pacemaker, how long the user of the
15 pacemaker would be at a certain location near the transmission
16 lines in addressing the potential effects.

17 Q. Do you know how long the 765 kV line that is
18 proposed is for the Braidwood application, how many miles?

19 A. Thirty miles is what was stated in the FES.

20 Q. If you were interested in the proximity of residences
21 to the transmission line, would that be along the entire 30-mile
22 length of the transmission line?

1 A. Yes. I wouldn't expect any differences in the
2 field at any -- if the current load is the same throughout
3 the 30 miles, it should be putting out the same electricity.

4 Q. So, if you want to know what the location of
5 residences to the transmission line, you really want that
6 information for the entire length of transmission line; is
7 that correct?

8 A. Yes.

9 Q. I think you mentioned in an answer to one of my
10 earlier questions that you were aware that the corridor for
11 the 765 kV line is adjacent to a corridor for the 345 kV line;
12 isn't that correct?

13 A. Yes.

14 Q. Have you ever, in your experience, evaluated the
15 environmental impacts from two corridors that ran adjacent
16 in this fashion? Maybe for different types of lines, but
17 have you ever evaluated that kind of circumstance?

18 A. I have. I don't recall which plant it was on.
19 I will just leave it at that. It was one of the evaluations
20 that I had done where a 345 and a smaller voltage line were
21 going to be in the same corridor.

22 Q. What is the effect on the intensity and size of

1 the electrical field from having two transmission lines in
2 close proximity?

3 A. It results in field strength that is something
4 less than the two if you were just to add them together as
5 separate entities. There seems to be a cancellation effect
6 under the -- in the middle of the corridor by the electric
7 fields from the two systems. I can't give you quantities
8 on how much, but there is some reduction in level.

9 Q. You say it is a reduction in terms of adding what
10 you would see if the two were standing alone?

11 A. Right.

12 Q. If we assume that there is a 345 kV line and a
13 smaller kV line in close proximity in the same corridor, is
14 the total electrical field strength greater than from just
15 the 345 kV line?

16 A. Yes, it is slightly greater. I can't put numbers
17 on it for you.

18 Q. I understand that. So for purposes of the
19 Braidwood evaluation you would have to take into account the
20 combined effect of the 765 kV line and the 345 kV line?

21 A. Yes.

22 Q. Do you have any notion as to what distance might

1 be sufficient so that they would be considered to be independent
2 of one another?

3 A. I am guessing 400-500 feet, if they were that far
4 apart, which would be a pretty massively wide corridor.
5 I haven't looked at your EROL, so I don't know just how wide
6 you are proposing that corridor to be. It could vary by a
7 couple hundred feet, but it is in that range.

8 Q. Are the shock effects intensified by the fact that
9 the 765 line is in close proximity to the 345 kV line?

10 A. I don't know the answer to that.

11 Q. I assume that is something you will look into?

12 A. I will look into it.

13 Q. Is there any cumulative effect from the generation
14 of ozone from the two lines?

15 A. I suspect not. I think you would have such a rapid
16 diffusion of the ozone when it created, that it would be very
17 hard to say that the two were adding a large concentration
18 at one point that you could sample or detect.

19 Q. What about the audible noise impact, could that
20 be intensified, in your opinion?

21 A. I think it could be, yes.

22 Q. I assume that is something else you will look into?

1 A. Yes.

2 Q. You testified that the audible noise impact is
3 created by rain, fog or snow interacting with the conductor;
4 is that correct?

5 A. Yes, sir.

6 Q. Which one of those three, fog, snow or rain causes
7 the greatest noise intensity?

8 A. The literature says that fog does, and that both
9 fog and snow will create more noise than rain. And the way
10 I would interpret that is you are just having more irregular
11 projections deposited per unit area than you would with rain
12 droplets. Snow might even be a little longer lasting, depending
13 on the temperature.

14 Q. Have you ever heard the noise from a 500 kV
15 transmission line?

16 A. I haven't for a 500. I have for a 345 line, for
17 example.

18 Q. Have you heard it for a 765 kV line?

19 A. No, I haven't.

20 Q. What did it sound like, the 345 kV line?

21 A. It was a buzzing sound, kind of a cross between
22 that and a noise one would hear as a refrigerator is running

1 and the sound you hear right now with a buzz to it.

2 Q. Where were you standing when you were listening
3 to this sound?

4 A. I have stood both right under the conductors and
5 about 25 feet or so from the outermost conductor.

6 Q. Did the noise interrupt the ability to conduct
7 a conversation?

8 A. No. The time I was there it was not foul weather.
9 It was a partly cloudy or sunny day.

10 Q. My question was imperfect. Have you ever listened
11 to the sound from a transmission line during either a foggy
12 condition or a snowing situation?

13 A. No, I haven't.

14 Q. As an environmental scientist, how does one determine
15 an acceptable noise level that could be deemed acceptable
16 before perhaps mitigating action might be required?

17 A. Again, I rely heavily on the literature to see
18 what is known effects that would interfere with sleep or with
19 speech. There are no federal requirements that I am aware
20 of. EPA recommends a level of 55 decibels not be exceeded,
21 so I would certainly look at that to see, at the literature
22 to see what is known about the levels that are reported by

1 people to disturb their sleep or their ability to verbally
2 communicate.

3 Q. Have you had the opportunity to read the Bonneville
4 report prepared by, among other people, Dr. Ellis?

5 A. Yes, I have.

6 Q. Are you aware that in that report it is indicated
7 that if the decibel level gets above 59, that numerous complaints
8 were registered with respect to 500 kV lines?

9 A. Yes.

10 Q. The EPA recommendation of 55 decibels, is that
11 with respect to transmission lines, or is that some general
12 application?

13 A. I think it is a general recommendation, or I am
14 relatively sure it is. It would apply to many situations.
15 But I have not looked at that recommendation per se. I will
16 to better define it for you.

17 Q. What mitigating action could be taken to lessen
18 the noise if one was inclined to do so, short of moving the
19 residence someplace and not building the transmission line?

20 A. Nothing comes to mind immediately. I know that
21 certain conductor configurations have said, and again, I can't
22 tell you specifically which ones, will affect the amount of

1 noise produced. I don't know whether insulation would be
2 proper in homes. I don't live too far from the highway myself.
3 My house is fairly close and it is quite noisy with the windows
4 open. But, again, with them closed you hardly notice them.
5 I think you do tend to adjust and it will vary from individual
6 to individual as to what is disturbing.

7 Q. You are referring to your own personal experience?

8 A. Yes.

9 Q. The traffice noise, right?

10 A. Right, which is different.

11 Q. Well, let's hypothesize that 765 kV lines proposed
12 by a particular applicant generated 65 decibels of sound and
13 that there were residences of sufficient proximity that would
14 be disturbed by this sound level. What action, if any, would
15 you might take as a reviewer of a nuclear power plant
16 application?

17 A. To evaluate the level of disturbance? Is that
18 what you mean by your question?

19 Q. No, I am assuming you have already done the evalu-
20 tion and you have concluded that the audible noise level is
21 somewhere in the range of 65 decibels. You have determined
22 that the EPA recommendation is 59. The Bonneville report

1 says that if you are above 59, you are going to get complaints.
2 There is some evidence under those hypothetical facts that
3 if there are people nearby they are going to be disturbed.
4 As I understand the rule of an NRC environmental reviewer
5 is that at some point they could condition the issuance of
6 a license to mitigate environmental effects.

7 A. We could ask in an environmental monitoring require-
8 ment that the utility keep a record of the number of complaints,
9 the nature of the complaints, and of course you would obviously
10 want to tie in the distance of the residence from the line,
11 and if it exceeded a certain level we would ask the applicant
12 to propose some mitigating action.

13 I have been sitting here trying to think of an
14 instance of putting up some type of soundproofing material.
15 Again, I am not an acoustical engineer, so I don't know what
16 would be feasible in a home, let's say if someone were to
17 report their sleep was disturbed by sleeping with an open
18 window when it is raining or foggy outside.

19 Q. Well, let me ask you some fixes, if I can use that
20 term, that appear obvious to me. How about is it feasible
21 to make the transmission lines taller?

22 A. You have just changed the ground rule of your

1 question. You first said aside from changing the transmission
2 line or moving the residence.

3 Q. Oh, well, I misled you. I did say aside from moving
4 the residence, but I meant aside from not building the
5 transmission line.

6 A. Oh, okay.

7 Q. I am not commenting on the configuration and the
8 type of design.

9 A. I should think having a tall area, you would get
10 more attenuation by air, or the reduction of the sound level
11 by the time it reached the receiver, if they were placed higher.

12 Q. Well, let me ask my general question again now
13 that we have clarified in both of our minds what it is that
14 I was asking. Again, if you determined that the decibel level
15 was 65 and --

16 A. Where is the 65 decibel? When you say 65, do you
17 mean the ground level, under the line or in the guy's house?

18 Q. Well, let me turn the question on you. Where do
19 you think a decibel level of 59 or above was that Bonneville
20 was talking about when they said numerous complaints were
21 received?

22 A. I would say right along the edge of the corridor.

1 Q. Let's assume that the decibel level at that line
2 is 65.

3 A. Okay.

4 Q. Am I improper in my assumption that you might
5 recommend some sort of mitigating action at that point to
6 reduce the noise?

7 A. Possibly, depending on the use of that particular
8 area.

9 Q. Let's assume there were some residences there.

10 A. Yes.

11 Q. Now, what mitigating action might you recommend
12 that would affect the design of the power lines?

13 A. Well, I would say let's look at your conductor
14 configuration, is there a better method for this stretch.
15 Is it even feasible to tie in a different kind of conductor
16 for this mile or two and leave the rest of your system in
17 tact? How much are we going to reduce it by increasing tower
18 height therefore increasing the conductor height? And again
19 look at the feasibility of the soundproofing material around
20 the residences. And as far as operation of the line, this
21 may be hard to do from the utility standpoint, but curtailing
22 the current flow during foul weather, if that were feasible,

1 we would certainly change the level of the audible noise.

2 These are all the things that I would want to have an
3 expert look at.

4 Q. Thank you. I know I asked you to engage in a good
5 bit of blue-skying and I appreciate it.

6 MS. CHAN: Mr. Gallo, I was wondering if we might
7 take a break. We have been at it a couple of hours and the
8 witness is getting tired.

9 MR. GALLO: Sure. How long do you want?

10 MS. CHAN: Ten minutes.

11 MR. GALLO: Why don't we come back at 11:30.

12 (Whereupon, a brief recess was taken.)

13 MR. GALLO: Let's go back on the record.

14 Elaine, have you found out anything about whether
15 or not the final environmental statement covers the evaluation
16 of the impacts of 765 kV lines?

17 MS. CHAN: During our brief break in the last few
18 minutes, Dr. Pentecost and I approached Jerry LaRoche to find
19 out whether or not it was considered. I will let my witness
20 speak to that.

21 THE WITNESS: Dr. LaRoche indicated that because
22 of the uncertainty of when the 765 kV line would be built,

1 or if it would be built, that it was given only secondary
2 treatment. And he didn't really go into a lengthy consideration
3 of electric field strengths and how they might impact the
4 environment and other effects of the 765 kV line.

5 MS. CHAN: You had also asked us to check and see
6 if some of the other documents provided to Mr. LaRoche on
7 the transmission lines were available. And he responded that
8 he did not have any documents in addition to the final that
9 was issued. He checked his records.

10 MR. GALLO: How about Oak Ridge, did anything
11 exist there?

12 MS. CHAN: I can't begin to surmise if they have
13 it at Oak Ridge.

14 BY MR. GALLO:

15 Q. Does the organization at Oak Ridge still prepare
16 final environmental statements for NRC?

17 A. Yes, they do. As a matter of fact, they are working
18 on one right now, the last one that we had to do.

19 MR. GALLO: I guess, Elaine, I have to request
20 that inquiry be made of that organization to see if they have
21 their input to the Braidwood SBF and air files. I would guess
22 that they would.

1 MS. CHAN: We will check.

2 MR. GALLO: Okay.

3 BY MR. GALLO:

4 Q. Dr. Pentecost, you characterized the review as
5 being, and correct me if I misstated your testimony, as being
6 a secondary review in the environmental statement of the impacts
7 of 765 kV lines?

8 A. That was Dr. LaRoche's assessment. And having
9 looked at this, I would agree.

10 Q. What does that mean? Does that mean that the
11 assessment is considered incomplete at this time or inadequate,
12 or just what does that mean?

13 A. Well, it means that we did not address 765 kV line
14 in the same depth that we would have if that were the design
15 as stated in your application.

16 Q. I think that's a good answer. If it was determined
17 unequivocally that the construction of the 765 kV line was
18 clearly associated with the Braidwood Units 1 and 2 application,
19 what action, if any, would you take with respect to this
20 evaluation? That's not a good question. Let me try it again.

21 If it was determined unequivocally that the construc-
22 tion at Braidwood of the 765 kV line was associated with the

1 Braidwood 1 and 2 application, what action, if any, would
2 be taken with respect to this assessment in the FES?

3 A. Can we go off the record for a minute?

4 Q. Do you want to consult?

5 A. Yes.

6 Q. Go ahead.

7 (Discussion off the record.)

8 MS. CHAN: On the record.

9 THE WITNESS: Once we receive information we have
10 asked from the applicant, I think I could make a better
11 determination whether I would want to recommend that additional
12 analysis be done just for the 765 or not. Right now we don't
13 have enough information to make that. It wouldn't be my
14 final decision, it would merely be a recommendation to my
15 management.

16 BY MR. GALLO:

17 Q. But if the issue stated before the NRC in the form
18 of Neiner Farms Contention 1, you would have to do that same
19 evaluation anyhow, wouldn't you?

20 A. Yes, I would.

21 Q. And is my understanding correct that that evaluation
22 could serve as a supplement to the final environmental statement?

1 If you don't know, just say you don't know.

2 A. It sounds like a legal question to me. I should
3 think the information could be helpful in determining whether
4 a supplement was needed or not.

5 Q. Do you consider yourself an expert on the subject
6 of long-term biological effects from the operation of 765
7 kV transmission lines?

8 A. I don't know that I would want to use the term
9 expert in the sense of a person working for a power administra-
10 tion, let's say, that spends his entire time on the subject,
11 but I think from the standpoint of a regulatory agency and
12 what we are asked to do here in every area, we synthesize
13 the material, we ask information of the applicant. In the
14 case of the contention, we ask for intervenors to clarify,
15 we ask for other government agencies to synthesize. So, in
16 that sense I would say I am.

17 MS. CHAN: I think here I would like the witness
18 to clarify. There were earlier questions about his actual
19 experience in the line analyses of various sorts, electrical
20 magnetic field, audible noise and ozone. I think an explanation
21 may be in order as to his assigned responsibilities and whether
22 or not someone else in the agency was responsible for that

1 at the time, so that --

2 MR. GALLO: Do you want him to make a statement
3 of clarification in that respect?

4 MS. CHAN: Yes, I think he would feel more comfort-
5 able.

6 THE WITNESS: As I stated earlier, I arrived at
7 the NRC in January of 1982 and was given an assignment shortly
8 after that. At that time, I realized the branch I joined,
9 because of their academic background and training, they had
10 honed in on specific concerns that were similar between projects.

11 So, we had people that were fisheries experts,
12 people that had gained some expertise on the job and because
13 of training, what have you, were experts on transmission line
14 effects.

15 In this case, Mr. Gears had prepared testimony
16 and compiled quite a file of literature and assessments, so
17 he was given many of the early assignments. And for the first
18 year and a half or so I was here, he was still in the branch,
19 so I was asked to do other things in the terrestrial ecology
20 area, transmission line effects per se.

21 BY MR. GALLO:

22 Q. Does that complete your statement?

1 A. Yes.

2 Q. Getting back to biologic effects, are you qualified
3 to conduct research to determine whether or not there are
4 biologic effects in humans with respect to experiencing the
5 electrical field from 765 kV lines?

6 A. No, I would not say I have the medical background
7 or the physiologic state of the art knowledge to do that.

8 Q. What type of technical training would be needed?

9 A. Well, in my opinion, a person with a strong human
10 physiologic background would be needed; a person with a fair
11 medical knowledge, such as in the case of pacemakers; everything
12 about the heart, the normal nervous control of the heart.
13 You need to understand this before you could determine whether
14 the pacemaker is going to malfunction under this condition
15 or that condition.

16 As far as laboratory research, I think, again,
17 a good knowledge of laboratory animals, let's say, a good
18 knowledge of physiology would be needed.

19 Q. How about the field of epidemiology?

20 A. That would come along with, I think, the medical
21 training.

22 Q. All right. You said that you had reviewed the

1 literature with respect to the potential effects from electric
2 and magnetic fields to humans as a result of the operation
3 of 765 kV lines. Is that true?

4 A. Yes. I have done a preliminary review. I have
5 relied pretty heavily on Mr. Lee, Mr. Ellis and others, a
6 Bonneville document entitled "Electric and Biologic Effects
7 of Transmission Uses and Review." That is dated October 1972
8 and I have tried to supplement that information with more
9 recent work.

10 Q. Are you familiar with the exhaustive review conducted
11 by the New York State Public Service Commission with respect
12 to the question of the health effects of the operation of
13 765 kV lines?

14 A. Yes, I am. And I have reviewed the summary document
15 prepared by the Department of Energy, which I see you have
16 a copy of here and I have here also.

17 Q. Is that identified as DOE/EV-0056, dated November
18 1979?

19 A. Yes, it is.

20 Q. Are you aware that one of the outgrowths of the
21 decision in the New York case was the plan to conduct research
22 into the potential biologic effects from the transmission

1 line operation?

2 A. Yes, I am.

3 Q. Do you have any information with respect to the
4 results of that research?

5 A. No. This is one of the items I am aware, there
6 were some 14 research projects that were funded and they are
7 at various stages of completion and I hope to get those reports
8 to review to help me with my analysis.

9 Q. Well, for your information, the intervenors, in
10 response to applicant's interrogatories, provided in those
11 responses two documents that provided a brief summary of the
12 status of those research programs.

13 Are you aware of those documents?

14 A. I think I saw the short one.

15 Q. One is dated April 5, 1984, and the other looks
16 like it was prepared as an agenda paper for a meeting that
17 was scheduled May 3rd, 1985 in Albany, New York before the
18 New York State Department of Health. Do you have both of
19 those documents?

20 A. I do not have the latter.

21 Q. All right. Let me show it to the witness.

22 A. If I have it, it would be in this stack.

1 MS. CHAN: It is labeled item E; is that correct?

2 MR. GALLO: Yes, that is the one.

3 BY MR. GALLO:

4 Q. Are you aware of the Russian substation and switch-
5 yard studies on the question of long-range effects from the
6 effects of magnetic and electric fields?

7 A. Yes.

8 Q. What is your understanding of the results of those
9 studies?

10 A. As I understand it, the -- if you are referring
11 to the early study, if you could give me a date, it might
12 help.

13 Q. I think it was in the early 1970s.

14 A. There was a claim that there were substation workers
15 who claimed of sexual impotency from having worked in substations
16 and they thought there was some effect. Later studies in
17 this country and elsewhere in the world of other workers in
18 similar environments were not able to document any correlation,
19 if that's the study you are referring to.

20 Q. Yes, it is. Do you know what action, if any, the
21 Russians took with respect to the studies that they conducted?

22 A. I think they set some standards of length of time

1 in which a worker could be in a certain electric field strength
2 and I believe it was 5 kilovolts per meter. It couldn't exceed
3 a certain time limit, but it was -- well, I don't that the
4 regulatory body or whatever group set it in Russia, what they
5 were basing it on entirely. They must have put a lot of stock
6 in the study, but that's only speculation on my part.

7 Q. Is there a comparable standard in the United States
8 or elsewhere in the world that you are aware of?

9 A. Not that I am aware of.

10 Q. Do you have an opinion as to why the matter apparently
11 is treated differently in the United States and elsewhere
12 as compared to the USSR?

13 A. No, I don't.

14 Q. Do you have an opinion as to whether the information
15 developed by the Russians, based on their study of switchyard
16 and substation workers, is properly extrapable to transmission
17 line electric and magnetic fields?

18 A. I suspect that it is not very useful in that regard
19 because here you would have workers spending seven-eight hours
20 a day around high field strengths of roughly the same intensity
21 throughout the day, where along the transmission line you
22 would have to stand in one spot right outside the outermost

1 conductors all day and the likelihood of that happening, I
2 think, it not too great.

3 In general, I don't think people would be exposed
4 to that on a continuous basis the way a substation worker
5 would.

6 Q. Would that be true with respect to an individual
7 who had an occupation as a lineman and was involved in the
8 maintenance of 765 kV lines as a general occupation?

9 A. It certainly would be more extrapable, if that
10 is a correct word here, to that profession. But, again, the
11 lineman, I wouldn't think, would spend the amount of time
12 each day. He would be changing positions along the line,
13 coming and going, so he wouldn't have the total exposure time
14 as a substation worker would.

15 Q. Are you aware of any study conducted with respect
16 to the effects of exposure by a lineman to high energy, or
17 extra high voltage transmission lines?

18 A. No, I am not.

19 Q. Are you aware of what I call the research results
20 from the Marino experiments? Do you know what I am referring
21 to when I say that?

22 A. Are these the ones where white blood cells were

1 cultured and were exposed to --

2 MS. CHAN: Counsel, perhaps if you would elaborate.

3 BY MR. GALLO:

4 Q. Let me identify it better for you.

5 A. Yes, I am confused.

6 Q. I am referring to the experiments conducted by,
7 and if you will look at the Boneville report on page 21 and
8 page 22, I will zero it in. They were the research efforts
9 with rodents that was performed by Dr. Marino. I believe
10 he is with the Veterans Administration in the State of New
11 York.

12 MR. GALLO: Let's go off the record for a minute.

13 (Discussion off the record.)

14 MR. GALLO: Let's go back on the record.

15 BY MR. GALLO:

16 Q. If you look at II-2, he is identified, Dr. Marino
17 is identified at the top of the page.

18 A. Yes.

19 Q. Now, are you aware that he has performed research
20 with rodents with respect to the effects of exposure to extra
21 high voltage transmission line fields?

22 A. Yes. From Mr. Lee's Bonneville Power review article,

1 I do recall reading that now.

2 Q. Do you recall what the results of Dr. Marino's
3 research work were?

4 A. I generally recall that the field strengths the
5 rodents were exposed to were much higher than would be expected
6 along a 765 kV line. And the design, he was criticized there
7 with the design that when the rodents were taking water, they
8 were receiving electric shock, so that was a variable that
9 could have had some effect, but I don't recall what his bottom
10 line as far as impacts was to that group of rodents.

11 Q. Do you recall that he concluded that there were
12 some adverse impacts?

13 A. No, I don't recall the exact conclusion.

14 Q. But you recall the criticisms to his research work?

15 A. Yes.

16 Q. Now, you have said you have reviewed the literature
17 on the issue of biologic effects and you have also testified
18 that with respect to various reactor applications involving
19 the construction of transmission lines, that you concluded
20 that the long-range biological effects were not a problem.
21 Is that a fair statement?

22 A. Yes.

1 Q. Now, in reviewing that literature, did you find
2 any literature that suggested that long-term exposure to extra
3 high voltage magnetic and electric fields might be harmful
4 to humans?

5 A. As of 1983, when I did the work for Limerick, I
6 was not aware of any, had not found any.

7 Q. And that includes your uncertainty now with respect
8 to just where Dr. Marino's work stacks up in that equation;
9 is that right?

10 A. Yes. And not having reviewed the New York State
11 research reports that I hoped to look through.

12 Q. Well, I would call your attention in particular
13 under what counsel for the NRC Staff has identified as Item
14 E. Look at the results of the work published by Dr. Winters.

15 MS. CHAN: May we see your copy because we don't
16 have it with us right now.

17 MR. GALLO: Oh, you don't have it with you?

18 MS. CHAN: No.

19 MR. GALLO: All right.

20 BY MR. GALLO:

21 Q. I am referring to some research work done by
22 Dr. Wendell Winters. He is with the University of Texas,

1 Health Science Center in San Antonio, Department of Microbiology,
2 and at pages 11 and 12 of what I have characterized as an
3 agenda paper for a meeting that purported to be held on May
4 3rd, 1985 of the New York State Department of Health in Albany,
5 the results of his research work is reported on pages 11 and
6 12. And for your benefit it is stated on page 12 that studies
7 were performed on human cells maintained in tissue culture
8 in which the effects of electric and magnetic fields on cell
9 proliferation were assayed using a certain technique. The
10 bottom line is that the data suggests that exposure of cancer
11 cells to electric and magnetic fields results in an increased
12 rate of proliferation.

13 What that means to me, and I will certainly let
14 you look at it now that I have characterized it for your
15 benefit --

16 MS. CHAN: Since Dr. Pentecost has not seen this
17 document yet --

18 MR. GALLO: Well, I am not going to ask him to
19 comment on it. I will just bring it to his attention.

20 BY MR. GALLO:

21 Q. But what it suggests to me is that if an individual
22 had cancer and was subjected to a certain intensity of electric

1 or magnetic field and the intensity levels are not clearly
2 indicated there, as far as I can see, that perhaps it would
3 exacerbate the production of the cancer cells.

4 You don't have to comment on it. That is just
5 what it suggest to me. And not being a medical doctor or
6 any other kind of doctor, I certainly might draw the wrong
7 judgment on that.

8 MR. THORNTON: If I could interrupt for a second.
9 The study on power line workers that you referred to earlier
10 is referenced in the DOE report on II-17. They do not give
11 an exact bibliographical reference to it. They say that
12 "Kouwenhoven, et al. reported no significant changes in power
13 line workers subjected to expensive medical examinations."

14 MS. CHAN: I appreciate you finding all this
15 information. I don't think my witness has drawn any conclusions
16 regarding this document yet.

17 MR. GALLO: We assumed that. He had previously
18 answered he wasn't aware of that particular study, right?

19 MR. THORNTON: Yes.

20 BY MR. GALLO:

21 Q. Dr. Pentecost, are you aware of any literature
22 discussing the effect of electrical fields on insects like

1 bees, honey bees?

2 A. The Lee document I referred to earlier in my
3 testimony does mention that, I believe.

4 Q. What conclusion did it draw with respect to the
5 effect of electric fields on honey bees?

6 A. I think unshielded hives, there were some disorien-
7 tation, some reduction in the vitality, the survival of the
8 hive. Again, I don't think it was clear the exact causative
9 factor, but apparently it did interfere with the colony.

10 Q. I don't know what you call honey bee farms, if
11 they are called honey bee farms, but are you aware that
12 individuals do commercially maintain honey bee hives for
13 the purpose of generating and producing honey?

14 A. Yes, I am.

15 Q. Are you aware of any such enterprises along the
16 proposed transmission line at Braidwood for 765 kV?

17 A. No, I am not because at this point we haven't had
18 that 30-mile segment identified. I haven't looked at land
19 use along that line.

20 MS. CHAN: While we are on the subject, I would
21 like to ask the applicant if we could arrange for a site visit
22 where Dr. Pentecost could view the length of the proposed

1 765 kV corridor?

2 MR. GALLO: When would he like to do that?

3 THE WITNESS: Let's go off the record for a minute.

4 (Discussion off the record.)

5 MR. GALLO: Back on the record.

6 During the off-the-record discussion, counsel for
7 the NRC Staff requested whether or not it would be possible
8 to arrange a site visit for Dr. Pentecost for the purpose
9 of traveling the proposed 765 kV line corridor by either heli-
10 copter or automobile and also inspecting an existing 765 kV
11 line system on the Commonwealth Edison system. The applicant
12 indicated that arrangements could be made.

13 I might add that we probably would extend an
14 invitation to Mr. Bock and his client to participate, if they
15 so chose.

16 MR. SMITH: All right.

17 MR. GALLO: Off the record.

18 (Discussion off the record.)

19 MR. GALLO: All right. Let's move on.

20 BY MR. GALLO:

21 Q. I want to ask you a series of questions,
22 Dr. Pentecost, about the shock effects. Can you explain to

1 me just what causes shocks from these 765 kV lines to occur.

2 A. When a large metal object is close to a line, say,
3 along the edge of the transmission line or under it, and this
4 object happens to be insulated from being grounded, a voltage
5 is built up in that object. When a person would walk up and
6 touch, make contact with that object, they being grounded,
7 the first thing they would notice would be a shock. If the
8 voltage and the current that could -- the voltage that could
9 be built up were intense enough and then the current that
10 would flow through the person were extensive enough, we would
11 exceed what is known as a let-go current level. The person,
12 literally their muscles would be contracted, they would not
13 be able to remove the arm, for example, if you were trying
14 to open a door of the metal object.

15 Q. Could you get a shock from just walking underneath
16 the transmission lines themselves?

17 A. That would depend on a lot of conditions. If a
18 person in rubber soled shoes with dry ground conditions, you
19 might be insulated enough that you could feel the hair responding
20 on the back of the neck or standing up on the head, what have
21 you, slightly. Some people can detect this at levels that
22 you find under a 765 line. Normally, you would not get a

1 shock, it would be more of a tingling sensation.

2 Q. That assumes that the transmission lines are installed
3 at their normal expected height?

4 A. Right.

5 Q. Now, you mentioned that if there was some piece
6 of equipment or automobile or tractor underneath the transmission
7 lines or in close proximity to them, that the piece of equip-
8 ment, let's call it a tractor, could become energized. And
9 if somebody touched the tractor, you might get a shock with
10 respect to at that point.

11 Is there a way for calculating and determining
12 what the intensity of the shock would be?

13 A. There are calculations, yes. There are ways of
14 calculating this. And normally they use something like an
15 18-wheel tractor trailer as being the largest metal type object
16 that one would ever expect to find along a transmission line,
17 and you would think of that being at a road crossing rather
18 than being out in a farm field or something like that. But
19 there would be ways of calculating this, yes.

20 Q. What would be the expected intensity of the
21 electrical field under a 765 kV line?

22 A. I would say in the range of 10 to 12 kilovolts

1 per meter.

2 Q. Now, let's assume that this piece of equipment
3 is located under such a line, what kind of charge would be
4 induced to the piece of equipment?

5 A. Are you referring again to the tractor?

6 Q. Well, if you want to stick to your example, which
7 was a tractor trailer, you are welcome.

8 A. That would be a worst case, in my opinion, because
9 you just have a larger metal surface. The units there we
10 would use to define that would be milliamperes of current
11 that would flow from that object to the grounded object once
12 contact was made.

13 I think the experts estimate around $7\frac{1}{2}$ milliamperes
14 as being the maximum for the tractor trailer under those
15 conditions you identified.

16 Q. Let's focus a moment on the Braidwood lines. I
17 would expect to find a tractor perhaps in close proximity.
18 Would you agree to that?

19 A. Yes, I would.

20 Q. An automobile?

21 A. Yes.

22 Q. A metal shed?

1 A. Yes.

2 Q. Fences?

3 A. Yes.

4 Q. Do you know whether or not they have irrigation
5 systems in that part of Illinois?

6 A. To the best of my knowledge, they do not.

7 Q. I suppose you could even find one of the tractor
8 trailers that you were indicating and describing; is that
9 correct?

10 A. At a highway crossing I would expect that, yes.

11 Q. And how many milliamps did you say would be the
12 intensity of the shock from such a tractor trailer, if it
13 were located on the transmission line and touched by it?

14 A. If it were stationary and sitting parallel to the
15 outermost conductor, roughly 20-some feet away, $7\frac{1}{2}$ milliamperes.

16 Q. What is the let-go threshold for a male?

17 A. And adult male, it is assumed to be, thought to
18 be in the range of 14 to 15 milliamperes.

19 Q. Is it different for a woman?

20 A. Yes. It is a function of body size. It is 10
21 for an average-sized female.

22 Q. And what would it be for children?

1 A. We think about 5. I'm not real sure on that, but
2 it is down in the area of concern if, in fact, we had a 7½
3 milliampere current flow from such an object. So, a child
4 would be certainly something that you would need to be concerned
5 about.

6 Q. Am I correct in concluding that if a small child
7 touched this tractor trailer that was charged with the 7½
8 milliamp charge that the child might experience some ill effects
9 from that?

10 A. Yes, they could. I think the number of 8 to 9
11 has been used, and, again, it depends on the size of the child,
12 as being a level that might cause respiratory failure and
13 interfere with the nervous signal to the diaphragm and interfere
14 with the breathing process. But, again, the literature says
15 small child. It doesn't say how small.

16 Q. Is there a standard imposed by anyone to limit
17 the charge that a fixed object like this tractor trailer should
18 be permitted to see?

19 A. I think the National Electric Code, which I have
20 a copy of here, specifies 5 as a maximum level. I have a
21 1984 edition of that. I can't cite just where in here, but
22 it is referenced in the Bonneville Power report.

1 Q. How does one assure that that standard is met when
2 you are talking in terms of the construction of a transmission
3 line, and in particular 765 kV?

4 A. The utility would have various means of grounding
5 their metal objects, assuring that metal fences were properly
6 grounded and it is commonly done in the industry.

7 Q. If it was grounded, does that make it render that
8 particular instrumentality harmless?

9 A. Yes, sir. That's my understanding, yes.

10 Q. What other actions might be taken?

11 A. I suppose it serves no satisfactory way of grounding
12 a building, for example, if a metal building, a metal shed
13 were in question, it could be moved from the line.

14 Q. What about your hypothetical tractor trailer?

15 A. Precluding its being under the line. Now, it's
16 going to be a little hard at a road crossing, especially if
17 you were to happen to have a stop sign or stop light directly
18 under the sag point of the line where you would expect it
19 to be the greatest. A railroad crossing would be another
20 case that might even be worse.

21 Q. What mitigative actions, if any, could be taken
22 with respect to, say, railroad crossings or highway crossings,

1 since I am assuming you can't ground the train or the trucks
2 in any way?

3 A. I suppose warning signs could be put up, "Avoid
4 contacting metal objects in this area," or something of that
5 nature. Again, how feasible from the utility's standpoint
6 I don't know, but that certainly is one possibility.

7 Q. Early in your testimony, I think you indicated
8 that perhaps for Koshkonong that you had evaluated the shock
9 effects because they were nearby a recreational facility of
10 some sort?

11 A. It was a privately-owned recreational park. It
12 was camping and fishing and the photos we saw showed recreational
13 vehicles directly underneath the lines.

14 Q. And were these transient, the recreational vehicles?

15 A. Yes, they were.

16 Q. What action, if any, was taken in that instance
17 to mitigate the shock effects? Well, strike that. Maybe
18 it wasn't necessary to do it.

19 Was it necessary to mitigate the shock effects
20 in that case?

21 A. It wasn't necessary. This was a project that never
22 came to be. I think there was an existing 230 kilovolt line

1 there. It could have possibly been as low as 135, but the
2 photographs showed the conductors coming right over these
3 vehicles. And we didn't propose any mitigating measures in the
4 draft environmental statement, but certainly we would have, had
5 we gone further in the process.

6 Q. Oh, you would have?

7 A. Yes.

8 Q. At that time, was there any notion of what kind
9 of action might have been recommended?

10 A. Well, precluding parking from that particular span
11 of transmission corridor. Again, to do that, you would have
12 had to have looked at how much land he had adjacent to it. That
13 would have been the simplest way of doing it. And possibly
14 temporary grounding structures could be attached to overnight
15 vehicles, camping vehicles, that would ground it properly.

16 Q. I would imagine that along a 30-mile stretch of
17 765 kV line corridor that it is very, very difficult to assure
18 that children are not coming within the corridor and perhaps
19 touching whatever is there in terms of metal objects, whether
20 the objects are there on a permanent basis or a transient
21 basis.

22 In the evaluation of this particular issue, does

1 an environmental scientist take into account the probability
2 question, that is do you look at things like railroad crossings
3 or highway crossings and evaluate the potential for shock
4 effects and stop there and dismiss the balance of possibilities
5 on some probability basis, that being that the probability
6 is exceeding the low or some such standard as that?

7 A. I think once I had the information on the proximity
8 of the residences to the corridor, and if there are any recrea-
9 tional facilities nearby, I might make some judgments as to
10 what part of the year people were expected to be there, the
11 likelihood of people being in the area. To me, that would
12 be more concern than a highway crossing because, for the most
13 part, people would be coming and going.

14 Q. Would it be fair to say that your evaluation is
15 not absolute and you couldn't assure that somebody might not
16 receive a shock nonetheless despite these measures?

17 A. Right.

18 Q. Let me turn your attention to page 5-10. I am
19 referring to the final environmental statement.

20 A. Yes.

21 Q. The very bottom paragraph on page 5-10, it says,
22 "Ungrounded fences, gates on or adjacent to right of way

1 "are routinely grounded and electric fences are equipped with
2 drain coils at appropriate intervals. These measures will
3 reduce the potential shock hazards to levels well below 4.5
4 milliamps."

5 Is it your understanding, and if you don't have
6 an understanding just say so, that this statement is just
7 limited to these particular items, that is grounded fences
8 and gates which either have been grounded or equipped with
9 drain coils and not intended to apply generally to any kind
10 of metal object within the range of the transmission line?
11 Is my question clear?

12 A. Your question is clear. I know there are ways
13 of grounding metal sheds, things such as a tractor trailer,
14 for example, but I don't know that drain coils would be the
15 technique. I am not an expert in that area. But I think
16 any suitable type of grounding, you would be able to get the
17 current lead off so that it would not pose a shock hazard.

18 Q. All right. But my question is a little different.
19 I am trying to understand the reach of the very last sentence
20 where it said "These measures will reduce potential shock
21 hazards to levels well below 4.5 milliamps." And my confusion
22 is as to what the words potential shock hazards mean. Are

1 we talking about all potential shock hazards, or just the
2 ones mentioned in the preceding sentence?

3 MS. CHAN: That sentence refers to the literature,
4 Lee, et al., and I think that we would have to look at his
5 work. We can't interpret it second-hand.

6 MR. GALLO: IS that the witness' testimony?

7 THE WITNESS: I would make that same statement.
8 I would want to see how broadly Lee interpreted that.

9 BY MR. GALLO:

10 Q. Let me pursue this a little further. We have
11 identified a number of equipment or other instrumentalities
12 that might be within the range of the transmission line, and
13 it being other than electric fences or gates or fences, just
14 plain fences; is that correct?

15 A. That's correct.

16 Q. So if I read this last sentence literally, it seems
17 to be just talking with respect to those items. I will leave
18 it at that.

19 My follow-up question was going to be is that if
20 that is intended to mean generally with respect to the
21 Braidwood 765 towers, that these actions will reduce the
22 potential shock hazards to these acceptable levels. I was

1 going to ask then what is the basis of that statement in view
2 of the fact that all that was considered was fencing and gates.

3 A. I can't answer that for you.

4 Q. I understand.

5 (Counsel Thornton and Counsel Gallo conferring.)

6 BY MR. GALLO:

7 Q. My colleague raises a good question.

8 Do you know whether or not this reference is to
9 765 kV lines at all, at the bottom of page 5-10?

10 A. If that statement is reference to it?

11 Q. Yes.

12 A. No, I don't. I would have to look it up.

13 Q. I am not asking you to look up the Lee report.

14 You don't have to do that. You just don't know how it was
15 used on page 5-10?

16 A. Yes.

17 Q. And, again, at the top of page 5-11 where a 765
18 kV line is referenced, there is a statement that "fields on
19 a 345 kV line would be no higher. The applicant has calculated
20 that fields associated with parallel 345 and 765 kV lines
21 would be at worst only slightly higher than for a 345 kV line
22 alone."

1 And Section 3.9.6 of the environmental report submitted by
2 the applicant for the operating license is cited. And you
3 had previously testified that you haven't had a chance to
4 look at that?

5 A. That's correct.

6 Q. I would suggest that that statement I just read
7 is not supported by that section of the environmental report.
8 I could be wrong. I won't ask a question since you really
9 haven't had a chance to read it.

10 A. Okay.

11 Q. I wanted to ask you just one question about ozone.
12 Just what is the potential harmful effect of ozone?

13 A. As I understand it from laboratory studies, under
14 much higher levels than you would expect along the transmission
15 line conductor, you do get some leaf tip burn that is not
16 sufficient to kill a plant, for example. I think coniferous
17 plants, or needle-bearing plants, would be more susceptible,
18 if there were a problem, than deciduous because the needle is
19 there essentially all year round. So people have been concerned
20 about clearance above especially that type of vegetation.
21 But that's what I have gleaned from the literature, that the
22 impact is a leaf tip burn, a death of a portion of leaves

1 that are exposed.

2 Q. Is there any potential harmful effect to humans?

3 A. Not that I am aware of.

4 MR. GALLO: Let's go off the record for a moment.

5 (Discussion off the record.)

6 MR. GALLO: Let's go back on the record.

7 BY MR. GALLO:

8 Q. Let me ask a couple of questions with respect to
9 pacemakers. What is your understanding of the potential problem
10 associated with the operation of a pacemaker should it come
11 into contact with an electric field or a magnetic field generated
12 by a transmission line?

13 A. Well, it is highly variable. There are several
14 different types of pacemakers that can be categorized as having
15 bipolar or unipolar catheters and the catheter is the device
16 that goes into the heart muscle tissue. The unipolar, the
17 cardiologists and experts seem to think, is more susceptible
18 to interference by electrical fields than is the bipolar
19 catheter.

20 At this point, again, I want to see the Department
21 of Energy research reports and the New York State research
22 reports to analyze them in more depth before I conclude, but

1 what I have seen to this point, a person would have to be
2 standing out under the line in a perfectly vertical position,
3 kind of an unusual circumstance, I would like, with someone
4 with a pacemaker, and have a special kind of pacemaker to
5 see an effect. And then the experts, the cardiologists, the
6 physicians will argue, in the New York testimony at least,
7 that it is very hard to interpret what effect it would have
8 on individual A versus individual B with the same type of
9 pacemaker in the same condition.

10 Q. Are you aware of any actual studies conducted with
11 respect to individuals who were wearing pacemakers and also
12 were exposed to electric fields?

13 A. I believe the New York hearing testimony, the summary
14 document that we have referred to, cites some evidence where
15 pacemakers have been tested outside the body for interference
16 with the pulse and people have been subjected in the lab to
17 various field strengths and examined.

18 One of the big questions here is the amount of
19 current that will flow through the body from the electric
20 field and that seems to be the function of where the person
21 is with respect to the electric field along the corridor and
22 the position the person is taking.

1 Q. Are you aware of any circumstances or actual cases
2 where pacemaker operation was disrupted by the operation of
3 a transmission line electrical field?

4 A. No, I am not.

5 Q. Are you aware, from any of those research studies,
6 that the operation of a pacemaker was disrupted by the
7 experiments that were conducted by subjecting these instruments
8 to an electrical field?

9 A. No, I don't recall it being a problem there, the
10 field strengths that are expected.

11 MR. GALLO: Let me just check my notes here and
12 see if I have forgotten anything.

13 (A brief pause in the proceedings.)

14 MR. GALLO: I think that's all the questions I
15 have at this time. Counsel, if you want to ask some redirect
16 or some further questions, this is your opportunity.

17 MS. CHAN: I only have one question by way of summary.

18 EXAMINATION

19 BY MS. CHAN:

20 Q. Dr. Pentecost, how do you characterize the status of
21 your review to date of the material on transmission lines?

22 Q. To date, I have conducted a preliminary review of

1 the summary of the New York State hearings and of the Lee
2 Bonneville Power documents. I have read over the FESOL and
3 have a general feeling from what we said about impacts of
4 operating transmission lines. I have not looked at the EROL.
5 I plan to do that. I have not had a site visit. This will
6 add considerable information to my evaluation.

7 I hope to review the research reports that were
8 an outgrowth of the New York public hearings and the research
9 being funded by the Department of Energy, current research,
10 i.e., the last two-three years.

11 And then the information we requested from the
12 applicant. Once field strength estimates are given, I can
13 compare those for reasonableness. And I will complete my
14 evaluation at that time.

15 MS. CHAN: Thank you. I have no further questions.

16 MR. GALLO: The only follow-up point I have with
17 respect to this last answer is that I believe, Elaine, we
18 discussed earlier that we perhaps might want to take a follow-up
19 deposition with respect to Dr. Pentecost's views after he
20 has completed his evaluation. I am not certain as to whether
21 or not we will do so, or it will be necessary in our view,
22 but I would like to reserve that option.

1 MS. CHAN: I can't answer that right now whether
2 or not the powers that be will agree, and I will have to get
3 back to you.

4 MR. GALLO: Well, the only powers that be that
5 should count are you and Dr. Pentecost.

6 MS. CHAN: No comment.

7 MR. GALLO: Do you have any other questions?

8 MR. SMITH: No.

9 MR. GALLO: Well, I think at this point we can
10 terminate the deposition.

11 (Whereupon, at 12:41 p.m., the deposition was
12 concluded.)
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22

1 STATE OF MARYLAND, to wit:

2 I, Sally V. Weeks, the officer before whom the
3 foregoing deposition was taken, do hereby certify that the
4 within-named witness personally appeared before me at the
5 time and place herein set out, and after having been duly
6 sworn by me, according to law, was examined by counsel.

7 I further certify that the examination was
8 recorded stenographically by me and this transcript is a true
9 record of the proceedings.

10 I further certify that I am not of counsel to any
11 of the parties, nor an employee of counsel, nor related to
12 any of the parties, nor in any way interested in the outcome
13 of this action.

14 As witness my hand and notarial seal this 23rd
15 day of May, 1985.

16
17
18 Sally V. Weeks
19 SALLY V. WEEKS
20 Notary Public

21 MY COMMISSION EXPIRES:

22 7/1/86

1
2
3 CERTIFICATE OF DEPONENT

4 I hereby certify that I have read and examined
5 the foregoing transcript, and the same is a true and
6 accurate record of the testimony given by me.

7 Any additions or corrections that I feel are
8 necessary, I will attach on a separate sheet of paper to
9 the original transcript.

10
11
12 _____
EDWIN D. PENTECOST

13
14
15 I hereby certify that the individual representing
16 himself/herself to be the above-named individual, appeared
17 before me this _____ day of _____, 1985,
18 and executed the above certificate in my presence.

19
20
21 _____
22 NOTARY PUBLIC IN AND FOR

MY COMMISSION EXPIRES: _____

PROFESSIONAL QUALIFICATIONS

Dr. Edwin D. Pentecost
U.S. Nuclear Regulatory Commission
Washington, D. C.



I am presently employed as an Environmental Scientist, in the Environmental & Hydrologic Engineering Branch, Division of Engineering, U.S. Nuclear Regulatory Commission (NRC). In this position I provide land use and terrestrial ecology input to the environmental reviews relative to nuclear power plant licensing. I have also conducted reviews of terrestrial ecology monitoring programs at operating nuclear power plants. I have also held the positions of Land Use Analyst and Program Assistant during my employment with NRC which commenced in January 1982. In the latter position I provided administrative support to the Director, Division of Engineering in the areas of budget preparation, work schedule tracking, technical contract administration and personnel for 120 staff members.

Prior to joining the NRC I was a supervisory biological scientist for two years with the Office of Surface Mining, U.S. Department of Interior. My position involved supervision of the activities of six biological scientists engaged in projects associated with coal mine regulatory programs. I was stationed at the Kansas City Regional Office in the Division of Technical Services and Research. My responsibilities were centered on the review and approval of coal mine plans on federal lands, reviews of state abandoned mine and active mining regulatory programs and providing technical assistance to coal companies. From 1974-1979 (Oct.) I was a terrestrial ecologist in the Division of Environmental Impact Studies at Argonne National Laboratory. In this position I wrote various terrestrial biology and land use sections of impact statements prepared for the NRC on nuclear power plant construction and uranium milling operations. I was also a principal investigator for wildlife studies at two coal research sites as a member of Argonne's Land Reclamation Program. For six years I taught general biology, zoology and ecology in the South Bend (Indiana) Community School System, University of Illinois and the University of Wisconsin - Stevens Point.

I received the PhD degree in zoology from the University of Illinois - Urbana in 1972, the M.S. and B.A. degrees in biology from Ball State University in 1967 and 1963, respectively.

I am a member of the Society of Sigma Xi, the Ecological Society of America, the Wildlife Society and the National Wildlife Federation. My professional interests are currently in applied ecology as related to terrestrial ecosystems, particularly land reclamation and wildlife biology.

Publications

Pentecost, E., 1974, Behavior of *Eumeces laticeps* exposed to a thermal gradient, J. Herpetology 8(2):169-173.

Pentecost, E. and R. C. Vogt, 1976, Amphibians and reptiles of the Lake Michigan Drainage Basin, Status of the Lake Michigan Drainage Basin, ANL/ES-40. Vol. 16, Argonne National Laboratory, 69 p.

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Dvorak, A. J. and E. D. Pentecost (Project Leaders). 1977. Assessment of the Health and Environmental Effects of Power Generation in the Midwest. Vol. II. Ecological Effects. ANL/ES-00. Argonne National Laboratory. 169 p.

Pentecost, E. C. 1978. A comparison of small mammal populations of a native Atriplex - Artemisia grassland community and a surface-mined reclamation area in the Red Desert of Wyoming. Bull. New Mexico Acad. Sci. 18(1):32.

Pentecost, E. C. and R. C. Stupka. 1979. Wildlife investigations at a coal refuse reclamation site in Southern Illinois. Addendum to Proceedings Symposium Fish/Wildlife Needs on Coal Surface-Mined Areas. Fish and Wildlife Service Office of Biological Services. FWS/OBS-78/81 A, pp. 107-118.

Dvorak, A. J. (Project Leader). 1977. The Environmental Effects of Using Coal for Generating Electricity. Prepared by Argonne National Laboratory for U.S. Nuclear Regulatory Commission. NUREG-0252.

Dvorak, A. J. and B. G. Lewis (Project Leaders). 1978. Impacts of coal-fired power plants on Fish, Wildlife and their Habitats. U.S. Department of Interior. Fish and Wildlife Service. Biological Services Program. FWS/OBS-78/29. 261 p.

Professional Paper Presentations:

- April 1978 Paper presented at Rocky Mt. Division of AAAS Annual Meeting in Albuquerque, entitled, "A comparison of small mammal populations of a native Atriplex - Artemisia grassland community and a surface-mined reclamation area in the Red Desert of Wyoming.
- December 1978 Paper presented at Symposium on Surface Mining Fish/Wildlife Needs in the Eastern United States in Morgantown, West Virginia, entitled, "Wildlife investigations at a coal refuse reclamation site in Southern Illinois."
- April 1980 Paper presented at the 13th Argonne Universities Association/Argonne National Laboratory Biology Symposium entitled, "Habitat restoration and wildlife utilization of coal-surface mined lands."
- June 1980 Lecture presented at Argonne National Laboratory for Summer College Faculty Institute. Title - Environmental Aspects of Uranium Mining and Milling.
- November 1980 Paper presented at meeting of Kansas Energy Advisory Council entitled, "Mined land reclamation requirements."

ROREM CONTENTION 1(c)

Roem Contention 1 states in pertinent part:

Intervenor contends that an adequate emergency plan for the Braidwood Station should include the following:

* * *

- c) a suitable plan for providing medical treatment to operating personnel who might be exposed to radiation in the event of an accident, including transportation to medical facilities equipped to treat radiation casualties.

MATERIAL FACTS TO WHICH THERE IS NO
GENUINE ISSUE TO BE HEARD

1. Adequate arrangements for medical services for victims of radiological injuries at a nuclear power plant consist of four elements: (1) trained plant personnel qualified to administer first aid to radiological accident victims; (2) an ambulance service competent in the transportation of the contaminated injured persons; (3) a local hospital qualified and trained to treat contaminated injured patients, and triage the noncontaminated externally exposed and/or injured patients; and (4) a backup hospital which can provide definitive evaluation and treatment of radiation injuries. (Affidavit of Roger E. Linnemann ("Linnemann Affidavit", Attachment B hereto,) par. 7.)

2. Commonwealth Edison Company ("CECo") maintains a Generating Station Emergency Plan ("GSEP") which includes a

plan for providing medical treatment to operating personnel at CEC's nuclear power stations. GSEP is being implemented at the Braidwood Station. (Affidavit of John C. Golden ("Golden Affidavit" Attachment A hereto), par. 3.)), par. 3.)

3. Radiation Chemistry Technicians ("RCT's") and certain supervisors at the Braidwood Station will be trained and qualified to administer first aid to personnel suffering radiological injuries. At least one such qualified person will be on shift at all times. The RCT will assist in the ambulance transportation of the victim to the hospital. Training to these personnel will be provided by Radiation Management Corporation ("RMC") in August, 1985. (Golden Affidavit, par. 5; Linnemann Affidavit par. 9.)

4. Braidwood Station has an agreement with the Braidwood Fire Department under which the Braidwood Fire Department will provide ambulance service to the Braidwood Station (Golden Affidavit, par. 6.) The Braidwood Fire Department presently has three ambulances, one of which may soon be retired, and one rescue vehicle. The Braidwood Fire Department has 28 personnel, all qualified and licensed to drive ambulances, including 12 emergency medical technicians. (Golden Affidavit, par. 6.)

5. The Braidwood Fire Department will receive training from RMC in August, 1985 in the proper handling of contaminated injured patients. (Linnemann Affidavit, par. 6; Golden Affidavit, par. 6.)

6. The Braidwood Station has agreements with five other local fire departments for the provision of ambulance service to back up the Braidwood Fire Department. Combined, these five fire departments have 6 ambulances and 2 rescue vehicles. Those five fire departments will be invited to attend the RMC training session in August, 1985. (Golden Affidavit, par. 7; Linnemann Affidavit, par. 10.)

7. The Coal City Emergency Squad, located about six miles from the Braidwood Station, has an agreement with CECO's Dresden Station to provide ambulance service. The Coal City Emergency Squad already receives RMC training, and could also be called on to back up the Braidwood Fire Department. (Golden Affidavit, par. 8; Linnemann Affidavit, par. 10.)

8. The Braidwood Station has an agreement with St. Joseph Medical Center in Joliet, Illinois under which that facility has agreed to treat contaminated injured personnel from the Braidwood Station and provide initial treatment of radiation exposure. (Golden Affidavit, par. 10.) The St. Joseph Medical Center maintains the training, facilities, and procedures adequate to provide such treatment. The St Joseph Medical Center could treat up to 25 contaminated injured patients. (Linnemann Affidavit, par. 9.)

9. CECO maintains an agreement with Northwestern Memorial Hospital in Chicago under which that hospital agrees to provide treatment to CECO personnel who suffer radiation

exposure injuries. (Golden Affidavit, par. 11.) The Northwestern Memorial Hospital is capable of providing definitive treatment necessary for severe radiation exposure injuries. (Linnemann Affidavit, par. 15;)

10. In addition, under CECO's agreement with RMC, RMC stands ready to provide expert medical and technical assistance in the care and treatment of Braidwood Station personnel who may suffer radiological injuries. (Linnemann Affidavit, par. 15; Golden Affidavit, par. 4.)

11. Under any conceivable accident scenario, no more than two or three Braidwood Station personnel would receive a dose of radiation exposure of such magnitude that hospital care would be required for the resultant injuries (about 100 rem or greater). (Affidavit of George Klopp, Attachment C hereto, pars. 5-6.)

DISCUSSION

Forem Contention 1, subparagraph(c), challenges the adequacy of the medical arrangements provided for Braidwood Station personnel who may be "exposed to radiation", including transportation to medical facilities equipped to treat "radiation casualties".

The standard for the provision of such medical services is found at 10 C.F.R. § 50.47(b)(12), which requires that

"arrangements are made for medical services for contaminated injured individuals." The Commission has defined "contaminated injured" as used in 10 C.F.R. § 50.47(b)(12) to include two classes of injuries: traumatic injury accompanied by radiological contamination, and exposure to dangerous levels of radiation. Southern California Edison Company (San Onofre Nuclear Generating Station, Units 2 and 3) CLI-83-10, 17 NRC 528, 536 (1983).

Despite Intervenor's use of the phrases "exposed to radiation" and "radiation casualties" in their contention, it is apparent that Intervenor's concern in this regard is broad enough to encompass both aspects of the Commission's interpretation of the § 50.47(b)(12) standard. (See "Intervenor Bridget Little Rorem and Appleseed's Responses to Interrogatories from Applicant (Commonwealth Edison Company)", April 17, 1985, p. 9.) It is also apparent that Intervenor is primarily concerned with two aspects of the medical arrangements: the capacity of designated medical facilities to handle "large numbers of such personnel in a serious emergency," and identification of specific transportation vehicles and transportation routes. (Ibid; see also Deposition of Bridget Little Rorem, May 21, 1985, pp. 50-58, Attachment D hereto.)

Guidance for the implementation of this standard is found in NUREG-0654/FEMA-REP-1 Rev. 1 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and

Preparedness in Support of Nuclear Power Plants." A licensee's responsibility for adequate medical arrangements is outlined by three evaluation criteria under the relevant planning standard of NUREG-0654 (Section II.L.):

1. Each organization shall arrange for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake, including assurance that persons providing these services are adequately prepared to handle contaminated individuals.
 2. Each licensee shall provide for onsite first aid capability.
- * * *
4. Each organization shall arrange for transporting victims of radiological accidents to medical support facilities.

From the criteria of NUREG-0654, and from the sound professional judgment of Dr. Roger Linnemann, it is apparent that four elements comprise adequate medical arrangements for victims of radiological injuries at a nuclear power plant: (1) trained plant personnel qualified to administer first aid to radiological accident victims; (2) an ambulance service competent in the transportation of the contaminated injured persons; (3) a local hospital qualified and trained to treat contaminated injured patients, and triage the noncontaminated externally exposed and/or injured patients; and (4) a backup hospital which can provide definitive evaluation and treatment of radiation injuries.

The affidavits of John Golden and Roger Linnemann detail the arrangements for medical services for Braidwood Station personnel who may suffer a radiological injury. Their testimony amply demonstrates that the four fundamental aspects of an appropriate medical plan are in place or will be fully established by September, 1985: on-site first-aid capability; transportation service from local ambulance services to a local hospital; a local hospital (St. Joseph Medical Center in Joliet, Illinois) capable of providing care for contaminated injured patients (as well as initial care for radiation exposure victims); and a backup hospital competent to provide definitive care for the treatment of radiation exposure injuries (Northwestern Memorial Hospital in Chicago).

Onsite first-aid capability at the Braidwood Station will be assured by the presence of at least one Radiation Chemistry Technician ("RCT") onsite at all times, who is trained and qualified to administer first aid to contaminated, injured personnel or victims of severe radiation exposure. The RCT will also be competent to assess the contamination on the victim, if any, and perform preliminary decontamination. The RCT will also assist in the transportation of the victim to the hospital.

The Braidwood Station has made arrangements with the Braidwood Fire Department for ambulance service. Personnel from that unit will receive training in August, 1985 in the

proper handling of contaminated, injured patients. The Braidwood Fire Department has at least two ambulances and 28 personnel. The Braidwood Station has made arrangements for backup ambulance service from five other local fire departments, which together have an additional six ambulances. The personnel from these other five departments will be invited to the August, 1985 training sessions. Further backup capability could be provided by the Coal City Emergency Squad, which is located about six miles from the Braidwood Station and has three ambulances. That unit already receives training in handling of contaminated, injured patients due to its commitment to CEC's Dresden Station. (As noted by Dr. Linnemann, noncontaminated victims of radiation exposure do not require special handling.)

These arrangements for ambulance service moot Intervenor's concern that specific transportation service should be identified. Their additional concern that specific routes should be identified is without basis. There is no requirement for such detailed planning. Even the Intervenor conceded that it was reasonable to expect a local ambulance service to be able to determine the best available route. (Deposition of Bridget Little Rorem, May 21, 1985, pp. 57-58.)

The Braidwood Station has made arrangements with the St. Joseph Medical Center in Joliet, Illinois (about 20 miles from the Braidwood Station) by which that facility will serve

as the local hospital designated for treatment and care of contaminated, injured Braidwood Station personnel. St. Joseph Medical Center already provides such service for CECO's Dresden Station and, as such, has already developed the procedures and facilities for providing such care. The St. Joseph Medical Center Staff also already receives training and will continue to do so on a semi-annual basis.

Contrary to Intervenor's concern, the St. Joseph Medical Center is capable of handling the number of contaminated injured victims that could be expected from the Braidwood Station. The St. Joseph Medical Center can properly care for up to 25 contaminated injured patients. This capacity is more than adequate to meet the number of onsite personnel who could be expected to require such treatment. The Commission has recognized that the number of onsite and offsite contaminated injured persons at any one time would be small, ranging from one to 25 people. San Onofre, CLI 83-10, 17 NRC at 532; See also the Appeal Board's decision in that proceeding, ALAB-680, 16 NRC 127, 137 (1982). The number of onsite personnel suffering such injuries would surely be less than the combined estimate of 25. In fact, the NRC Staff witness whose testimony provided the basis for the Commission's endorsement of the combined estimate for offsite planning purposes, indicated that planning for about six contaminated injured personnel from the site was adequate. (Hearing transcript, Southern California

Edison Co., (San Onofre Nuclear Generating Stations, Units 2 and 3), Docket Nos. 50-361-06, 50-362-06, at Tr. 11,059-61.)

St. Joseph Medical Center would also serve for initial care of Braidwood Station personnel suffering from severe radiation exposure. Inasmuch as no special emergency facilities are needed for this care, any such patients would not tax the facilities at St. Joseph Medical Center designated for the treatment of any contaminated injured patients. Should further treatment of a radiation exposure injury be necessary, the patient would be transferred to the Northwestern Memorial Hospital in Chicago. CECo has arrangements with that hospital for the treatment of CECo personnel suffering severe radiation exposure injuries. Northwestern Memorial Hospital is capable of providing the definitive care necessary for the treatment of such injuries. CECo also has arrangements with Radiation Management Corporation ("RMC") which can provide such care through its own staff and its access to facilities.

Again in response to Intervenor's concern about the adequacy of the facilities to accommodate the number of Braidwood Station personnel suffering radiation injuries, it is beyond dispute that the Northwestern Memorial Hospital and RMC would be able to provide appropriate care for the number of radiation exposure victims that could be expected. In Mr. Klopp's judgment, it is inconceivable that, under any accident scenario, more than two to three Braidwood Station

personnel could ever be exposed to a radiation dose which would result in injuries that require hospital treatment. Indeed, Dr. Linnemann has known of no such cases in his 16 years experience in working with 25 nuclear power plant sites.

No factual issues has been raised by Intervenor Bridget Little Rorem and Appleseed which controverts the facts established in the affidavits of Dr. Golden, Dr. Linnemann and Mr. Klopp. Accordingly there is no genuine issue of material fact with respect to that aspect (subparagraph (c)) of Rorem Contention 1 which concerns medical arrangements for Braidwood personnel suffering radiological injuries. Commonwealth Edison Company is entitled to summary disposition of that subcontention as a matter of law.