

NUCLEAR REGULATORY COMMISSION

ORIGINAL

In the Matter of:

LOUISIANA POWER AND LIGHT COMPANY

(Waterford Steam Electric Station,
Unit 3)

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DOCKET NO. 50-382

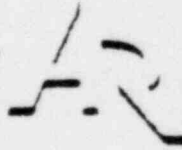


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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:)
)
LOUISIANA POWER AND LIGHT COMPANY)
) Docket No. 50-382
(Waterford Steam Electric Station,)
Unit 3))

Room 223, East Courtroom
Court of Appeals Building
600 Camp Street
New Orleans, Louisiana

Tuesday,
March 30, 1982

The above-entitled matter came on for further
hearing, pursuant to adjournment, at 9:00 a.m.

BEFORE:

SHELDON J. WOLFE, Chairman
Administrative Judge
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

DR. HARRY FOREMAN
Administrative Judge
Box 395, MAYO
University of Minnesota
Minneapolis, Minnesota 55455

DR. WALTER H. JORDAN
Administrative Judge
881 West Outer Drive
Oak Ridge, Tennessee 37830

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APPEARANCES:

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Light Company:

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-and-

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C O N T E N T S

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			VOIR				BOARD
<u>WITNESSES</u>	<u>DIRECT</u>	<u>DIRE</u>	<u>CROSS</u>	<u>REDIRECT</u>	<u>RECROSS</u>		<u>EXAM.</u>

IRWIN D. J. BROSS

By Mr. Jones	1298	
By Mr. Blake		1345

1345

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EXHIBITS

NUMBER:

IDENTIFIED RECEIVED WITHDRAWN

Joint Intervenors':

No. 22	1300	1336	
No. 23	1301	1336	
No. 24	1301	1336	
No. 25	1302	1336	
No. 26	1303	1336	
No. 27	1304	1336	
No. 30	1305		1306
No. 31	1343	1344	

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P R O C E E D I N G S

9:00 a.m.

JUDGE WOLFE: All right. Mr. Jones.

MR. JONES: Your Honor, at this time I would like to call Joint Intervenors' next witness, Dr. Irwin Bross.

JUDGE WOLFE: Would you remain standing, Doctor, and raise your right hand.
Whereupon,

IRWIN D. J. BROSS,
called as a witness by Counsel for the Joint Intervenors, having first been duly sworn by the Chairman, was examined and testified as follows:

JUDGE WOLFE: Please be seated.

DIRECT EXAMINATION

BY MR. JONES:

Q Dr. Bross, do you have before you at this time a copy of a document entitled, "Sworn Statement of Dr. Irwin D. J. Bross"?

A. I do.

Q Have you had the opportunity to review this document, Doctor?

A. Yes.

Q Was this document prepared at your direction and in consultation with you?

A. Yes, it was.

1-2 1 Q Are the answers to the questions which are
2 contained therein true and correct, to the best of your
3 knowledge, information and belief?

4 A I believe so.

5 Q Are there any changes which you have found to
6 be appropriate with relation to the statement or the
7 questions, or any other type of --

8 A Well, you have pointed out a couple of
9 changes. I don't know if this is how I should introduce
10 the point or not, but they are acceptable to me.

11 MR. JONES: Your Honor, if you please, at
12 this time, with regard to Question 18, we would move the
13 Board to correct a typographical error, "reasonable,"
14 and substitute therefor the word "measurable," it having
15 been pointed out yesterday, of course, that there was a
16 typographical error in the citation of the quotation.

17 At this time, also, Your Honor, we would move
18 the Board with regard to Question 29 to delete the word
19 "high" in the first line of Question 29.

20 Your Honor, at this time, also, if I may, I
21 would like to go off the record for one clerical matter.

22 JUDGE WOLFE: Yes.

23 (Discussion off the record.)

24 BY MR. JONES:

25 Q Dr. Bross, are you also familiar with the

1-3 1 publication entitled -- I'm sorry -- with a paper entitled,
2 "A Simple Mechanism for Synergism in Genetic Damage from
3 Low-Level Radiation or Chemical Mutagens"?

4 A. Yes.

5 Q. Are you the author of that paper, sir?

6 A. That's a draft.

7 Q. Are you familiar with a paper -- strike that.

8 MR. JONES: I would note for the record,
9 Your Honors, that that is the document which has been
10 designated as Joint Intervenors' Exhibit 22.

11 (The document referred to was
12 marked Joint Intervenors' Exhibit
13 No. 22 for identification.)

14 BY MR. JONES:

15 Q. Dr. Bross, are you familiar with a paper
16 entitled, "Why the Assurances That the Water is 'Safe'
17 Have No Scientific Validity"?

18 A. Yes, that's testimony.

19 Q. Okay, and are you the author of that testimony?

20 A. Yes.

21 MR. JONES: For the record, Your Honors, I
22 would like to point out that the exhibit just referred to
23 is Exhibit 23 on Joint Intervenors' exhibit list.

24 //

25 //

1 (The document referred to was
2 marked Joint Intervenors' Exhibit
3 No. 23 for identification.)

4 BY MR. JONES:

5 Q Dr. Bross, are you also familiar with the
6 documents entitled, "Letter to H. Ray Patterson, Editor in
7 Chief of Health Physics," dated September 16, 1981?

8 A Yes.

9 Q Are you the author of that letter?

10 A Yes.

11 MR. JONES: Let the record reflect that the
12 document which the witness has referred to is that
13 document designated as Joint Intervenors' Exhibit 24.

14 (The document referred to was
15 marked Joint Intervenors' Exhibit
16 No. 24 for identification.)

17 BY MR. JONES:

18 Q Dr. Bross, are you familiar with the document
19 entitled, "Direct Estimates of Low-Level Radiation Risks
20 of Lung Cancer at Two NRC-Compliant Installations"?

21 A Yes.

22 Q Can you tell the Board what this paper
23 represents?

24 A I believe that what was submitted was in
25 fact a photocopy of the galleys, because the actual reprints

1 are not available. The paper is March 1982.

2 It's just been published. As a matter of
3 fact, I have not seen the actual journal itself, because I
4 don't think they send it out quite that fast to us; but
5 this is what is in the journal.

6 Q Okay, and what journal is this --

7 A "Yale Journal of Biology and Medicine."

8 JUDGE FOREMAN: Could you pull the microphone
9 just a little closer to you?

10 THE WITNESS: Are you having trouble hearing
11 me?

12 JUDGE FOREMAN: It will be fine to sit back,
13 but just pull the microphone close to you.

14 THE WITNESS: I was a little afraid that if
15 I was going to get too close to it, I would overload it.

16 JUDGE JORDAN: You are just right now.

17 THE WITNESS: Would you please tell me -- I
18 have no awareness of these things -- if I get off my
19 location.

20 MR. JONES: Let the record reflect that the
21 document the witness has just referred to is designated
22 as Exhibit No. 25 on the Joint Intervenors' exhibit list.

23 (The document referred to was
24 marked Joint Intervenors' Exhibit
25 No. 25 for identification.)

1-6

1 BY MR. JONES:

2 Q Dr. Bross, are you also familiar with the
3 document entitled, "The 1980 Reassessment of the Health
4 Hazards of Low-Level Ionizing Radiation"?

5 A I am.

6 Q Can you describe for us briefly what that
7 document represents?

8 A There was an invited presentation in
9 Heidelberg.

10 Q All right.

11 MR. JONES: Let the record reflect that the
12 document which the witness has referred to is designated
13 as Joint Intervenors' Exhibit 26.

14 (The document referred to was
15 marked Joint Intervenors'
16 Exhibit No. 26 for identifica-
17 tion.)

18 BY MR. JONES:

19 Q Doctor, are you also familiar with the
20 document entitled, "A Dosage Response Curve for the
21 One-Rad Range, Adult Risks from Diagnostic Radiation"?

22 A I am.

23 Q And are you the author or co-author of that
24 paper?

25 A Co-author.

1-7 1 Q Was that paper published in "The American
2 Journal of Public Health" in February 1979?

3 A Yes.

4 MR. JONES: Let the record reflect that the
5 document described by the witness is Joint Intervenors'
6 Exhibit No. 27.

7 (The document referred to was
8 marked Joint Intervenors' Exhibit
9 No. 27 for identification.)

10 BY MR. JONES:

11 Q Dr. Bross, at this time are there any
12 additions or amendments which you wish to add to your
13 prefiled written testimony?

14 A Well, I would like to include a paper referred
15 to in the testimony, but somehow, inadvertently, I suppose,
16 omitted from the list that you have given just now.

17 The paper which was published in the journal
18 called "Investigative Radiology" in January-February 1980
19 is titled, "Cumulative Genetic Damage in Children Exposed
20 to Preconception and Interuterine Radiation."

21 It is by myself and Mr. Natarajan. It is
22 referred to in my testimony. It should have been in the
23 list.

24 MR. JONES: Your Honor, we would at this time
25 move to add the paper described by the witness as Joint

1-8 1 Intervenors' Exhibit 30.

2 (The document referred to was
3 marked Joint Intervenors' Exhibit
4 No. 30 for identification.)

5 JUDGE WOLFE: You are just moving to add it
6 to your list at this time, requesting leave to add it to
7 your list?

8 You are not moving the admission into evidence?

9 MR. JONES: We would, further, subject --

10 JUDGE WOLFE: Well, which is it, or both?

11 MR. JONES: Actually, we're moving for both,
12 Your Honor.

13 JUDGE WOLFE: Any objection?

14 MR. BLAKE: Judge Wolfe, I think that the
15 Board should understand that Counsel were never even
16 informed of this until this very moment.

17 I do not have a copy of this exhibit. I am
18 unprepared to take a position on it, and I think in view
19 of the weeks that we have spent talking about the
20 admissibility of exhibits, and in fact as late ago as
21 yesterday arriving at an agreement, at least between me
22 and Mr. Jones, stipulating to the admissibility, I regard
23 it as very bad.

24 I will leave it at that, that Counsel couldn't
25 even be apprised of the addition of an exhibit at this

1-9 1 juncture.

2 I oppose it and I have to for the moment
3 because I haven't even seen the document.

4 JUDGE WOLFE: Mr. Turk.

5 MR. TURK: I also oppose the admission of the
6 referenced article. I have not seen it. I have never
7 known that it was going to be a proposed exhibit.

8 In view of the reasons stated by Mr. Blake and
9 in view of the awful history of late identification of
10 proposed exhibits without Counsel really having time to
11 prepare for cross-examination, even on those proposed
12 exhibits which we've known about before today, I think
13 this is a terribly late time to raise a new exhibit.

14 MR. JONES: Your Honor, in view of the
15 positions taken by opposing Counsel, I would move for leave
16 to withdraw the proferred exhibit.

17 JUDGE WOLFE: All right, the motion to
18 withdraw allowed. Proposed Joint Intervenors' Exhibit 30
19 is withdrawn.

20 (The document referred to,
21 previously marked for
22 identification as Joint
23 Intervenors' Exhibit No. 30,
24 was withdrawn.)

25 MR. JONES: Your Honor, I do believe that

1-10 1 the witness has some remarks to direct to the paper which
2 he mentioned, and I would move the Board at this time that
3 the witness be allowed to make a supplemental statement
4 with respect to that question.

5 JUDGE WOLFE: In other words, you are
6 requesting leave for the witness orally to supplement his
7 written direct testimony by testifying as to whatever the
8 findings and/or conclusions were in this paper that was
9 withdrawn as Joint Intervenors' Exhibit 30; is that
10 correct?

11 MR. JONES: That's correct, Your Honor.

12 JUDGE WOLFE: Any objection?

13 MR. TURK: Yes, I do object.

14 At this time I don't know what that paper
15 says. I'm unprepared to cross-examine on the paper or on
16 any additional direct testimony concerning the paper
17 beyond that which was required to be filed in writing by
18 March 9th.

19 We are now at hearing and for the first time
20 I hear that there's a request to file additional direct
21 testimony not previously known to Counsel, upon which
22 Counsel could not have prepared for cross-examination.

23 There was a clear order requiring that
24 testimony be filed two weeks before hearing. In the
25 Commission's regulations in fact, the requirement is that

1-11

1 there be 15 days prior to commencing a hearing at which
 2 time written testimony must be submitted, except upon leave
 3 of the Licensing Board.

4 I don't think that there's any shown
 5 justification for a late attempt today to expand the
 6 direct testimony beyond that which is before us.

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1 MR. TURK: To the extent that the additional
2 article or any additional comments about the article might
3 be relevant and come within the scope of direct testimony
4 already filed, then it will be before us.

5 But to expand beyond it at this time, I think
6 is impermissible.

7 MR. BLAKE: Judge Wolfe, there are occasions
8 when supplemental direct or additional direct is called
9 for. I am at a loss at this point to react to Mr. Jones'
10 request because I haven't even heard the basis for why
11 he -- this witness ought to be allowed at this juncture,
12 and without any prior notification, to supplement his
13 testimony.

14 I think I would have to respond to whatever
15 the basis might be that Mr. Jones would offer. It certainly
16 is not usual, nor done without some cause.

17 It flies in the face of the general ability
18 of counsel to prepare to cross-examine and respond to pre-
19 filed written testimony.

20 JUDGE WOLFE: Mr. Jones.

21 MR. JONES: Your Honor, we recognize the
22 unusual nature of this request. Nevertheless, we believe
23 that the witness comprehends this as being an important
24 adjunct to his testimony.

25 It may not be possible for the witness to

2-2 1 refer to the specifics which he has in mind in responding
2 to counsel's cross-examination.

3 And, accordingly, we feel that it would be
4 appropriate for the Board to hear what the witness has to
5 say at this time to -- for an inclusion in the record.

6 JUDGE WOLFE: This proposed supplemental oral
7 testimony -- does this expand upon testimony that's already
8 part of the written testimony?

9 MR. JONES: That is my understanding, Your
10 Honor. The witness has not at this time disclosed fully
11 to me what it is exactly that he proposes to say.

12 JUDGE WOLFE: I would suggest you consult
13 with him for a couple of minutes and find out what this
14 testimony is. Is it a departure, for one thing, from
15 anything that's stated in the written direct testimony;
16 or is it just a supplementation to expand upon what is
17 presently covered in the written direct testimony?

18 This would be of interest to the Board.

19 MR. JONES: If it please Your Honor --

20 JUDGE WOLFE: We'll recess for a couple of
21 minutes. You may speak to your witness.

22 MR. JONES: Thank you, Your Honor.

23 (A short recess was taken.)

24 MR. JONES: Your Honor, if it please the
25 Board, the witness advises that the specific topic of the

2-3
1 paper he refers to is cited in full in the witness' answer
2 to Question No. 37, and that the purpose of his remarks
3 will be to amplify the answer which is contained in Answer
4 37, that it will in no way expand upon his testimony, nor
5 will it fundamentally or substantively change his testimony.

6 JUDGE WOLFE: Going back to square one now,
7 the document which you propose to offer as Joint Inter-
8 venors' Exhibit 30 --

9 MR. JONES: Yes, Your Honor.

10 JUDGE WOLFE: -- is the article cited by
11 the witness in his answer to Question 37?

12 MR. JONES: That's correct, Your Honor.

13 I might point out that it would appear to me
14 that the subject of the paper is highly relevant and
15 material to this proceeding, inasmuch as we've been strug-
16 gling through some five days now of hearings to arrive at
17 this point, to address ourselves to the question of
18 synergistic low-level radiation reactions.

19 It appears to me from the title of the paper
20 and from the answer of the witness that this is something
21 which addresses the question extensively.

22 JUDGE WOLFE: Mr. Blake, you have been shown
23 where in the document as to which the witness wishes to
24 orally supplement his testimony is cited in the witness'
25 answer to Question 37. I take it that you have had an

2-4
1 occasion to review that document to see what it says. Is
2 that correct?

3 MR. BLAKE: No, sir, we do not have a copy
4 of that document.

5 JUDGE WOLFE: That's not my question. My
6 question is -- Perhaps you are answering me.

7 But have you had occasion to read that docu-
8 ment previously?

9 MR. BLAKE: No, sir.

10 JUDGE WOLFE: Even though it was cited in
11 Dr. Bross' answer to Question 37?

12 MR. BLAKE: Correct.

13 JUDGE WOLFE: How about you, Mr. Turk?

14 MR. TURK: The same answer is true for the
15 Staff.

16 JUDGE WOLFE: And might I ask, without going
17 too much into detail, why not, Mr. Blake?

18 MR. BLAKE: Well, as you'll recall, Judge
19 Wolfe, it was identified with essentially two working days
20 before we commenced this hearing that Dr. Bross would
21 actually appear.

22 I at that time explained to you -- and I must
23 reiterate now, as counsel must always do in preparation for
24 a hearing, you have to call your priorities; you have to
25 make your determinations about how you spend your time.

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1 And I chose to spend my time based on exhibits
2 which had been identified as exhibits, and a combination
3 of preparing cross-examination on the testimony before
4 us.

5 In this case we had a document identified in
6 the testimony, which was not proffered as an exhibit. I
7 elected not to look at that document.

8 JUDGE WOLFE: When did you receive this written
9 testimony of Dr. Bross?

10 MR. BLAKE: March 9.

11 JUDGE WOLFE: Mr. Turk, the same question.

12 MR. TURK: The Staff received the testimony
13 sometime -- somewhat later than March 9th due to the extra
14 time that it takes to get things through the Commission mail
15 system. It was approximately March 10th or 11th that we
16 actually received copies of the testimony.

17 At about the same time we received approxi-
18 mately two inches thick proposed exhibits for the first
19 time -- I should qualify that -- with the exception of
20 those materials which were identified during discovery.

21 We then learned for the first time of the
22 other proposed exhibits; we received copies of those.

23 We received testimony of all other witnesses
24 in that same time period. And in the brief two weeks or
25 less than two weeks before hearing, there was a lot to do

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1 other than explore statements contained in testimony of
2 witnesses who were apparently not going to be appearing
3 today, and as to whose testimony we felt there was reason-
4 able grounds there should be no testimony admitted.

5 And I would note that our belief was in
6 fact justified, in view of the Board's ruling as to pro-
7 posed Exhibit No. 28, which is the testimony of Dr.
8 Samuel Epstein, wherein the witness did not appear. The
9 Board ruled that the sponsored testimony was inadmis-
10 sible.

11 And in anticipation of such a ruling, we
12 felt that the Bross testimony would similarly be inad-
13 missible.

14 We learned only -- I believe on Thursday --
15 perhaps Friday, but I believe Thursday of the week prior
16 to coming to hearing the following Monday, that Dr. Bross
17 would be here.

18 There was no time to explore further the
19 statements in his testimony.

20 (Bench conference.)

21 MR. TURK: I might add that if this additional
22 statement which Dr. Bross wishes to make is along the same
23 lines as what his testimony already contains, there may be
24 a point during testimony -- I'm not sure -- but there may
25 be a point during testimony when it can be elaborated

1 upon.

2 But I'm not sure whether he's going to make
3 additional statements, which I have not yet had time to
4 consider or review.

5 JUDGE WOLFE: Well, certainly the witness,
6 Mr. Jones, did answer Question 37 and did cite this docu-
7 ment. What more generally does the witness wish to do?
8 Just further amplify -- clarify or really go into some
9 detail now with this supplemental testimony?

10 Can you give me some advice on that?

11 MR. JONES: It's my appreciation, Your Honor,
12 that the witness wishes to amplify and clarify the state-
13 ment which appears in the answer to Question 37.

14 (Bench conference.)

15 MR. JONES: Your Honor, may I address the
16 Board for a moment, perhaps in resolution of the conflict
17 which appears before you at this time.

18 During Your Honors' colloquy, I spoke to the
19 witness, and he advises that it was not his intention to
20 provoke procedural debate before this forum, and that,
21 accordingly, he would at this time withdraw the request
22 to supplement his testimony.

23 JUDGE WOLFE: All right. Request granted.

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1 MR. JONES: Your Honor, at this time we would
2 move for the adoption of the witness' prefiled testimony --
3 Strike that.

4 We wish to move for the admission of the
5 witness' prefiled testimony, his curriculum vitae and
6 accompanying bibliography. We would further move for the
7 admission into evidence of Joint Intervenors' Exhibits 22,
8 23, 24, 25 and 26.

9 JUDGE WOLFE: All right.

10 (Bench conference.)

11 JUDGE FOREMAN: Mr. Jones, you had identified
12 Exhibit No. 27. Do you want to ask that that be in-
13 cluded?

14 MR. JONES: Yes, Your Honor. I would also
15 include Exhibit 27 as part of the motion.

16 JUDGE WOLFE: All right. Have these exhibits --
17 proposed exhibits been marked for identification?

18 MR. JONES: They have, Your Honor, and are
19 pending --

20 JUDGE WOLFE: Has the necessary number of
21 copies been provided to the reporter, three of each?

22 MR. JONES: They will be momentarily. We
23 have the appropriate numbers of documents.

24 JUDGE WOLFE: All right. Let's consider
25 then any objections to the motion to incorporate by

3-2 1 reference into the record the statement -- sworn statement
2 of Dr. Bross?

3 Did you say there was a curriculum vitae
4 attached to this? Oh, yes. All right.

5 -- inclusive of the curriculum vitae and in-
6 clusive of a table -- inclusive of a bibliography and in-
7 clusive of a table marked "Confidence Intervals for Infant
8 and Childhood Mortality by Parents Gonadal Dose."

9 Excuse me. A graph rather.

10 MR. JONES: That's correct, Your Honor. All
11 of those items are included in the exhibit.

12 JUDGE WOLFE: Any objection? Well, Applicant
13 has already stipulated to the admissibility of this docu-
14 ment; is that correct?

15 MR. BLAKE: Judge Wolfe, it is correct that
16 Applicant has no objection to the admissibility of the
17 identified exhibits.

18 JUDGE WOLFE: I see.

19 MR. BLAKE: Nor do we have -- and that by
20 virtue of our stipulation of yesterday with Mr. Jones,
21 nor do we have any objection to the admission into evi-
22 dence of the curriculum vitae, the graph, nor the
23 bibliography.

24 I do, however, have an objection to portions
25 of the sworn statement of Dr. Irwin D. J. Bross, which I'll

3-3 1 identify now.

2 JUDGE WOLFE: Your stipulation only covers
3 these proposed exhibits that were authored by Dr. Bross?

4 MR. BLAKE: Yes, that's correct.

5 JUDGE WOLFE: All right. What are your ob-
6 jections to the testimony?

7 MR. BLAKE: The basis for my objection is
8 that there is no record evidence to support the statements
9 which appear at some points in questions, and at other
10 points in answers in Dr. Bross' testimony regarding the
11 expected releases from the Waterford 3 plant.

12 And, in addition, I see nothing in Dr. Bross'
13 qualifications which would allow him to independently
14 testify on expected releases from that plant. Specifically,
15 I would move to exclude from Dr. Bross' testimony the
16 first sentence in Question 17, the --

17 JUDGE WOLFE: Take that a little slower,
18 please.

19 MR. BLAKE: All right, sir.

20 JUDGE WOLFE: All right.

21 MR. BLAKE: Question and Answer No. 29, which
22 refer to 25 and 75 millirem and the one-rad range, else-
23 where specifically defined in Dr. Bross' prefiled testi-
24 mony as a range of dose between 100 millirem and 10 rem.

25 JUDGE WOLFE: Now, what is your objection

-4 1 then here?

2 MR. BLAKE: The same objection.

3 JUDGE WOLFE: The same objection, namely --

4 MR. BLAKE: Similarly --

5 JUDGE WOLFE: -- namely, that there's nothing
6 in the record to date in support?

7 MR. BLAKE: That's correct. Nothing in the
8 record and nothing in his qualifications which would allow
9 him independently to arrive at that determination.

10 JUDGE WOLFE: All right.

11 MR. BLAKE: Similarly, Question and Answer
12 40, 4-0, which again includes references to 25 and 75 milli-
13 rem and the one-rad range, defined by Dr. Bross in his
14 response to Question 15.

15 Similarly, Question and Answer 41, which while
16 it contains no specific quantified level talks in terms of
17 low-level radiation in Waterford 3 emissions. And since
18 Dr. Bross has specifically defined what he means by low-
19 level radiation in his answer to Question 15 as the one-
20 rad range, 100 millirem to 10 rem, I add this question and
21 answer to the list.

22 And, finally, Question and Answer 51, 5-1,
23 again which refers specifically to the one-rad range else-
24 where defined by Dr. Bross.

25 That concludes my objections.

1 JUDGE WOLFE: Mr. Turk?

2 MR. TURK: I join in the objections on the
3 testimony. I have the further objection to the admission
4 of one of the proposed exhibits.

5 JUDGE WOLFE: Which one is that, please, now?

6 MR. TURK: This is proposed Exhibit No. 23,
7 entitled "Why the Assurances that the Water Is Safe Have
8 No Scientific Validity."

9 I have attempted to be fairly liberal in my
10 reading of the proposed exhibits in order to keep down the
11 number of objections. When I came to this one, I noticed
12 that, first of all, it is testimony filed concerning
13 chemical risks in the Niagara Falls area.

14 Not only is it related to Niagara Falls, it
15 also is in the nature of rebuttal testimony -- or so it
16 would appear, or testimony at least which is supportive
17 of testimony presented by the New York Public Interest --
18 well, I forget what the acronym stands for -- NYPRG,
19 N-Y-P-R-G.

20 It does not appear to have anything whatsoever
21 to do with the chemical environment surrounding the Water-
22 ford plant or present in New Orleans or Louisiana. It
23 does not say anything at all which is either material or
24 relevant and that it does not at all have any bearing on
25 the issues to be decided here, nor does it make any facts

1 in issue more or less probative.

2 Pursuant to the Commission's regulations
3 and the Federal Rules of Evidence, the rules governing
4 procedures in U. S. Courts, I think it is clearly irrele-
5 vant and immaterial and should not be admitted.

6 JUDGE WOLFE: All right. Mr. Jones.

7 MR. JONES: Your Honor, I would like to begin
8 by first addressing myself to Mr. Turk's objection with
9 respect to Joint Intervenors' proposed Exhibit 23.

10 I believe that this paper is both relevant
11 and material to the issues which are germane to Joint
12 Intervenors' case, in that it is a rigorous discussion
13 of hazards from low-level pollutants.

14 And the question of hazards from low-level
15 pollutants is as important to this energy case as is
16 the question of hazards from low-level radiation.

17 It further, in our view, is relevant in its
18 discussion of the mechanism by which toxic substances cause
19 damage to living tissues, which is something that our
20 witness yesterday devoted his entire testimony to.

21 It also points out -- we think rather force-
22 fully -- the problems which arise in populations which are
23 burdened with chemical pollutants which are assertedly
24 within the limits of regulatory standards.

25 In summary, it's our belief that the paper

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demonstrates that in a burdened environment, the fact that experts, whether they be industry experts or state officials or federal officials, take the position that regulatory standards have been met does not always adequately assure public health and safety.

And so in addressing itself to these issues, we assert that Dr. Bross' contribution in this respect is both relevant and material.

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4-1 1 MR. JONES: I should now like to address
2 myself to Mr. Blake's objections in his motion to strike
3 portions of Dr. Bross' testimony.

4 This motion, of course, is also concurred in
5 and joined in by the NRC Staff.

6 As I appreciate the nature of Mr. Blake's
7 objection, with respect to Question 17, we are once again
8 faced with the question of whether the plant should be
9 judged and viewed in terms of its maximum permissible
10 regulatory standard vis-a-vis the asserted releases which
11 Applicant and Staff have testified about.

12 JUDGE WOLFE: Wait a moment. We are talking
13 now about the first sentence in Question 17?

14 MR. JONES: That's correct, Your Honor.

15 JUDGE WOLFE: And as I understand Mr. Blake's
16 objection, there's nothing in the record in support of
17 this question, so as a hypothetical question or as a
18 regular question -- well, as a hypothetical question, it
19 must be founded on some fact in the record.

20 MR. JONES: Well, Your Honor, I believe that
21 it's appropriate for the witness --

22 JUDGE WOLFE: And at the very least it's a
23 leading question, but I think Mr. Blake's objection is
24 it assumes a state of the record that is not so.

25 Where does this appear as a factual matter

4-2 1 in the record today, this 25 to 75 millirem figure? Where
2 does it appear, for example, under NRC operating license
3 specifications?

4 MR. JONES: Your Honor, it's our position
5 that the figure 25 to 75 millirems as allowable release
6 doses is the standard which is fixed by the EPA.

7 JUDGE WOLFE: By EPA?

8 MR. JONES: Yes, that's our understanding
9 of the matter.

10 And it was also the testimony of Dr. Branagan
11 that the maximum permissible -- I'm sorry -- the maximum
12 dose which could be sustained to an individual, even the
13 hypothetical individual which we talked about during the
14 bulk of Dr. Branagan's testimony, was capable of sustaining
15 up to 23 millirems, and that 23 millirems would be the
16 level at which the NRC would take some form of enforcement
17 action if there were releases in that order of magnitude.

18 Accordingly, that's the basis for the question.

19 JUDGE WOLFE: All right.

20 MR. JONES: If I might make one further
21 statement of amplification, Your Honor, we believe that
22 the witness, through his testimony, is prepared to
23 establish a factual situation which will correspond to the
24 millirem levels set forth in the predicate of Question 17;
25 and we feel it appropriate for this question -- or rather,

4-3 1 we feel it's appropriate for the issue to be explored
2 through cross-examination, rather than through the device
3 which Applicant has sought to use before this Board
4 previously of striking the witness' testimony without
5 allowing the witness a full and thorough opportunity through
6 cross-examination and redirect to establish the basis for
7 the conclusions which are expressed in the witness'
8 testimony.

9 As Your Honors can fully appreciate, I trust,
10 all of the prefiled testimony which has been brought
11 before the Board thus far tends to be substantially
12 conclusionary in nature, and it is our understanding that
13 the purpose of the cross-examination process is to test
14 the probity and validity of the conclusions set forth by
15 witnesses in their prefiled testimony; and that accordingly,
16 where the witness can more convincingly set forth the
17 basis for his position, that it is more appropriate --
18 strike that -- that that should be the testimony which
19 should be adopted by the Board as being the most persuasive
20 in reaching its own findings of fact and conclusions.

21 And accordingly --

22 JUDGE WOLFE: Yes, but what is being
23 objected to is not part of the witness' testimony. What
24 is being objected to is the question, is it not?

25 MR. JONES: Well, if I may, Your Honor --

4-4 1 JUDGE WOLFE: Mr. Blake, your objection was
2 to the first sentence in Question 17?

3 MR. BLAKE: Correct.

4 JUDGE WOLFE: Your objection did not extend to
5 the answer?

6 MR. BLAKE: Not in this case.

7 JUDGE WOLFE: The objection is not to any
8 conclusional testimony of the witness. The objection is
9 to the question.

10 MR. JONES: If I may, Your Honor, I would
11 again submit that if the witness has an adequate explanation
12 for the predicate to the question, that it would be
13 appropriate at that -- strike that and let me reverse the
14 context.

15 I would submit to Your Honors that if the
16 witness can in his cross-examination adequately sustain
17 the basis for the predicate to the question, that it is
18 appropriate to allow the predicate to remain, and I would
19 suggest to Your Honors that at this time it is our view
20 that it is in effect premature to raise the motion to
21 strike with respect to the first sentence in Question 17.

22 JUDGE WOLFE: All right. Go ahead, Mr. Jones.

23 MR. JONES: With respect to the other
24 objections raised by the Applicants, I would also urge the
25 same view, that if at the conclusion of the witness'

4-5 1 testimony he has failed to provide an adequate basis for
2 both question and answer from his testimony, that it may
3 then be appropriate for the Applicant to renew its motion;
4 but I think it's entirely premature to allow the Applicant
5 to move to strike a portion of the testimony before the
6 witness has the opportunity to be heard on the basis for
7 those particular portions of the testimony.

8 JUDGE WOLFE: And that's the conclusion of
9 your argument?

10 MR. JONES: Those are my views on the subject,
11 Your Honor.

12 JUDGE WOLFE: All right. Anything more?

13 JUDGE JORDAN: I am not a lawyer and it's
14 dangerous for me to ask a question outside the field, but
15 Mr. Blake has been a source of information on matters which
16 are outside my field for a long time now.

17 Therefore, I guess the reason I address this
18 question to Mr. Blake is because of my past experience.

19 As the Chairman points out, I will also -- and
20 I intended to say that, although it might well have slipped
21 my mind -- ask other Counsel, too, if they have views.

22 That's the matter of, say, the 25 to 75
23 millirem. Let's assume that it is correct that it has not
24 been established on the record.

25 Now, if that question were allowed in as it

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1 is, would that enable the Intervenors to have proposed
2 findings which say the plant puts out 25 to 75 millirems?
3 Therefore, would the Applicant be prejudiced as a
4 consequence of the ability of the Intervenors to cite this
5 as part of the record?

6 I really am asking for your help and advice,
7 Mr. Blake, and the other people, too.

8 MR. BLAKE: Dr. Jordan, it is questionable
9 that with respect to 17 itself, that that would be the case.
10 There's always been some question in my mind in question-
11 and-answer format testimony exactly the probative or
12 reliable value of the question itself; but it is clear
13 from some of the other answers in here that that would be
14 the case, where the witness has affirmatively in his
15 answer portion of the testimony stated that the emissions
16 will be so-and-so, either one rad or in the 25 to 75
17 millirem range.

18 So that is indeed one threat that I see.

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5-1 1 MR. BLAKE: The second and probably the more
ge 2 important, however, is that the assessments are based on
3 that level of emission or causal dose from emissions from
4 the plant; and, therefore, we are talking about and focusing
5 on something which in my view has not been established in
6 the record as fact.

7 That's really the second.

8 I would like to address this 25 to 75 millirem
9 figure. As you are aware from having set on the Appendix
10 I Board, shortly after the Appendix I, the EPA issued,
11 40 CFR Part 190, which Mr. Jones has made reference
12 to.

13 As you'll recall as well, there was some
14 concern at that point in time that all of the work that
15 had gone into Appendix I and the rule-making proceeding
16 would have to be completely reconstituted by the EPA's
17 rule-making proceeding.

18 In fact, that was avoided by EPA's explicit
19 statements which were made at the time that 40 CFR Part
20 190 was published, that it was EPA's view that for plants
21 at sites, even up to five and certainly for a single-unit
22 site, that compliance with 10 CFR Part 50, Appendix I, of
23 the NRC's regulations would constitute compliance with
24 EPA's regulations.

25 I say that because there ought to be no

5-2 1 confusion here with regard to what this plant is bound by.
2 It is bound by Appendix I and there's no confusion about
3 extending it to these EPA levels.

4 Secondly, it is my recollection that
5 Dr. Mauro has testified in this proceeding, and in
6 response to your question, Dr. Jordan, whether or not
7 other contributions from the entire uranium fuel site
8 addressed in 40 CFR 190 would add anything meaningful or
9 measurable to doses in the area of the environs of
10 Waterford 3.

11 His answer was no. In fact, that is
12 uncontroverted in the record at this point.

13 So my objection stands.

14 JUDGE JORDAN: Very well. Thank you.

15 Does anyone else wish to comment on that?

16 Mr. Turk?

17 I was particularly concerned as to whether
18 admission of the question would prejudice the Applicant.

19 MR. TURK: There is a further reason why
20 historically hypothetical questions must be tied to facts
21 in the record or facts which may be later put into the
22 record, and I note that because in my view there are no
23 facts presented by any of the direct testimony filed by
24 the Joint Intervenors which will indicate that a dose of
25 25 to 75 millirems or a dose in the one-rad range, as the

5-3 1 terms used by Dr. Bross, will ever be experienced as a
2 result of the Waterford operation.

3 The reason historically, as I understand it,
4 why hypotheticals must be in the proper form is possibly
5 largely tied to the problem of confusion in the record.

6 Testimony will come in and question after
7 question will be asked. We will not always be prescient
8 enough to use in the questioning of the witness the fact
9 that the assumed fact is only hypothetical.

10 That's number one.

11 Number two, where the fact cannot be tied to
12 evidence in the record or evidence to be put in the record,
13 then it's not relevant. It has no bearing on the case.

14 For that reason, there is a very proper
15 objection to the use of hypotheticals not tied to record
16 evidence.

17 I have other comments which I would like to
18 address in response to Mr. Jones on both the admissibility
19 of these portions of testimony, as well as on the exhibits,
20 but I don't believe Mr. Blake has yet had a chance to
21 respond to Mr. Jones, and I would wait until he has had
22 that opportunity.

23 JUDGE JORDAN: Since I had a direct question
24 to Mr. Blake and you have joined in that, I think perhaps
25 we ought to allow Mr. Jones to respond to their answers to

5-4 1 my direct question, and then we will go back to the
2 Chairman and the objections otherwise.

3 MR. JONES: Judge Jordan, Members of the Board,
4 I believe that Mr. Turk's statement with respect to the
5 treatment of hypothetical questions speaks precisely to the
6 point which I previously addressed; namely, that Joint
7 Intervenors....

8 I believe that Mr. Turk's remarks just now
9 with respect to hypothetical questions speaks directly to
10 the point which I had previously sought to bring before
11 the Board; namely, that it is premature to judge the
12 probity of such questions until the witness has had the
13 opportunity to fully be heard.

14 Secondly, I recognize that Your Honor's
15 question was whether or not there would be prejudice to
16 the Applicant, and it's our view that rather than
17 prejudicing the Applicant, the prejudice at this point
18 would fall upon the Joint Intervenors, since there are
19 facts which we believe will be elicited from the witness
20 and further defense through the cross-examination of
21 the witness' statement, which at this point in time -- I
22 can't predict what will be the ultimate outcome of the
23 witness' cross-examination testimony, but it is at least
24 our view at this point prior to commencing the cross-
25 examination process that the witness is fully capable of

5-5 1 providing the basis for those views and of answering the
2 objections of Applicant and Staff.

3 Accordingly, we would submit to Your Honor
4 that the prejudice, if any, would not be to the Applicant
5 by allowing the hypotheticals at least to remain as
6 testimony subject to later rulings by the Board; rather,
7 the prejudice would be upon the Joint Intervenors who
8 would not be allowed to introduce critical elements in
9 their case.

10 MR. TURK: If Counsel has terminated his
11 remarks, I'd like to respond very briefly.

12 JUDGE WOLFE: All right.

13 MR. TURK: Mr. Jones is now making a
14 statement that if the witness is allowed to be cross-
15 examined, he will somehow be able to support the 25 to
16 75 millirem which is assumed in the question, or the
17 one-rad range which is assumed in the question.

18 There is nothing in the direct testimony of
19 the witness which even indicates that he was going to make
20 such an assessment.

21 In effect, Mr. Jones would be now inserting
22 a very significant new line of direct testimony, or if
23 testimony generally, in that he would now for the first
24 time be advising us, Counsel for the Staff as well as
25 Counsel for the Applicants, that this witness wishes to

5-6 1 make a new dose calculation.

2 We have had no prior indication that the
3 witness was going to do that. There is nothing in the
4 direct testimony which we have been able to see which
5 indicates that this witness should be cross-examined as to
6 bases for any new dose calculation which he may be coming
7 up with.

8 JUDGE WOLFE: How about the witness' answer
9 to Question 40, recognizing that a motion to exclude has
10 been made to that question and answer?

11 In the answer on the second page of the
12 answer to 40 there is wording, "It should be noted that
13 while 25 - 75 millirem may be an average under normal
14 operating conditions, for a variety of reasons, the
15 individual exposures may be substantially higher."

16 Granted, while this is subject to a motion
17 to strike, regardless, this is direct testimony and upon
18 cross-examination the witness can be queried as to the
19 basis for this 25 - 75 millirem.

20 MR. TURK: If it had not been for the
21 question which preceded that statement, if instead the
22 question had been give us an estimate of the releases and
23 tell us how that will affect the population, then the
24 question would be properly cross-examinable, in my view.

25 But since the question asks, "Would introduction

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1 of radiation in the one-rad range containing liquid and
2 gaseous and particulate emissions from Waterford aggravate
3 certain risk," in my view, until now we did not have
4 adequate notice that the witness was coming up with some
5 dose calculations.

6 Rather, this all seems to be tied to the
7 initial question which assumes 25 to 75 millirems.

8 JUDGE WOLFE: All right. Anything more?

9 MR. JONES: I have nothing further, Your
10 Honcr.

11 JUDGE WOLFE: Mr. Blake?

12 MR. BLAKE: No.

13 JUDGE WOLFE: We will have a recess. We
14 will recess until quarter of 11:00, in which case if we
15 have not completed, we will continue to recess without
16 further notice until 11:00 o'clock.

17 Hopefully, we will have made our determinations
18 by that time.

19 All right. We stand in recess.

20 (Recess taken.)

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1 JUDGE WOLFE: All right. The Board is ready
2 to rule.

3 The Staff's objection to proposed Joint
4 Intervenors' Exhibit 23 is denied. We believe the document
5 is relevant because it discusses mechanisms by which en-
6 vironmental pollutants may relate to carcinogenesis.

7 Accordingly, Joint Intervenors' proposed
8 Exhibits 22, 23, 24, 25, 26 and 27 are admitted as
9 exhibits.

10 (The documents heretofore marked
11 for identification as Joint
12 Intervenors' Exhibits Nos. 22,
13 23, 24, 25, 26 and 27 were
14 received in evidence.)

15 JUDGE WOLFE: With respect to Applicant's
16 motion to exclude portions of the testimony of Dr. Bross,
17 which is supported by Staff, we grant the motion to ex-
18 clude as to the first sentence of Question 17.

19 Since the question is hypothetically based
20 upon a fact not spread on the record, the second sentence
21 will stand. But to make it intelligible, the Board will
22 delete the word "this" from the second sentence.

23 We grant the motion to exclude as to Question
24 29, since in its entirety it's based upon facts not of
25 record. However, we believe the answer to Question 29

6-2 1 should stand, provided Mr. Jones now provides a question,
2 which would have elicited the answer to Question 29.

3 So if you would, Mr. Jones -- take your
4 time, phrase a proper question to which there will be no
5 objection, to elicit the answer to Question 29.

6 You see, in ordinary circumstances and in the
7 usual court or administrative proceeding where oral testi-
8 mony is given, if such a question had been put to the
9 witness and objected to, then counsel obviously could re-
10 phrase the question to elicit that which he wishes to have
11 elicited.

12 So we're giving you that opportunity to frame
13 a proper question to the witness, Mr. Jones.

14 MR. JONES: I appreciate that, Your Honor.
15 If I might ask leave of the Board, would it be possible
16 for me to consider this over the lunch recess and report
17 to the Board at th commencement of this afternoon's
18 session?

19 JUDGE WOLFE: All right.

20 We now turn to Question and Answer 40. The
21 Board partially grants the motion to exclude as to
22 Question 40, to the extant the words, "in the one-rad
23 range," are excluded, because this wording is based on
24 facts and not spread on the record.

25 We, thus, amend the question to read: "Would

6-3 1 introduction of radiation contained in liquid and gaseous
2 and particulate emissions from the Waterford 3 nuclear
3 power plant aggravate this risk? By what mechanism is the
4 risk enhanced?"

5 Is there some objection to this deletion of
6 the words so deleted?

7 MR. JONES: I have none, Your Honor.

8 JUDGE WOLFE: Absent objection then, we will
9 proceed.

10 And I take it there was no objection to the
11 earlier ruling -- or earlier rulings.

12 (No response.)

13 JUDGE WOLFE: All right.

14 The motion to exclude is denied as to the
15 answer as to Question 40. We note that the witness does
16 advert to 25-75 millirems, et cetera.

17 While a question -- a hypothetical question
18 need be predicated on the facts of the case, here we have
19 the witness speaking to 25-75 millirems. And we see
20 nothing improper about the witness proceeding to address
21 that subject, obviously subject to cross-examination.

22 MR. BLAKE: Judge Wolfe, may I ask a question
23 at this point?

24 JUDGE WOLFE: Yes.

25 MR. BLAKE: In my argument, I not only based

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1 it on the fact that there was -- on the grounds that there
2 were no facts in evidence to support the hypothetical,
3 but also included in my view that this witness had no
4 qualifications to address that.

5 Did the Board take that into consideration
6 in its considerations?

7 JUDGE WOLFE: As I said, you can go into this
8 on cross-examination, which subsumes the question of credibility or
9 expertise of the witness. So, yes, this -- you would be
10 permitted to cross-examine on qualifications certainly.

11 MR. BLAKE: My only question is whether or
12 not I had made it clear enough.

13 JUDGE WOLFE: Yes.

14 The motion to exclude is partially granted as
15 to Question 41, since low-level radiation, as earlier
16 defined by the witness in his testimony, is not a
17 fact established in the record.

18 Question 41 is rephrased by the Board to
19 delete the words, "low level," and now reads: "Can you
20 make a statement with regard to the health risks from
21 radiation in emissions from Waterford 3 as it impacts that
22 portion of the population already at risk on pre-
23 existing genetic damage, as evidenced by 'indicator
24 diseases'?"

25 Any objection or statements of prejudice by

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1 the Board's deletion of these two words? We will hear --

2 MR. JONES: No objection from Joint Inter-
3 venors, Your Honor.

4 JUDGE WOLFE: Absent objection then, we will
5 proceed.

6 MR. TURK: I'm wondering whether we really
7 need to wait until after the lunch recess for the re-
8 formulation of Question 29. Perhaps if we just took a
9 moment or two, we can get that out of the way and then
10 proceed.

11 JUDGE WOLFE: I will proceed with the Board's
12 ruling. We'll see how Mr. Jones -- what he ultimately
13 decides.

14 We'll proceed then to rule that we -- in
15 light of this deletion of the two words, "low level," the
16 motion to exclude the answer to Question 41 is thus
17 denied.

18 With respect to Question 51, the motion to
19 exclude is partially granted. The words, "in the one-rad
20 range," are stricken as not being based upon facts spread
21 on the record.

22 The question now reads: "What is your assess-
23 ment for the health risk to South Louisiana's population
24 of the introduction of additional radiation resulting from
25 plant operations at the Waterford 3 nuclear generating

1 facility?"

2 Any objection? Any prejudice being shown
3 will be --

4 MR. JONES: No objection, Your Honor, from
5 the Joint Intervenors.

6 JUDGE WOLFE: Absent objection then, we will
7 proceed.

8 The motion to exclude the answer to Question
9 51 is thus denied, since the question to the Board's mind
10 is now properly phrased.

11 Have you rephrased the question --

12 MR. JONES: Your Honor, I fear that I have
13 been assiduously following the Board's ruling with relation
14 to the other matters. Unfortunately, I have not had in the
15 past five minutes any additional time to devote to the
16 question.

17 JUDGE WOLFE: Yes.

18 MR. JONES: I feel that it would be preferable
19 to be allowed to confer with the witness perhaps, and
20 also with other counsel --

21 JUDGE WOLFE: All right. So that we can move
22 this along, the Board is going to grant the request to
23 incorporate into the record by reference the sworn state-
24 ment of Dr. Bross and all of the attachments, except
25 for the Question and Answer 29. We will rule on that

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1 separately after the lunch period.

2 Okay.

3 MR. JONES: Thank you, Your Honor.

4 (The document referred to, the statement of
5 Dr. Irwin D. J. Bross with attachments, follows:)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY & LICENSING BOARD

In the Matter of

LOUISIANA POWER & LIGHT COMPANY

Docket No. 50-382

(Waterford Steam Electric Station
Unit 3)

SWORN STATEMENT OF DR. IRWIN D. J. BROSS

1. By whom are you employed and what position(s) do you hold?

Answer. I am employed by Roswell Park Memorial Institute for Cancer Research as Director of Biostatistics.

2. Is this in a specialized health field? If so, what is the description of the type of health field?

Answer. Yes. Cancer Research and Public Health.

3. What previous positions have you held?

Answer. From 1952-1959, I was Head, Statistical Design and Analysis Section at Cornell University Medical College and the Sloan-Kettering Institute in New York City. From 1949-1952, I was Research Associate in the Biostatistics Department of the Johns Hopkins University in Baltimore.

4. What are your academic qualifications and degrees?

Answer. I hold a M.A. and Ph.D. in Experimental Statistics from the University of North Carolina, the latter granted in 1949.

5. Have you done post-doctoral work? If so, in what field or fields?

Answer. No formal post-doctoral work.

6. Have you done any research in the fields of cancer and/or human exposure to radiation?

Answer. Since 1952 I have been heavily involved in cancer research and since about 1967 in research on health effects of low-level radiation.

7. Please describe your research.

Answer. My direct involvement in research on radiogenic cancer occurred when I became Acting Head of Epidemiology at RPMI in addition to my job as Director of Biostatistics. During my 7 years as Acting Head, I developed a program in Biometric Research on Cancer Epidemiology which developed the biostatistical technology for radiation research, which was subsequently applied to data from the Tri-State survey. More recently, I have analyzed data from the Portsmouth Naval Shipyard Study on health effects among nuclear submarine workers.

8. What publications have your works appeared in?

Answer. My more than 300 articles have appeared in many different journals. These journals include the most prestigious journals in general science, general medicine, statistics, epidemiology, public health, cancer research, and other disciplines. (See Bibliography).

9. Which of your published works deal with the areas of your research?

Answer. Almost all of them.

10. Do you have any as yet unpublished research data compiled?

Answer. Yes.

11. Have you participated in any scientific colloquia? If so, where, when, under whose sponsorship, and what topics have you dealt with?

Answer. I participated in many scientific colloquia on many different topics on health hazards of radiation. I have recently given invited papers to the American Statistical Association (1980), and the Yale Symposium on the health effects of low-level radiation (1981). In 1979, I spoke at the invited symposium in Dusseldorf on metastasis and at the University of Heidelberg on radiation hazards.

12. Have you ever appeared as an expert witness in state, federal or congressional hearings or courts?

Answer. I appeared at a 1978 NRC hearing held specifically for the purpose of reviewing our radiation-leukemia findings. I was a principal witness at Congressional hearings on radiation hazards in 1978 (Serial No. 95-179) and at Other Congressional hearings such as one on February 25, 1980 on cancer research. I appeared at a state legislative hearing on December 10, 1981 (and on several previous occasions) and before the Ontario Provincial Legislature. I also have been involved in the quasi-judicial NRC and the New York State hearings on licensure.

13. Would you please define for purposes of this discussion:

(a) "DNA"

Answer. The genetic information stored in a double helix chemical structure.

(b) "Carcinogen"

Answer. An agent capable of causing cancer (here, human cancer).

(c) "Doubling dose"

Answer. The dosage of a carcinogen that will double the risk of cancer (relative to baseline levels for a given category of individuals).

14. Would you please define synergism and indicate how this phenomena would affect health risks to a population.

Answer. In general, synergism means that the combination of two risk factors produces a more-than-additive effect on the risk. For specificity, the scale used for measuring risk and the characteristics of the population at risk and the diseases under study may have to be spelled out.

15. What do you mean by "the one rad range"? How does the term rad relate to the term rem? Is there any special significance or difference between the two terms in discussions of low level radiation?

Answer. At the 1978 NRC hearing mentioned in Question 12, it was stipulated that for the purposes of that hearing, the terms rad and rem could be used interchangeably in referring to diagnostic x-rays and low-level nuclear radiation. The 1-rad range is the range up or down by a factor of 10 from 1 rad (100 to 10,000 millirem). This specifies more exactly what is generally called "low-level radiation". Below 100 millirem is commonly called "background radiation". Above this range is "therapeutic radiation", although usually this would be 50 rads or more.

16. What do you mean by and what is the significance of "indicator diseases"?

Answer. By "indicator diseases", we mean lesser diseases that tend to precede the occurrence of more serious diseases such as leukemia and cancer. For children, the indicator diseases are asthma, urticaria, eczema, pneumonia, dysentery, and rheumatic fever. For adults, heart disease and several other diseases can play this role. The persons reporting prior indicator disease have a much higher risk of developing leukemia from low-level exposures than those who report no indicator disease.

17. Under NRC operating license specifications, light water nuclear power* plants are allowed to release radioactive effluents in amounts which will result in radiation doses to the public of 25-75 millirems each year. How does this additional annual radiation exposure relate to the background radiation exposure?

Answer. Background radiation is generally taken as 100 millirem per year, although at particular locations, the actual figure may be somewhat higher or lower. The roughly 10-fold increase in leukemia with each decade of life is attributable, at least in part, to cumulative background exposure (which is directly proportional to age). If the excess radiation to the public is 50 millirem per year, this might be taken as roughly equivalent to aging 50 percent faster per year.

18. The NRC staff has concluded, regarding radiation emissions, that "...there will be no reasonable radiological impact on members of the public from routine operation of the station."* How does this risk analysis compare with the results of your research?

Answer. The risk analysis used by the NRC staff fails to use the current figures for health hazards of low-level radiation and does not take cumulative effects or synergistic effects from chemical pollution into account. Since the new risk estimates are 100 times greater than the ones NRC uses, the cumulative effects are much greater than NRC recognizes and the probable synergistic effects are much more serious, the NRC statement on radiological impact is at least questionable and in all likelihood is wrong.

*U. S. NRC, Final Environmental Statement related to the operation of Waterford SES, Unit No. 3, NUREG-0779, paragraph 5.9.1.2, p. 5-36.

19. Do you accept the biostatistical techniques and the risk analysis of the BEIR III report?

Answer. The BEIR III report is unacceptable since it completely ignores the quantitative estimates of radiation risks which can now be derived from biostatistical-epidemiological studies of populations actually exposed to low-level radiation. Extrapolations beyond the range of data is unacceptable from a statistical standpoint when there is actual data in the range, as there now is from more than 30 studies (Yale Symposium).

20. Can you describe the mechanism by which radiation and chemicals cause adverse health consequences? What is the operation of that mechanism?

Answer. Basically, the mechanism causing cancer and other effects to occur many years after the original chemical or radiation exposure is genetic damage to the DNA of human genetic material. This can be thought of as a "break point" or defect in the complex chemical structure of the double helix. The defect in the DNA represents misinformation which has little or no effect (so far as the whole organism is concerned) as long as it is confined to a single cell. For the whole-body economy to be affected, it is necessary that the misinformation be reproduced by cloning (approximately 32 doubling times are needed). This is the explanation for the long "latent period" between the initial damage and the clinical manifestation of this damage. Eventually the misinformation (which generally involves the manufacture or control of enzymes involved in the host defense system) can result in the deterioration of the host defense system. This, in turn, allows the damaged cells to eventually become metastatic cancer cells.

21. Is there any difference between the mechanisms by which chemicals and radiation cause these adverse health consequences?

Answer. Yes. The radiation damage is random or non-specific whereas chemical mutagens ordinarily attack the structure of the DNA only at very specific points.

22. Does it matter in terms of public health consequences whether chemical mechanisms or radiation mechanisms are in effect?

Answer. Although the mechanisms are different, the adverse health effects are similar. It probably does not matter greatly whether a particular site of damage is produced by a random radiation effect or a systematic chemical effect as long as there is permanent misrepair of the break that puts misinformation into the genetic structure of the DNA.

23. How would the action of this mechanism be manifested in a population?

Answer. The genetic damage would not be immediately obvious because of the redundancy of biological systems; hence, current "target" theories assume that several break points are required to cause initiation of the cancer process (rather than a single break point). However, the damage cumulates in the sense that the genetic material of the population is degraded. Thus an increased proportion of the population will have multiple defects in their genetic material and their risks of cancer and other diseases are thereby increased. Suppose, for instance, hypothetically it takes 4 defects to produce cancer. If an individual had 3 pre-existing genetic defects, then it would take only 1 additional defect to initiate the cancer process. The manifestation of the genetic damage of a population, therefore, is likely to be increased morbidity (e.g., indicator diseases) in

the population but not necessarily cancer. Eventually, however, cancer rates go up, as the frequency of persons in the "susceptible group" (e.g., 3 defects) increases and the low-level radiological and chemical exposures produces the additional break-point now needed to initiate cancer.

24. In your view, is the health risk associated with this mechanism cumulative in a population from generation to generation?

Answer. Yes. As the successive generations are exposed to chemical or radiological mutagens, the proportion of the population in the susceptible group or next-to-susceptible damage categories builds up. Thus, there is a cumulative effect.

25. Could this health risk be cumulative over the lifetime of an individual? What support do you have for this view?

Answer. The cumulative effect of background and other environmental exposures is reflected in a steady increase of cancer risks with age that were noted in Question 17. In a mutagenic environment, the risk that a cell in a susceptible individual will sustain the additional break point needed to initiate cancer is proportional to time and in this sense is cumulative.

26. Could you identify any category(ies) of individuals more likely than the rest of the population to demonstrate health effects from a cumulative risk?

Answer. As previously noted, there is a susceptible group (persons who probably had pre-existing genetic damage) that are more likely than the rest of the population to be affected by low-level radiation or other exposures. We cannot identify these persons positively by the genetic technology now available although we can distinguish these persons in a probability sense by their prior medical history.

27. What is the qualitative result of cumulative low level radiation exposure? (i.e., what, if any, diseases are associated with such exposures).

Answer. The list of the diseases is a long one and we do not know where it ends. Leukemia and lymphoma are clearly radiogenic. There are also a number of technogenic solid tumors, such as lung cancer, bladder cancer and esophagus cancer. The indicator diseases are also radiogenic. In general, it looks as though most of the diseases which are called "chronic diseases" are likely to be produced or promoted by mutagens in the environment.

28. Qualitatively, how does the health risk from low-level radiation exposure compare to the risk from relatively high level exposure?

Answer. Quantitatively, the answer to this question is given by the dosage response curve. According to recent evidence, the curve is far from linear. The current data suggests that the curve starts to level off at around 10 rem and is relatively flat for doses in the vicinity of 100 rem, and is relatively flat for doses in the vicinity of 1000 rem, actually turning downward at even higher doses because the cells are sterilized and cannot clone. Qualitatively, this means that the risks for low-level radiation are not so very different from the risks for high-level radiation.

29. Given Louisiana's high cancer mortality rate due to chemical carcinogens present in the Mississippi River, such as chloroform, carbon tetrachloride, dimethylsulfoxide, benzene and others, and in the air between Baton Rouge and New Orleans, i.e. halogenated hydrocarbons, can you state the nature of the risk to the population posed by the introduction of radiation in the one rad range into this

environment? Assume for this assessment a radiation dose to the population of 25-75 millirems/year.

Answer. In view of the limitations of our current scientific knowledge on the synergistic effects between specific chemicals (such as those named in the question) and low-level ionizing radiation, I don't think it is possible to give any precise quantitative predictions of specific risks in the exposed population. It is, however, possible to make a rough qualitative assessment by extrapolating from the experience in the U.S.S.R., where there are conditions similar to those that would exist with the operation of Waterford Three.

30. Why are the U.S.S.R. conditions similar?

Answer. The policy of siting nuclear reactors on chemically contaminated rivers is virtually forced by the geography of the Soviet Union. For practical purposes, Russia is a landlocked country. The main water resources for chemical or nuclear plants are the long river systems. Since these plants require large amounts of water, the siting policy in the U.S.S.R. has been to string these plants like beads along these long river systems. This results in a build-up in chemical and radiological contamination downstream. Hence, many areas in the U.S.S.R. have been experiencing the conditions that would exist on the lower Mississippi in Louisiana with the operations of Waterford Three.

31. Has this siting policy with a mix of chemical and nuclear plants along the Soviet Russian rivers had any adverse health effects on the population?

Answer. It seems to be having disastrous effects. In all of the technologically advanced nations (including the U.S.S.R.) there was a

declining infant mortality rate for many years. However, recently, in the U.S.S.R. these rates have turned around and are now rising rather rapidly. The rates now about double U.S. rates. This was first reported by CIA statisticians but has since been confirmed by Russian statisticians (according to newspaper reports).

32. Are there explanations other than contamination of the river waters for the increase in infant mortality rates in the U.S.S.R.? Why single out pollution?

Answer. There are always many post-hoc explanations for statistical facts and both the CIA and the Russian statisticians have given explanations other than pollution. While these explanations may sound plausible, the turn-around of a national rate requires some exposure to hazards on a national scale. Pollution is nationwide because of the siting strategy of the Communist technocrats and the high density of population along the river systems. However, attributing the turn-around to correction of underreporting in a remote province (the Russian explanation) or to vodka-drinking mothers (the CIA explanation) makes little epidemiological sense.

33. Are there positive reasons for attributing some or most of the increased infant mortality to chemical-radiological contamination of the Russian river system?

Answer. Yes. Drinking water is the key to infant mortality. The elimination of bacterial contamination was the key to the reduction in the mortality from infectious disease. To turn the U.S.S.R. rates around, there has to be a replacement of the bacterial contamination by technogenic contamination of the drinking water.

34. What could be predicted for the Waterford Three siting policy on the basis of the experience with Soviet siting policy?

Answer. First, an increase in infant mortality that would reflect the genetic damage from the chemical-radiological contamination. Second, an increase in deaths of children before adulthood due to the genetic damage. Finally, an increase in the cancer rates for the adult population. These effects could occur from simple cumulative risks, but they would be greater if there are synergistic effects. The rapid increase in Soviet infant mortality rates suggests that there well may be synergistic effects from the chemical-radiological pollution in the river systems. Clearly, the U.S.S.R. has adopted a dangerous siting policy which the U.S. can avoid because it has more siting options.

35. Is there any actual scientific evidence that would suggest that there may be synergistic effects for deaths at early ages in the children of persons exposed to radiation?

Answer. Yes. There is strong evidence in a recent report in Science on the children of persons who had been exposed to the Japanese A-bomb (Schull, W.J., Masanori, O, Neel J.V.: Genetic Effects of the Atomic Bombs: A Reappraisal. Science, Vol. 213, pp. 1220-1227, September 11, 1981) In this case, of course, both parents were exposed to low-level ionizing radiation to the gonads (less than 10 rems) so it is not an example of synergism between chemicals and radiation. The report in Science found no statistically significant differences, but this was due to the use of a faulty statistical analysis. A straightforward analysis of the same data shows the clear evidence of synergism showing Graph I (See Appendix A, attached hereto.)

36. Can you explain Graph I?

Answer. Graph I (shown in Appendix A) demonstrates three things. First, from the ranges of the 95% confidence intervals (shown as vertical brackets), it is clear that the groups designated are distinct in terms of detectable effects in children from radiation exposure of their parents. Second, observing the horizontal dotted lines as the range of infant mortality among controls, it is also clear that only one group's percentage mortality falls wholly above the control range: the group in which both parents were exposed to 0-9 rems radiation.

The fact that infant mortality in this group is significantly elevated over that shown for exposures to father and to mother independently indicates a synergistic effect among children. Thirdly, it is important that the 95% confidence intervals for this zero-nine rems-to-both-parents group falls wholly within the upper segment of confidence intervals of the groups in which parents were exposed to much higher combined levels of radiation. So this graph demonstrates that synergism results in greater infant mortality in a group exposed to lower doses of radiation than in those exposed to higher doses. Nor can this result be predicted from the groups in which only one parent was exposed to zero-nine rems.

37. Is there any other evidence of synergism when both parents are exposed to radiation?

Answer. Yes. We had earlier shown that a similar phenomena occurs with diagnostic x-rays where there can be exposure of either parent before pregnancy or exposure of mother and fetus during pregnancy. Certain combinations of exposures showed synergism (Bross, I.D.J., Natarajan, N.: Cumulative Genetic Damage in Children Exposed to Preconception and Intrauterine Radiation. *Investigative Radiology* 15 (1): 52-64, 1980).

38. Is there any evidence that both reproductive wastage such as infant mortality and cancer in adults can be produced by the same contamination?

Answer. Yes. The chemical contamination at Love Canal produced doubled risks of spontaneous abortion and of birth defects (Bross, I.D.J.: Muddying the Water at Niagara. New Scientist, Vol. 88, No. 1231, pp. 728-729, December 11, 1980). In the same area, there is also excess cancer (Janerich, Burnett, Feck, et al: "Cancer Incidence in the Love Canal Area". Science, Vol. 212, pp. 1404-1407, June 19, 1981). Since both phenomena are due to genetic degradation, it is not surprising that they tend to go together. However, infant mortality shows up more quickly (9 months) than solid cancers (15 or more years).

39. Can you specify any subgroups within this South Louisiana population which might be special risk?

Answer. As noted in Question 26, there is a susceptible subgroup which is more likely to report indicator diseases than the general population, but it cannot be precisely identified by genetic markers.

40. Would introduction of radiation in the one rad range contained in liquid and gaseous and particulate emissions from the Waterford Three nuclear power plant aggravate this risk? By what mechanism is the risk enhanced?

Answer. There is now evidence from several studies that the doubling dose for myeloid leukemia in men is around 5 rem (See Yale Journal of Biology and Medicine, "Direct Estimates of Low-level Radiation Risks of Lung Cancer at Two NRC-compliant Nuclear Installations: Why are the New Risk Estimates 20 to 200 Times the Old Official Estimates,

Bross and Driscoll). It is likely that the persons affected by this low-level radiation are the susceptibles with pre-existing genetic damage. The emissions from Waterford Three could aggravate the risk. It should be noted that while 25-75 millirem may be an average under normal operating conditions, for a variety of reasons, the individual exposures may be substantially higher. Apart from accidental releases, there are factors in every system that concentrate as well as dissipate particulate radioactives. In Pennsylvania, this occurred with cows eating grass downstream from the release. An average exposure is likely to be misleading because some people may not get any exposure and some may get 10 or 100 times this exposure.

41. Can you make a statement with regard to the health risk from low level radiation in emissions from Waterford Three as it impacts that portion of the population already at risk from pre-existing genetic damage as evidenced by "indicator diseases"?

Answer. For persons with pre-existing genetic damage as evidenced by "indicator diseases", etc., the risks of leukemia may be much more than doubled. In our studies of childhood leukemia (Bross, I.D.J. and Natarajan, N.: Genetic Damage from Diagnostic Radiation. JAMA, Vol. 237, pp. 2399-2401, May 30, 1977), the risks of leukemia in the children where indicator diseases are reported were increased by factors of 10 or more.

42. Can you make a statement with regard to the doubling dose which would affect this population with pre-existing genetic damage (due to chemical carcinogens in the Louisiana environment)?

Answer. Since the persons with pre-existing genetic damage cannot be accurately identified, it is not possible to make a quantitative state

ment about risks in this group. However, a doubling dose such as 5 rem involves averaging of risks over a population including these persons. Therefore, the doubling doses of these persons would, if anything, be substantially lower than 5 rem.

43. What are the stages or steps in the oncological process?

Answer. We now know with reasonable certainty the general steps and stages in the cancer process, although there are many details (e.g., of the time frame) which still have to be filled in. The first two steps in the process are initiation and promotion. The initiation of the cancer process occurs when the break-point is put into the DNA of human genetic material by a radiological or chemical process. This step is strictly one of physical science--physics and chemistry. However, nothing occurs clinically unless the second step, promotion, also takes place. It is during this step that the misinformation which is fixed in the genetic material, probably by misrepair of the lesion, is reproduced billions of times by cloning by the damaged cell. This is a biological process rather than a physical process.

During this phase, the cells are under surveillance of the host defense system and their growth may be slowed or even aborted. While long-term effects on the host defense system are probably genetic, chemicals and radiation can also produce immediate effects on the system. Both chemical and radiological insult is used, for instance, to knock out the host defense system of animals so that transplanted human cancer cells can be used in animal studies. After about 32 doubling times, the cone of damaged cells may be large enough to be clinically detected or to cause symptoms. The later steps in the cancer process include growth of the

primary tumor, local dissemination to the lymph nodes, generalized metastases, and usually the death of the patient.

44. What roles do radiation and chemical agents play in the oncological process?

Answer. As noted in the previous question, radiation and chemical agents can initiate the oncological process by causing genetic damage. They can also have direct effects on the host defense system which may promote cancer.

45. Are there any other mechanisms in which chemical agents and radiation work together?

Answer. Animal studies (where the terms "initiation" and "promotion" have a related but more specialized meaning) distinguish "complete" carcinogens from other carcinogens. A "complete" carcinogen can both initiate and promote whereas other carcinogens may do one or the other but not both. Radiation is a complete carcinogen and so is tobacco tar. However, radiation can also act together with a chemical initiator or a chemical promotor.

46. Is the damage from low-level radiation aggravated by excessive levels of chemical carcinogens?

Answer. As explained in the previous question, chemical carcinogens can work jointly with radiation effects to produce the combination of initiation and promotion that is needed for the clinical manifestation of cancer.

47. Can you cite any incidence of populations which have been exposed to risk factors (industrial chemical carcinogens and nuclear power plant emissions) similar to those which exist in south Louisiana with the

operation of Waterford Three? What has been the result as far as you know?

Answer. Two examples of populations exposed to risk factors, the Soviet river populations and the residents of Love Canal, have already been mentioned and the adverse health effects have been noted. Because the Niagara Falls Area has both chemical and radiological dumpsites, the high technogenic cancer rates in this area might possibly reflect some synergistic action, but this is speculative. What is not speculative is that Niagara Falls is in the upper decile of U.S. counties for the technological cancers such as lung, bladder, and esophagus. My testimony of December 10, 1981 ("Why the Assurances that the Water is 'Safe' Have No Scientific Validity") to the New York State Assembly Committee on Environmental Conservation dealt in more detail with these risks.

48. Does synergism exist or operate at low levels of exposure?

Answer. Synergism operates at low levels of exposure (and possibly more efficiently at these levels).

49. What happens to a piece of DNA that has been broken? Is the result a lasting one?

Answer. There is a repair process for break-points in DNA. However, animal studies suggest that it is not a very accurate one. Probably it is a misrepair of the break-point that puts permanent misinformation into the DNA.

50. Do you know of any biostatistical models which relate risk from existing genetic damage in a population to additional risk from radiation in the one rad range, with reference to first and second generation exposure in the same population?

Answer. An example of this is given in Questions 35, 36, and 37.

51. What is your assessment for the health risk to South Louisiana's population of the introduction of additional radiation in the one rad range resulting from plant operations at the Waterford Three nuclear generating facility?

Answer. As indicated by the previous answers, it is not possible to give a very precise quantitative assessment of the health risks to Southern Louisiana populations from the additional radiation in the 1-rad range produced by plant operations at Waterford Three. However, as is also suggested by preceding questions there is sufficient scientific knowledge about the cancer process, genetic damage, radiation risks, chemical hazards, and potential interactions of chemical and radiological hazards to make a qualitative assessment. In other words, there is sufficient scientific knowledge and past experience (primarily in the U.S.S.R.) to indicate that the policy of siting nuclear reactors on the lower Mississippi River could pose a major public health hazard to the population of Southern Louisiana.

In my view, this evidence is more than sufficient to establish a very strong prima facie case that the siting policy would endanger the public health and safety and at this point, I would appeal to the Primacy Principle: With possible technological hazards, the benefits must go to the public and not to the technology. This principle is discussed in my book, SCIENTIFIC STRATEGIES TO SAVE YOUR LIFE (Chapter 3).

In the U. S. (through not in the U.S.S.R.) there are viable alternatives to a policy of siting nuclear plants on a river with a heavy chemical burden already. Since these options exist for us, an application of the Primacy

Principle indicates that it is clearly in the public interest to locate Waterford Three (or its equivalent) elsewhere. Indeed, I would add that the siting policy of putting nuclear plants on U. S. river systems should be reconsidered by NRC and this strategy eliminated. Unless this is done, the disastrous situation in the U.S.S.R., where the infant mortality rate is double that of the U. S. and is rapidly rising, could be the shape of things to come in the U.S.

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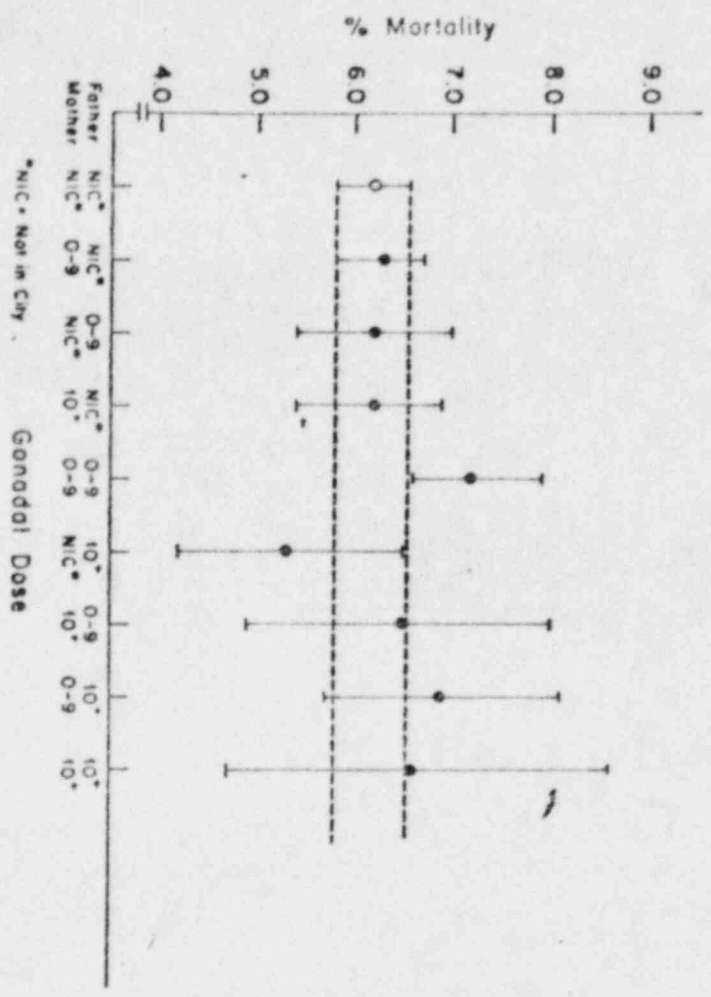
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Confidence Intervals for Infant and Childhood Mortality
by Parents Gonadal Dose



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JUDGE WOLFE: Have you now finished, Mr. Jones, or is there something more?

MR. JONES: Not at this time. I only wanted to point out that at this time we will tender 13 copies of the witness' statement and also three copies of each exhibit to the court reporter for inclusion in the record at this point.

JUDGE WOLFE: All right, fine.

MR. JONES: Parenthetically -- if I may take one brief moment for an aside -- as Your Honor will recall at the end of the day yesterday we had a bit of a procedural problem with respect to the curriculum vitae of Dr. Pandit who was our witness yesterday.

This morning I have tendered three copies to be included as an exhibit. I would at this time move the Board for inclusion of Dr. Pandit's vitae as Joint Intervenors' Exhibit 31.

(The document referred to was marked Joint Intervenors' Exhibit No. 31 for identification.)

- - -

7-1 1 JUDGE WOLFE: As a precedent to that, I take
ge 2 it you are withdrawing your offer of yesterday to have
3 Dr. Pandit's curriculum vitae incorporated into the
4 record as if read; is that correct?

5 MR. JONES: Either way. I had --

6 JUDGE WOLFE: You don't have the necessary
7 number of copies for incorporation into the record, so
8 now you are marking his curriculum vitae as Joint
9 Intervenors' Exhibit 31; is that correct?

10 MR. JONES: That's correct, Your Honor.

11 JUDGE WOLFE: All right. Any objection?

12 MR. TURK: The Staff has none.

13 JUDGE WOLFE: All right. The request is
14 granted and Joint Intervenors' Exhibit 31 is admitted
15 into evidence.

16 MR. JONES: Thank you, Your Honor.

17 (The document referred to,
18 previously marked Joint
19 Intervenors' Exhibit No. 31
20 for identification, was
21 received in evidence.)

22 MR. JONES: I have nothing further at this
23 time.

24 JUDGE WOLFE: All right. Cross, Mr. Blake?

25 //

CROSS-EXAMINATION

7-2 1
2 BY MR. BLAKE:

3 Q Dr. Bross, have you ever visited the Waterford
4 3 plant?

5 A No, I have not.

6 Q Have you read the FSAR related to Waterford 3?
7 Do you know what FSAR stands for?

8 A Can I answer generally on this? I received a
9 big stack of paper. I glanced through this stack of
10 paper, if that's what you call reading.

11 I did not make any effort to internalize the
12 stack of paper, because in my view this material has no
13 scientific or statistical value from the public health
14 standpoint.

15 It does not say anything, in my view, about
16 what will happen to the people in Louisiana if the plant
17 is built. That's my concern, public health.

18 Q Would you know, Dr. Bross, in the large
19 stack of paper which you have referred to whether or not
20 there were a number of volumes which looked similar to the
21 one that I am holding?

22 A No. It was a stack about so thick.

23 Q I see.

24 A But it was different. It was loose-leaf
25 paper. It was not bound.

7-3 1 MR. BLAKE: The record should reflect that
2 what it is I am holding is a copy of Volume V of Louisiana
3 Power & Light's Final Safety Analysis Report.

4 BY MR. BLAKE:

5 Q Having shown you that document, is it fair
6 to say now that you have not read or reviewed the Final
7 Safety Analysis Report for the Waterford plant, which is
8 comprised of a set of books that look like that?

9 A Yes.

10 Q Have you read the Applicant's Environmental
11 Report?

12 A Again, as I told you, my view of all this
13 material is that it is irrelevant, immaterial and
14 incompetent to public health at this hearing; and,
15 therefore, I did not make any attempt to internalize
16 these documents.

17 Q Dr. Bross, I may well ask you about your
18 opinion as to the materiality, relevance and worth of
19 certain documents.

20 At the moment all I'm asking you is whether
21 or not you have read certain documents?

22 A Well, I told you I just --

23 Q Have you read --

24 A I glanced through the documents. I'm not
25 sure which documents I glanced through because of my

7-4 1 position.

2 I'm not sure which exact documents I glanced
3 through, but if you were counting that as reading, I'm
4 not sure exactly what you mean by reading. If you mean
5 leafing through, looking at these things, some of them I
6 have looked through.

7 In that sense, I have not read in detail any
8 documents.

9 Q You have not read in detail any documents?

10 A That's right.

11 Q You mean any documents relating to the
12 operation of Waterford 3?

13 A Any of the testimony from the utility
14 witnesses. I have read through them, I glanced through
15 them, but as far as I'm concerned, this testimony does not
16 bear on what interests me, which is public health.

17 Q Dr. Bross, have you read a document that
18 looks like the one that I am holding, which is the Staff's
19 Final Environmental Statement related to the operation of
20 Waterford Steam Electric Station, Unit No. 3?

21 A Well, my answer to that question is the same
22 as the others. I believe I thumbed through it, but only
23 in that sense.

24 Q You believe that you have thumbed through
25 this one?

7-5

1 A Right.

2 Q But you never thumbed through the FSAR or
3 the Environmental Report?

4 A If it was a big thick series of volumes, I
5 have not received that.

6 As I mentioned, I got about a dozen -- I
7 don't know the exact number, but a fairly large number --
8 of loose-leaf materials, which I thumbed through.

9 Q I see. Is this what you would refer to as
10 a loose-leaf document?

11 A I think it was photocopy or something like
12 that. As I say, I can't testify on individual documents,
13 whether I have even leafed through them; but in view of
14 my position, which is that I wouldn't spend the time to
15 read them in detail under any circumstances, this is --
16 you know, we could continue this line of questioning, but
17 my answer to every question would be the same.

18 Q That is that while you may have leafed through
19 a photocopy version, although you are not sure of this
20 document, you wouldn't be familiar with it?

21 A No.

22 Q Are you familiar with 10 CFR Part 50, Appendix
23 I?

24 A Well, I have to give you the same answer.

25 Q You'd have to give me the same answer?

7-6

1 A Yes.

2 Q That is that you are not familiar it. You
3 may have leafed through it, if it was sent to you, but in
4 any event it has no bearing on public health and safety?

5 A Right.

6 Q Would you give me the same response to
7 40 CFR Part 190?

8 A Yes, if it's in the same set of documents.
9 I assume you're not going to be bringing in something
10 completely different from what we're talking about.

11 These are all documents, as it were, in the
12 utility witnesses and the Staff witnesses, is that correct,
13 that you're referring to?

14 When you give numbers, I don't know what
15 these numbers really represent.

16 Q You don't recognize the term 10 CFR Part
17 50, Appendix I?

18 A No.

19 Q It is the Commission's regulations which
20 establish for nuclear powerplants, Dr. Bross, the emissions
21 which are allowable for routine operations.

22 Would you still retain your opinion that
23 that has no bearing on public health and safety?

24 A That's the gist of my testimony.

25 Q That the Commission's regulations have no

7-7 1 bearing --

2 A I'm saying very specifically that compliance
3 is not safety. In other words, I'm concerned with safety.
4 As a public health bureaucrat of the State of New York
5 for many years, my job is protecting the public health and
6 safety.

7 It is not dealing with legal questions like
8 compliance, which is your province.

9 As far as I'm concerned, the evidence that
10 I've introduced clearly shows that compliance is not
11 safety. The two have nothing that is directly relating.

12 One is a legal concept; the other is a
13 scientific concept.

14 I only testify on the scientific aspect.

15 Q Are you familiar with how Appendix I was
16 developed? How the Commission's regulations which govern
17 routine releases from nuclear powerplants?

18 A Do you mean specific numbers or the general
19 approach?

20 Q The general approach to the derivation of
21 that regulation; do you know how that was done?

22
23 A The only thing I can respond on this is
24 that during times that I have testified in Washington and
25 before Congressional committees or study groups set up

7-8 1 by Congress, the question of how the permissible levels
2 of the Nuclear Regulatory Commission and other regulatory
3 agencies has come up.

4 In the course of those hearings the information
5 that I received in my efforts to present, as it were, the
6 health aspects of how you would organize a level that would
7 be as permissible were generally regarded as not pertinent,
8 because I was told the levels were set on different bases
9 altogether.

10 So I do not believe, from what I have had as
11 personal experience, that actual health facts and figures
12 have had very much to do with regulations that in the
13 first place reflect the numbers which were set and have
14 been unchanged for 20 years or thereabouts, such as
15 the five-rem level, and which were set at a time when
16 there really was very little scientific evidence.

17 Q Do you know to what level Appendix I would
18 hold nuclear powerplant releases of a plant like Waterford
19 3?

20 A You are asking me questions about compliance.
21 I have the general feeling that the figures are about five
22 rems for the workers with complicated exceptions, and
23 five hundred rems for the public, with again some
24 complicated exceptions, and then some special circumstances
25 dealing with dosages that are legally allowed under certain

7-9 1 circumstances to the general public remote from the plant.

2 I have made no effort to memorize these
3 figures, because I regard them as essentially irrelevant
4 and immaterial and incompetent if we're dealing with the
5 public health and safety, which is what I'm testifying on,
6 and only that.

7 Q So it would be your understanding of the
8 regulations that with respect to the off-site population
9 that the plant's releases would be generally limited to
10 something in the neighborhood of 500 millirem, unless --

11 A Well, there are special circumstances where,
12 for instance, I think it was in your testimony you mentioned
13 this, that the figures that you objected to in the questions
14 were EPA figures, which you have referenced, which of
15 course are substantially lower than 500 millirem.

16 But as I say, there are variants that reduce
17 the number to lower levels in that sense, if that's what
18 you're referring to?

19 Is that what you wanted?

20 Q Your understanding would be that the NRC would
21 generally limit it to 500 millirem, but based on the
22 argument that you heard this morning, that EPA might have
23 lower numbers?

24 A Well, the NRC may also have lower numbers
25 under special conditions for compliance of plants. I mean,

7-10
1 there are a series of regulations which I do not pretend
2 to be an expert on, which I don't regard as having any
3 relevance to the public health and safety.

4 Now, I realize this is not an opinion which
5 will be shared by everyone, and particularly by the
6 Administrative Judges, but my purpose here today is
7 basically to say we should stop this nonsense. We should
8 stop dealing with compliance, when this compliance is not
9 protecting the public health and safety.

10 You are asking me questions exclusively on
11 compliance, and not on safety.

12 Q Are you aware of what the expected releases
13 will be from Waterford 3, setting aside compliance for
14 the moment?

15 A You mean, have I glanced through the
16 materials that were sent to me and see what the estimates
17 of releases by the utility witnesses or the NRC Staff
18 were? Is that the question?

19 Q Well, first of all, I don't know what
20 documents were sent to you, Dr. Bross, so I can't frame
21 my questions based on the documents which were sent to you.

22 I have to ask the questions as I best
23 can.

24 A Right.

25 Q And I want to ask you again, are you aware

7-11

1 of what the estimates are of releases from the Waterford
2 3 plant?

3 A. In the sense of leafing through them, yes; in
4 the sense of remembering them, no.

5 - - -

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BY MR. BLAKE:

Q Do you have your own opinions or judgments about what the releases will be from this plant?

A I don't testify as an expert witness on radiation releases from nuclear plants, the calculations of these quantities. If you had the impression that I was going to give you an alternative estimate of these quantities, that was not my intention.

I have very little credence -- and I believe the estimates that are calculated by -- all of the estimates that I've seen, using standard methods which have been used for a long time in many of these hearings, I have no belief that these figures have any value from a public health standpoint.

So as far as I'm concerned, this is a lot of Mickey Mouse arithmetic. And I have no use in the area of public health for calculations which mislead the public on what the actual hazards are.

As far as I'm concerned, these estimates do precisely that.

Q Using your term, "Mickey Mouse arithmetic," let me refer you to a couple of portions of your own sworn testimony at this point -- and specifically your answer to Question No. 51.

Can you read for us your first sentence in that

1 answer?

2 A "As indicated by previous answers, it is not
3 possible to give a very precise quantitative assessment of
4 the health risks to Southern Louisiana populations from
5 the additional risk" -- and the part that's struck I won't
6 read -- "produced by the plant operations at Waterford 3."

7 Q Excuse me, Dr. Bross, but no portion of that
8 sentence was stricken from your testimony.

9 A Oh? Well, all right. Then I will clarify
10 this point.

11 The only reason that sentence -- The only
12 reason those words, which I said were stricken --
13 apparently incorrectly -- "in the one-rad range" are
14 there simply as a matter of English, to reference the
15 question that was asked previously.

16 What the question dealt with was what the
17 Administrative Judges have, as far as I'm concerned,
18 done -- which as far as I'm concerned improves all of the
19 questions, which is to remove any intent by me that I'm
20 talking about a specific release estimate made by me.

21 That's not my intention. I'm talking about --
22 if you like -- wherever the releases from the plant would
23 be.

24 Q Do you have any basis for this testimony now
25 admitted under oath in this proceeding for the statement

1 that you have just read? Do you have any basis for this
2 statement in your sworn testimony?

3 A. That it is not possible to give precise
4 quantitative assessments of the health risks? Yes.

5 Q. Continue to read the sentence, please, Dr.
6 Bross, the entire sentence.

7 A. -- "to Southern Louisiana populations from
8 the additional radiation in the one-rad range produced
9 by plant operations by Waterford 3."

10 And let me amplify this point -- make it
11 perfectly clear what I intended.

12 In other words, this is a statement of if the
13 additional radiation is in the one-rad range, this is
14 what we could try to say would happen. I am not mak-
15 ing this as a unconditional statement. Basically it's a
16 conditional statement referring to the previous sentence.
17 It's a matter of English -- that indicates that the --
18 if we're talking about radiation in the one-rad range,
19 which is what I'm talking about here, and this is released,
20 then this is what will happen.

21 That's all the statement means.

22 Q. I see. So a fair reading of that statement
23 is, "As indicated by the previous answers, it is not
24 possible to give a very precise quantitative assessment of
25 the health risk to Southern Louisiana populations, if

8-4
1 additional radiation in the one-rad range produced by
2 plant operations at Waterford 3 results" -- is that a
3 fair --

4 A. No, I would just strike the -- as I said
5 originally, just strike the "one-rad range," which was
6 simply a matter of English to show what I was referring
7 to in my answer, since that was what was said in the
8 question.

9 I'm not saying that there is any particular --
10 I told you that I don't intend, and I can't -- and I
11 don't pretend to have expertise in the calculation of
12 these Mickey Mouse arithmetic figures.

13 Q. Let me refer you to your own testimony in
14 answer to Question No. 40, looking particularly at the top
15 of the second page --

16 A. Uh-huh.

17 Q. -- where that answer carries over, and the
18 sentence.

19 Do you have any support for the statement
20 which you make in your testimony: "It should be noted
21 that while 25 - 75 millirem may be an average under
22 normal operating conditions, for a variety of reasons,
23 the individual exposures may be substantially higher"?

24 A. All right. Let me explain that precisely.
25 As far as I --

8-5
1 Q Would you start, please, by explaining the
2 basis for the 25 - 75 millirem figure?

3 A Exactly. That's what I intend to do.

4 We -- As far as I have been informed, and
5 in the answer to this question -- understanding that this
6 is a level which is a compliance level -- in the previous
7 questions, I believe, that has been set, and that it
8 refers to an average exposure -- that compliance levels
9 set average exposures.

10 And so under the -- if you prefer, you could
11 add, "It should be noted," and then this statement is
12 essentially conditional.

13 It's -- What I really want to say is simply
14 that if you deal with an average figure on exposures, that
15 individual exposures may be very different from average
16 exposures.

17 And, of course, in all of the -- what I have
18 referred to and which seems to bother you a little -- Mickey
19 Mouse arithmetic -- on these numbers like this, the numbers
20 tend to be average numbers.

21 And so when somebody says that there is a
22 level of such-and-such, that means only that that's some
23 sort of hypothetical average figure that has been cal-
24 culated.

25 And from a public health standpoint, what

8-6 1 affects human health and safety is exposure to actual radia-
2 tion. And maybe most of the persons are exposed to no
3 radiation. Someone gets a very high dose. That's what
4 affects them, not the average.

5 And that's the point I'm making there.

6 Q Is it your understanding, or is your testimony
7 here based on your understanding that the average exposure
8 to off-site individuals -- not on-site, off-site
9 individuals -- will be in the range of 25 - 75 millirem?
10 That's what you --

11 A You mean from the actual plant? Is that
12 what you're --

13 Q Yes, sir.

14 A -- referring to?

15 Q Yes, sir, from the plant.

16 A I'm not making any statement about what the
17 exposures will be from the actual plant. I'm not giving
18 an estimate of what the actual exposures are. That was
19 not my intention.

20 Q Not actual, average, I asked you. Is it
21 your understanding that the average exposures would be
22 in the neighborhood of 25 - 75 millirem?

23 A You're -- In what sense are you asking the
24 question? I've said I don't give you an estimate of what
25 averages or any other exposures are from the plant.

1 I'm saying that this is simply saying that --
2 All the question really has -- if you can strike these
3 numbers entirely -- it's simply saying that when you deal
4 with average numbers, these are from a public health stand-
5 point not particularly meaningful.

6 And that the numbers may vary from a tenth or
7 a hundredth of the average to a hundred times the
8 average. And so averages -- What I'm saying is averages
9 are not of much value to protect public health and
10 safety -- average numbers, average compliance numbers.

11 Does that make it clear?

12 I am not at any point in my testimony esti-
13 mating what the releases are, or will be, from Waterford
14 3.

15 Q I'm trying to understand, Dr. Bross -- I
16 think I now understand that you don't know what the average
17 releases are going to be, and you certainly haven't at-
18 tempted to estimate them.

19 A Yes. I think I've said that several times.

20 Q Now, I'm trying to understand what it is which
21 underlies your testimony. Is your testimony independent
22 of whatever the releases are?

23 A No, it is certainly not. What I'm saying
24 is that the Mickey Mouse numbers on releases, which are
25 in the utility testimony, are not estimates that are

8-8
1 reliable from a public health standpoint. Whatever these
2 estimates are -- I don't know what they are.

3 They're almost certainly going to be sub-
4 stantially in excess of these numbers. But what they are,
5 I don't know.

6 The numbers are simply not reliable. This is
7 not a reliable way to estimate what's going to happen.

8 Look, you're talking about hypothetical
9 questions. This whole thing has been a hypothetical
10 question.

11 The numbers that you're calculating are com-
12 pletely hypothetical. The plant is not built. You don't
13 have operating experience, particularly in this level of
14 plants, on which to base precise estimates of what the
15 long-term effects will be. There's a short or are on short-
16 term experience with these plants.

17 The actual numbers, therefore, for actual
18 radiation releases, when they are measured, can be very
19 substantially above what you have said. And, in fact, if
20 you got to the next sentence on this point, I could give
21 you a general answer rather than a specific answer as to
22 what all of this means, because the State of
23 Pennsylvania held a hearing on Shipping Port -- Mr. Clean.

24 And Ernest Sternglass attempted to use the
25 utility figures to disprove the claims of safety. He was

8-9
1 showing, he felt, that there was a connection between the
2 official figures released by the utility and releases.

3 Now, in the course of that hearing, which went
4 on for three days, the counterarguments -- this was my
5 education in dosimetry, which I regard simply as a can of
6 worms -- the utility witnesses and the NRC and EPA all
7 jumped on dose estimates, and said, "Output samples
8 taken -- you know -- are up. We have a sample that's
9 10,000 times higher than the other."

10 But you have when you get estimates -- or
11 if you take one spadeful of dirt -- because what we are
12 talking about is particulates -- there's no measurable
13 radiation, and you go four inches away and take another --
14 a little piece of dirt or brush or whatever, and there's a
15 very high level.

16 This kind of inaccuracy underlies all the
17 utility calculations. And I think, therefore, on the
18 basis of my experience at the hearing, I have, as it
19 were, no faith and confidence in these estimates.

20 And as far as I'm concerned, they have no
21 credibility.

22 Now, that's -- If you say, "What is the
23 exact estimate," I don't know that we have any good way of
24 calculating it at the present time.

25 You don't know what this plant is going to

8-10
1 produce. You don't know -- The most important single
2 factor in estimating what the actual -- and that's what, of
3 course, is going to kill people if there's actual re-
4 leases -- will be.

5 The most important single factor has been
6 left out of all of the utility calculations. That factor
7 is management.

8 And with good management you can have a
9 technology operating at levels which are a tenth of the
10 acceptable levels. And with bad management, you can have
11 it operating well over acceptable levels that other
12 people manage.

13 So management is really the critical factor
14 here, which, for instance, is not even involved in any of
15 your calculations.

16 I'm here to talk about the real world, instead
17 of Mickey Mouse.

18 Management is what matters.

19 - - -
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9-1 1 Q Dr. Bross, let me return to a couple of the
ge 2 points that you've made.

3 Have you evaluated any of the actual releases
4 from plants against their estimated calculated projected
5 doses under Appendix I regulations?

6 Have you done that for one plant in this
7 country that operates under Appendix I?

8 A I thought I said and I'll say it again, since
9 you've asked the question: My business is not Mickey Mouse
10 arithmetic.

11 I have not done any of the Mickey Mouse
12 arithmetic you're referring to. Never.

13 Q Are you aware of any actual operating plant
14 which has exceeded Appendix I doses as projected by the
15 plant for compliance prior to the plant's operation?

16 A You are asking me about compliance. I don't
17 know about compliance.

18 Q Are you aware of any plant --

19 A That's not compliance. I don't -- You are
20 asking me do I know of a plant that is not in compliance.

21 My answer is no, I don't keep check on
22 compliance. That's not my business.

23 Q Do you consider yourself an expert in the
24 area of management?

25 A Well, since you've put it that way, let me

9-2 1 answer your question at a little more length.

2 I think it's good that this issue of
3 management comes before NRC, because I think this is what
4 they should really be judging in these matters.

5 There's an area which I have called meta-
6 technology. Metatechnology is the technology for the
7 safe effective and economical use of technology.

8 This is my area of special interest in the
9 biomedical area. I'm the president of a corporation called
10 Biomedical Metatechnology, a big long name but it's a
11 very small corporation.

12 The problems of managing technology have been
13 a special interest of mine for a good many years, but not
14 confined to or exclusively involving radiation technology.

15 However, the area in which I have had the
16 greatest extensive experience in metatechnology actually
17 does involve radiation. It involves the use of mammography
18 for the mass screening of women to detect breast cancers,
19 and mammography is a very good example of a technology which
20 can be used in an intelligent way. It can be managed
21 intelligently and effectively, or it can be used in a
22 mindless way.

23 The mass screening of persons who are symptom
24 free under the age of 50 is an example of mindless ways,
25 and if you would like a specific example of my intervention

9-3 1 in this area, I went to the National Cancer Institute to
2 try to stop this mindless policy.

3 After a good bit of fuss, this policy was
4 finally terminated. The mass reading of women under 50
5 by mammography by the National Cancer Institute and the
6 American Cancer Society was stopped.

7 This is an example of my interest in public
8 health.

9 And also in the area of management, I was
10 involved very early with automobiles, automobile safety,
11 and with tobacco hazards.

12 Again, both of these things are products
13 which can be used intelligently or they can be very
14 dangerously used.

15 Now, nuclear power, in my view, is no
16 different from any of these other things. So it is
17 something, however, which requires-- it is different in
18 this respect. I should correct myself.

19 It requires really exquisite management. It
20 requires a level of management that is beyond most
21 corporate management people.

22 So if you want to take this as an answer as
23 to whether I have worked in this field and been interested
24 in management, the answer is yes.

25 The reason I'm here today is basically

9-4 1 managerial.

2 What I'm saying is that we have a lesson to
3 learn from the mismanagement of nuclear reactors in Soviet
4 Russia, where the siting policy in Soviet Russia has
5 produced disastrous health effects.

6 We can avoid that. We can avoid that here.
7 We can avoid repeating the mistakes of siting policies that
8 were made in the Soviet Union; and the siting policy, of
9 course, is siting nuclear reactors on chemically burdened
10 long river systems.

11 So I'm concerned with this as a policy
12 question. Now, the members of this judgment here have to
13 make a specific decision; but as far as I'm concerned,
14 my hope, if I'm going to accomplish anything today, is
15 that the NRC will take very seriously the whole question of
16 is it sensible policy to site nuclear reactors on long
17 river systems that are undergoing very heavy current
18 chemical burdens.

19 That's the whole point of this hearing as
20 far as I'm concerned, and it's the point of the hearing
21 as far as the question of the synergistic effects, the
22 cumulative effects, and so forth.

23 These are what we are seeing most probably
24 in Soviet Russia, and that's what we'll see here if we
25 burden our long river systems with a lot of nuclear plants

9-5 1 in addition to the chemicals, and that is what I would
2 try to prevent.

3 It's a management question.

4 Q Do you consider yourself an expert in
5 management?

6 A In metatechnology, yes. In fact, I might be
7 the only expert. No, actually, there are three or four.

8 (Laughter.)

9 Q I'm curious about the end of your answer
10 with regard to your interest in this proceeding.

11 If I were to tell you, Dr. Bross, that it is
12 not the purpose of this proceeding to establish policy
13 with regard to siting nuclear powerplants, either in Russia
14 or in this country, would you still see a purpose to your
15 testimony here?

16 A Well, we are dealing here today with a
17 specific case, Waterford 3, which is an example of siting
18 on the lower Mississippi River, which is a very heavily
19 burdened long river system.

20 So it is a specific example of a policy.
21 From a managerial standpoint, if you want to make
22 intelligent decisions, you deal with the decision not for
23 a very specific individual case and then another case and
24 another case and another case, but for general policies.

25 So while this hearing is on a very specific

9-6 1 case, as I would see it, it would set a precedent for
2 other cases and for the policy. Therefore, I would regard
3 the hearing as certainly pertinent.

4 But as far as the population in the State of
5 Louisiana is concerned, they are endangered not by a
6 general policy, but by a specific plant.

7 Q You've referred to a heavily burdened river.
8 Have you done studies yourself of the Mississippi River
9 in this area?

10 A No. I believe some other testimony will be
11 presented on that, but I'm not testifying on the --

12 Q You are not familiar; you just --

13 A No. I have some experience with the burden
14 in, as you mentioned before, the Niagara Falls situation,
15 but I have not come here to tell you about your burdens.

16 As you well know, as several persons have
17 stated earlier, they felt that they were not given
18 sufficient advance information on my testimony and on my
19 coming even; and, of course, the only reason I'm here is
20 that you have made me come.

21 If my testimony had been simply admitted as
22 testimony, I had no intention of really coming; but since
23 you want cross-examination, that's fine with me.

24 I think that the purpose of an NRC hearing
25 is to bring out in the public domain facts which would

9-7 1 otherwise be suppressed or little known.

2 Of course, as far as I'm concerned, the
3 main mistake that was made in Russia was their sitting
4 policy is exclusively made by the Communist technocrats.
5 There is no public input.

6 Here we have, hopefully, a place where we
7 can have public input. That's where we have a substantial
8 advantage over the Communist system. So we, hopefully,
9 can avoid their mistakes.

10 Q As you may appreciate, Dr. Bross, it wasn't
11 as though I wanted to force you to come here for cross-
12 examination, but it's important, if you can imagine this,
13 for the Judges and for us to meet you personally and see
14 you and hear your answers to questions.

15 A I didn't think it was personal.

16 THE REPORTER: Your Honor, while we have a
17 pause here, would you admonish the witness and Counsel
18 both, please, to not speak while the other one is
19 speaking?

20 JUDGE WOLFE: All right.

21 MR. BLAKE: I stand admonished.

22 THE WITNESS: I stand admonished, too. I'll
23 probably make a mistake, though.

24 BY MR. BLAKE:

25 Q Dr. Bross, I asked you whether or not you

9-8 1 had any specific estimates regarding the releases from the
2 Waterford 3 plant. Am I correct that your answer is no?

3 A. That's correct.

4 Q. And, also, that you are unaware of what the
5 numbers are that are being estimated by others?

6 A. You asked me questions about compliance and
7 I don't know the answer.

8 Q. I'm not talking compliance at this point. I
9 want to know whether or not you have any knowledge about
10 the estimated releases from Waterford 3 which others
11 have estimated?

12 A. No.

13 Q. Now I'll ask you whether or not your testimony
14 is entirely independent of whatever the releases will be
15 from Waterford 3?

16 A. The testimony is certainly not independent
17 of what the releases are from Waterford 3.

18 It is independent of the Mickey Mouse
19 estimates of the utility and the Staff on what these
20 releases are.

21 The real releases, of course, are what are
22 the dangers; and as far as my reference, which was in my
23 earlier testimony, which you are now allowing me to
24 amplify, on the hearing on Shipping Port, the actual
25 exposures or actual releases in the case of the Shipping

9-9 1 Port reactor were very, very, very far above the estimates
2 which had been given.

3 As I said, the plant is called "Mr. Clean,"
4 but again, there is a very great difficulty in actually
5 assessing what these releases are.

6 I don't make my inferences on what the higher
7 levels of -- maybe this will help. I wouldn't draw
8 inferences on what the actual levels of exposures would
9 be directly from the kinds of approaches that you're
10 thinking of, but indirectly from the fact that the methods
11 have been used many times in the past, and they have
12 completely failed.

13 Now, this point, I think, is very important
14 in assessing what credibility we can give to any of the
15 testimony that you've introduced; and that is, we have a
16 situation where there is a certain recognized arithmetic.
17 It's a very standard form. As one of your witnesses has
18 testified, it's internationally standard.

19 The Russians calculate the releases and the
20 hazards by the same Mickey Mouse arithmetic or pretty much
21 the same Mickey Mouse arithmetic we use; and they use the
22 same wrong estimates of hazards and the same wrong estimates
23 of releases.

24 Now, what I'm saying is that in the testimony
25 that I did introduce specifically, I have given for the

9-10 1 nuclear studies -- this is in the testimony, which I believe
2 is this long one. In the back of it is a list of
3 references you can find in this in Appendix 2, a list of
4 medical X-rays and a list of studies involving nuclear
5 exposures, divided into categories nuclear weapons and
6 occupational exposures.

7 You will find listed here 20 studies which
8 have shown positive health effects properly analyzed by bio-
9 statistical methods.

10 These are studies of what actually happened to
11 people who had these exposures, and we know they had
12 excess cancer and other mortality.

13 Now, in virtually all these cases -- I won't
14 say every single one, because I didn't actually check this,
15 but in virtually every single case, and in some cases there
16 are, in fact, half a dozen or more Mickey Mouse calculations
17 made.

18 As for example, at the Big Smokey shock where
19 the Transnuclear Agency, NRC and DOE and everybody and
20 their brothers also made these calculations, in every
21 single case these calculations, these Mickey Mouse
22 calculations showed there was no risk and it would be
23 impossible to detect any risk.

24 Now, that's a theory. That's your Mickey
25 Mouse arithmetic.

9-11 1 In every single case, by studying the actual
2 populations exposed to these long levels, you have a clear
3 evidence of health hazard.

4 Now, you have two alternatives and I'll give
5 you your choice. These are multiplied.

6 You can deal with exposure or you can deal
7 with the health hazard per unit of exposure, or you can
8 deal the product, which is the estimated health hazard.

9 If your Mickey Mouse arithmetic is wrong in
10 every single case, if the Mickey Mouse arithmetic says
11 there is no hazard, that whole series of scientific
12 studies -- and there's so many of them now, 20 of them --
13 you can throw three or four out without hurting the
14 argument -- then something is wrong with your Mickey
15 Mouse arithmetic.

16 Now whether you want to say we don't know how
17 to calculate exposures correctly and we're grossly
18 underestimating the exposure, or you are saying, well, we
19 are grossly underestimating the actual health risks, which
20 are maybe a hundred times greater, according to our
21 calculations (that's an area I have studied), rather than
22 exposures themselves.

23 But something is certainly wrong if these
24 numbers give no indication of hazard when there is a
25 serious hazard.

9-12
J
1 Now, by inference, my inference is I know
2 that they are probably off by a hundred on the health
3 hazards, because I've written this up in a paper and done
4 series of studies.

5 All of the evidence now on low-level exposure
6 shows this.

7 But there's another possibility, namely that
8 the exposure levels are very wrong, and I think the
9 Defense Nuclear Agency's estimates, for example, I don't
10 know what their figures -- I didn't do any estimates on
11 Big Smokey, for instance, but they must be wrong because
12 their estimates when multiplied out this way are completely
13 off.

14 Now, I would be inclined to split the
15 difference and say that both are wrong, and that your
16 estimates are really not doing a thing to protect the
17 public health and safety.

18 They are simply giving negative estimates
19 which reassure the population. Now, if that's your
20 purpose, of course, they are useful.

21 But if you want to protect the public health,
22 which is my business, these are counter-productive.

23 - - -
24
25

10-1
bm

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1 THE WITNESS: By inference, if you like then,
2 to sum it up: The evidence would seem to appear -- while
3 I'm not testifying in the sense that you're speaking of,
4 doing calculations -- but on the basis of this indirect
5 argument, it seems very likely to me that the actual ex-
6 posures are going to be much larger than the Mickey Mouse
7 calculations, and have been consistently.

8 BY MR. BLAKE:

9 Q Is your testimony independent, therefore, of
10 whatever the release numbers are that are estimated by
11 others?

12 A It's independent of your estimates, but I
13 just want to make it clear that it is not independent
14 of the actual releases, of course, which determine what
15 the hazard is.

16 Q Do you know what the actual releases are?

17 A You don't have a plant built. The only
18 numbers --

19 Q Do you know what the --

20 A -- any numbers we have would be hypothetical
21 at this point. Every question involved here is hypo-
22 thetical.

23 You have a set of Mickey Mouse arithmetic
24 numbers, which you think are estimates of hazards. I
25 don't think they're worth a damn.

10-2 1 Excuse me.

2 I don't think they're worth anything, because
3 my business is protecting public health and safety, not
4 getting something settled one way or another as far as
5 the utility is concerned.

6 And I think you're endangering the health --

7 Q Before the --

8 A -- of the public in Louisiana.

9 Q Are you familiar at all with the methodologies
10 which are used for estimating off-site doses from releases
11 from a plant like this? Have you ever done such a cal-
12 culation?

13 A No, no.

14 Q Are you familiar with the techniques which
15 are employed -- the pathway techniques, the chi over Q's
16 which are used? Are you familiar --

17 A I am not testifying as a witness on these
18 types of calculations. I do not claim expertise in this
19 kind of calculation. I wouldn't do this kind of cal-
20 culation.

21 Q Are you familiar --

22 A I don't care what --

23 Q -- with the calculational techniques?

24 A No. I mean, how many times are you going to
25 ask me the same question?

10-3

1 I've told you, I don't use these techniques.
2 I don't believe in them. They're no good.

3 What do you want me to say?

4 Q By and large, Dr. Bross, I'll probably con-
5 tinue to ask you the same question unless I get a
6 responsive answer.

7 Are you a physician, Dr. Bross?

8 A No.

9 Q Have you ever taken a course in anatomy?

10 A No.

11 Q Physiology?

12 A No.

13 Q Biochemistry?

14 A No.

15 Q Otology?

16 A No.

17 Q Pharmacology?

18 A No.

19 Q Toxicology?

20 A No.

21 Q Public health?

22 A Yes.

23 Q Where?

24 A At Hopkins. I suppose that's really -- I
25 should really put it another way. I gave the course;

10-4
1 it's not exactly taking it.

2 I'm not testifying as a physician, by the
3 way; and I do not claim to be expert in medicine; and I
4 do not treat patients.

5 I would like it very clearly understood that
6 I have an area of expertise; this is what I'm testifying
7 on. I'm not testifying on any areas where I'm not an
8 expert.

9 Q Have you ever done any research yourself;
10 that is, basic research, gathered data yourself?

11 A For 30 years I have been in the area of public
12 health at -- medical research and cancer research,
13 especially for the past 20-odd years.

14 During this time I have done studies which
15 have been published and represent in the bibliography
16 some 300-odd papers. In most of those papers I am an
17 author or there's a couple of co-authors. In a few
18 cases there are multiple co-authors.

19 Except when there is multiple co-authorship,
20 every paper for which my name appears on the title as an
21 author is a paper where I was involved in directing, or
22 in some cases in actually participating in the research.

23 Q Let me ask you the question again: Have you
24 ever gathered any data yourself to do this research which
25 you referred to?

10-5

1 A I thought I answered the question. I'm a
2 statistician. My business is dealing with data. That's
3 what I'm in business for.

4 When persons work with me as co-authors --
5 in some cases they may produce the data, so every single
6 case of the 300 is not cases where I've done the data.

7 But, for example, if you would like a
8 specific, in 1959 when I went to Roswell Park to become
9 Director of Biostatistics, I became involved at that
10 time in what is called the Tri-State Survey. I was
11 directly involved as a statistician in that study.

12 Now, in all these large studies, it is my
13 responsibility to manage the study, if the management of
14 the study data is collection of data, which is what I
15 would certainly regard it as, then I've been directly
16 involved with the operations of collecting the data, doing
17 quality control of the data, data processing of the
18 material, doing the statistical tabulations, doing the
19 statistical analyses, preparations of reports -- in other
20 words, all phases of the study.

21 Q Have you yourself ever done any research to
22 generate that data, or to actually gather it; or have you,
23 in fact, merely analyzed the data gathered by others?

24 A In the Tri-State Survey -- as an interview
25 survey -- in the responsibilities of the persons managing

10-6
1 the study of this type, as an epidemiologist, which is what
2 I was -- and biostatistician, involves drawing up a
3 question schedule and being involved in the plans for
4 the administration of the question schedule.

5 If what you're referring to is did I go out
6 and carry out a couple of thousand interviews for that
7 survey, no, that was done by field interviewers. On
8 occasion I have worked on -- let's say, insofar as dealing
9 directly with data as a participant in obtaining the
10 question schedule, this would be only involved in things
11 like pilot studies, or in testing questions out.

12 Q Would you agree, Dr. Bross, that the first
13 Tri-State data report was issued in 1966 by Graham, Levin,
14 Lilienfield, et al.?

15 A No.

16 Q -- and appeared -- You would not?

17 A No, there are earlier papers. Maybe you're
18 referring to the first one on a particular topic.

19 When the Tri-State study was sent up -- there
20 must be about -- I don't know exactly -- 15 or 20
21 papers that were produced by various participants in the
22 Tri-State Survey, which was involved with Roswell Park's
23 collection of the data.

24 Let me make this clear. When the survey was
25 first set up -- and I went to Roswell Park -- the person

10-7
1 who is the best known epidemiologist in this country --
2 Dr. Abraham Lillienfield -- was actually setting this study
3 up in the areas of the three states.

4 Now, my department is the Department of Bio-
5 statistics. And at that time Dr. Mort Levin, Saxon Graham,
6 as his assistant, were in the Department of Epidemiology.

7 I did not become head of epidemiology at
8 Roswell until sometime in the mid-sixties, like '66 or
9 something.

10 And so my -- I was directly involved in the
11 design of the study, in the planning of the sample, in
12 getting the question schedules up, in all these phases of
13 the study as a statistician and not just as an analyst.

14 That's my business.

15 Q When did the first paper regarding the Tri-
16 State study of which you were a co-author appear?

17 A At which I was a co-author?

18 Q That's correct.

19 One in which you were given some credit.

20 A I think it was around '66 or '67, something
21 like that. It was --

22 Q Would you agree that it might be 1968, and
23 that it is Reference No. 128 in your bibliography?

24 A It could be. I don't remember exactly.

25 The --

10-8

1 Q Some several years after other reports had
2 been issued on the Tri-State Study?

3 A Well, I'll tell you what happened with the
4 Tri-State Survey. It was a rather complex story, but
5 since you're interested: The survey was run, and it was
6 the most expensive thing of its kind.

7 And it also had a cost overrun problem in those
8 days. What actually happened was the data was collected,
9 and the material that was obtained was given some pre-
10 liminary analyses early in the sixties.

11 It was not given a really thorough analysis
12 for the simple reason that they used up all their money.
13 And they didn't have any money for what some people regard
14 as lesser evils, like analysis.

15 So as a matter of fact, the study was not
16 analyzed very intensively at the time when it was actually
17 completed.

18 About that time, Dr. Levin left for Hopkins;
19 and I became acting head of the department. And after
20 that I participated more directly in the statistical
21 analyses of the Tri-State Survey because it was in my own
22 department.

23 Q That is commencing with about 1966 or so,
24 you started to be more actively involved in analyzing the
25 statistics of the Tri-State Survey?

0-1

1 A Yes. The preliminary studies were out of the
2 way, and there were several reports -- mostly demographic
3 reports, because the persons were interested in producing a
4 series of studies which would amply document this entire
5 study, which is one of the classic studies in American
6 epidemiology.

7 So that while I was involved at the very be-
8 ginning -- and participating through the other period -- I
9 didn't get too much involved in writing up the reports
10 until I became head of epidemiology and it became my
11 responsibility directly.

12 Q So your testimony is that you had some involve-
13 ment from the beginnings in the Tri-State Study, but had no
14 involvement in the writing up of any of the data until
15 several years after others had published on it?

16 A That's correct.

17 Q Let me ask you a couple of questions about
18 your bibliography. Do you have a copy of that, Dr.
19 Bross?

20 A No, I don't think I do. I was not expecting
21 bibliographic questions, but maybe I'll have a little
22 help from ... Okay.

23 Q Dr. Bross, you refer to this bibliography in
24 your testimony. And my recollection is the statement is
25 that you've published more than 300 articles; is that

10-10

1 correct?

2 A Yes.

3 Q Is it typical for biostatisticians to list
4 in their bibliography and to cite as articles which they
5 have written letters to the editor?

6 A That question requires a little longer
7 answer. The answer is --

8 Q Could you give me the short answer --

9 A The answer is yes and no, because of this
10 reason. In many cases a letter to the editor actually re-
11 presents a paper. And the paper that I have put in the
12 record is exactly an example of that.

13 It is written in the form of a letter to the
14 editor. And a good many of my publications are written in
15 this form.

16 The reason for that is very simple from my
17 standpoint. In many cases editors will publish as a
18 letter to the editor material that they might have a
19 hassle with their readership about, if they published it
20 in another way.

21 So it's simply a device in many cases for
22 publishing material without getting the editor into the
23 kind of trouble that sometimes a controversial paper will
24 do.

25 That's not true of every letter I've written

1 to the editor. But, in general, the letters to the editors
2 that I have written -- this is not my opus; this is not
3 my complete list of letters to the editors which would
4 run over, I think, 600, but just a few that I thought were
5 particularly pertinent.

6 Q Including in this bibliography letters to the
7 editors of newspapers, which you would regard in the
8 same way as letters to scientific journals?

9 A In some cases letters to the newspapers have
10 this quality. They are not short letters, I might say --
11 for the most part; and they're listed this way.

12 For instance, I have -- since you raised the
13 point -- written a piece on the accident at Kena --
14 Genet. And this was published in the newspaper -- I
15 don't think it's in the bibliography.

16 But it was a long piece and dealt in some de-
17 tail with the problems of management that were revealed
18 in the failure of this plant.

19 And when I write rather extensive material of
20 this kind, I do include it in my bibliography. Most of
21 my bibliography consists of papers which have appeared in
22 journals which are reasonably reputable.

23 Q Let me focus on your work basically over the
24 last five years.

25 A Okay.

10-12 1 Q Since -- and I'll choose out of your biblio-
2 graphy the '77 article which appeared in JAMA, No. 279
3 in your bibliography.

4 A 279?

5 Q Yes, sir.

6 A "Genetic Damage from Diagnostic Radiation"?

7 Q Yes.

8 A Okay.

9 Q Looking at the articles which are about five
10 years hence, bringing you up to date over the last five
11 years --

12 A Uh-huh.

13 Q By my count there were some 47 publications
14 since then which you've listed?

15 A Are you subtracting the numbers from --

16 Q Sure.

17 A Okay.

18 JUDGE WOLFE: Off the record, please, one
19 moment.

20 (Discussion off the record.)

21 JUDGE WOLFE: Back on the record.

22 - - -

11-1 1 BY MR. BLAKE:

ge 2 Q Of those, some 17 by my count are letters to
3 the editor.

4 A Possibly. I have no specific information on
5 that. I didn't count them.

6 Q Of the remaining 30 items, it appears that
7 only 8 in my view deal with health effects of radiation:
8 Nos. 289, 294, 295, 296, 299, 303, 309 and 323.

9 A Well, I don't know whether you intend for me
10 to go straight through on this. Some of the --

11 Q Well, assume for the moment that my arithmetic
12 is correct here.

13 A I don't want to argue about that kind of thing.

14 Q Fair enough.

15 Of the eight that deal, by my understanding
16 of your bibliography, with health effects of radiation, it
17 appears to me that four of them were presentations to
18 Congress or to the NRC: 294, 295, 296 and 303.

19 A Well --

20 Q Now that we're down to just four, maybe you
21 could check --

22 A 294, I might say what that item is. That
23 is proceedings of a congressional seminar, and the
24 proceedings -- this was a presentation of material. It
25 wasn't just attendance, if that's what you're thinking.

11-2

1 Q No. No, I'm not thinking that.

2 A It was essentially a report on the subject
3 which was published. I mean, it was published in that
4 kind of a journal, in that kind of a volume, for
5 congressional testimony; but it was, you know, not a
6 one-page item or anything like that.

7 Q Well, of these four, including this
8 presentation by way of congressional testimony which was
9 published, were any of those in any sense peer reviewed?

10 That is, is it your impression that by
11 publishing congressional testimony, that that is subject
12 to peer review?

13 A Your raising the question about peer review
14 is very interesting, because --

15 Q Could you answer my question and then --

16 A Right, I'll answer your question very.
17 directly. The gentleman sitting --

18 JUDGE WOLFE: Dr. Bross.

19 THE WITNESS: Yes.

20 JUDGE WOLFE: Please keep your temper.

21 THE WITNESS: Okay. You are right.

22 JUDGE WOLFE: The Counsel is entitled to
23 ask you questions, and answer the questions.

24 THE WITNESS: I appreciate it. I'm sorry. I
25 apologize.

11-3 1 JUDGE WOLFE: All right.

2 THE WITNESS: When he talks about peer
3 review, there is a specific point that is a little
4 sensitive, which is this --

5 BY MR. BLAKE:

6 Q Would you please answer my question?

7 A Right. The peer review process in the
8 journals operates in some journals and in some cases and
9 not in others.

10 The peer review process for persons such as
11 myself who publish reports of radiation hazards is a
12 process which essentially blocks the publication of
13 reports.

14 Now this has happened repeatedly, not just
15 for me, but for a large number of other persons; and as
16 a result, for certain journals where it is automatic for
17 the editor simply to send a copy for peer review to a member
18 of the radiation protection community, which is essentially --
19 do I have to elaborate on what that means?

20 It's a self-styled community which is
21 dedicated to the proposition that low-level radiation is
22 harmless. All right.

23 Now, when an article from myself or others
24 goes to a journal which refers it to one of the members
25 of the radiation protection community, the immediate

11-4 1 result is not just that the article is turned down, it is
2 that the article is deliberately delayed, very often for
3 periods of up to a year.

4 This makes it very difficult, on occasion, to
5 public new findings when they are topical. Therefore,
6 under the circumstances, it is necessary, unfortunately,
7 to take advantage of alternative methods of publishing
8 material.

9 Now, when i have testified on the material
10 today, the "Journal of Investigative Radiology" is a
11 peer review journal, and my article was in fact critiqued
12 in that journal.

13 In "The Health Physics," the material was
14 submitted to the editor, and while it is a letter, it's
15 a long letter and essentially an article, and I think
16 it went through a peer review process of sorts.

17 It may not be formal peer review process
18 exactly, because when it was done in this case -- this
19 is why letters are preferable in some cases -- the article
20 was sent to the persons who wrote the original article
21 that misanalyzed the data, because they had the right to
22 respond to my article.

23 That was the arrangement and that's fine with
24 me. So the actual timing interval on this sort of thing
25 is that, for instance, this paper could get into "Health

11-5 1 Physics," which like "Investigative Radiology" is not
2 exactly a journal which likes to publish reports of
3 hazards, and it was able to do this in a reasonable length
4 of time. It will probably get in sometime this year.

5 If I were to try to go through four or five
6 different journals, such as "Science," which I have done,
7 this peer review process simply blocks publication.

8 Peer review, under ordinary circumstances --
9 my papers -- I didn't publish in -- if you read over the
10 names of the journals in which I have published, they
11 are not journals which are negligible journals; but if
12 I want to get something in reasonably fast, I do write it
13 very often as a letter to the editor so as to go through
14 this process more expeditiously.

15 Q My question was do you regard publishing in
16 the Congressional Record or in proceedings regarding
17 congressional testimony as having undergone peer review?

18 A If that's your question, the answer to that
19 is it is not a reviewed journal, not a reviewed publication.

20 Q Is the answer no?

21 A I guess if I say it's not reviewed, it says
22 it's not peer reviewed, right? This material is not
23 reviewed at all necessarily. Sometimes it gets some
24 review.

25 So what you are trying to do is argue or to

11-6 1 claim or to imply in the usual way that somehow or other
2 the publications don't meet peer review criteria or
3 something like that.

4 Q I'm not claiming anything, Dr. Bross. I'm
5 asking you for your opinion about whether or not your
6 statement, Example 294, involving congressional testimony,
7 is in your view, by way of its publication, been subjected
8 to peer review?

9 A Not peer review per se. There is some
10 review in that process, you know.

11 It's not the kind of peer review that you're
12 thinking of perhaps. There is a review.

13 In other words, the material is submitted,
14 it's revised, it's sent back, and things like that.
15 There is a review process in those kinds of publications,
16 too.

17 Q You mean it's edited?

18 A Yes.

19 Q But that's not anything akin to having a
20 scientific peer review by knowledgeable members of a
21 similar scientific community, is it?

22 A Well, it's exactly the same thing that most
23 of the publications of your witnesses have gone through.

24 In other words, when you have Oak Ridge put
25 out its own private house organ, and all people put these

11-7 1 articles in a house organ for Oak Ridge or the house organs
2 of the radiation protection community, such as the
3 International Atomic Energy Committee, or whatever it's
4 called, and the various committees nominally devoted to
5 radiation protection, with that in the title. I don't
6 get the titles exactly straight, but that's what I'm
7 referring to. They go to the U.S. and international bodies.

8 These things are published. They take all
9 kinds of junk and this is in no more sense peer reviewed
10 than the material I'm talking about.

11 That's in the listings because that's a
12 journal, you know, a sort of quasi-official journal. I
13 don't see any great difference.

14 Q Would you put the other four documents that
15 we've been talking about in the same class?

16 A I don't remember. Which were they?

17 Q Let me refresh your memory. 294 was the one
18 we've just been talking about; 295?

19 A Yes, that's congressional testimony.

20 Q 296?

21 A What was that? That's testimony.

22 Q 303?

23 A Actually, in a way -- well, let me just say
24 something about that testimony.

25 The testimony which was given in 296 was

11-8
1 published in a peer-reviewed journal later.

2 Q What number is that in your bibliography?

3 A "Effects of Radiation," that's Serial No.
4 95179.

5 Q I'm sorry. Where does that same publication
6 appear as published in a peer-reviewed scientific journal
7 elsewhere in your bibliography?

8 A Oh, that's in the -- a good part of that
9 material was in the "American Journal of Public Health,"
10 299, sometime later.

11 JUDGE WOLFE: Mr. Blake, this would be a
12 good time for a recess?

13 MR. BLAKE: Sure.

14 JUDGE WOLFE: All right. We'll recess until
15 2:00 o'clock.

16 (Whereupon, at 12:45 p.m., the hearing was
17 recessed, to reconvene at 2:00 p.m., the same day.)

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AFTERNOON SESSION

2:00 p.m.

JUDGE WOLFE: All right. Mr. Blake.

MR. JONES: Your Honor --

MR. BLAKE: The counsel --

MR. JONES: Go ahead.

MR. BLAKE: I was just going to say that the counsel have conferred with regard to Question 17.

MR. JONES: If it please the Board, Your Honor, I have rephrased the Question 29. I have also, pursuant to that rephrasing, made one editorial deletion. I have discussed this with counsel for Applicant and the NRC Staff.

They concur in both the question and the answer, as editorialized. I have also conferred with Dr. Bross, and subject to the editorial change, he stands prepared at this time to adopt both the question and the responsive answer.

JUDGE WOLFE: Yes, would you read the question slowly, please.

MR. JONES: Surely.

Question 29 should now read: "Can you state the nature of the synergistic risk to the population of Southeast Louisiana which will be caused by the operational releases of the Waterford 3 nuclear facility?"

1 Continuing on the next page --

12-2
2 JUDGE JORDAN: Will you do that again? I
3 couldn't keep up.

4 "Can you state the nature of the synergistic" --

5 MR. JONES: -- "risk" --

6 JUDGE JORDAN: Go ahead.

7 MR. JONES: -- "to the population of South-
8 east Louisiana, which will be caused by the operational
9 releases of the Waterford 3 nuclear facility?"

10 The answer is to be edited to delete -- on
11 the second line, beginning on the righthand side with
12 the parenthesis, "such as those named in the question,"
13 closed parenthesis.

14 So that for the record, the witness' answer
15 should now read in full as follows, and I quote: "In
16 view of the limitations of our current scientific knowledge
17 on the synergistic effects between specific chemicals
18 and low-level ionizing radiation, I don't think it is
19 possible to give any precise quantitative predictions of
20 specific risks in the exposed population. It is,
21 however, possible to make a rough qualitative assessment
22 by extrapolating from the experience in the U.S.S.R.,
23 where there are conditions similar to those that would
24 exist with the operation of Waterford Three."

25 JUDGE WOLFE: All right. In light of

12-3
1 conference between counsel and without objection, the
2 rephrased Question 29 in the Bross testimony and the
3 amended answer will be incorporated into the record as
4 if read, as part of Dr. Bross' testimony.

5 All right, Mr. Jones?

6 MR. JONES: Yes, that's correct.

7 JUDGE WOLFE: All right. Mr. Blake, back to
8 your cross.

9 BY MR. BLAKE:

10 Q Dr. Bross, when we broke for lunch, we were
11 working our way through the last five years or so of the
12 documents which you had identified in your bibliography.
13 We had decided -- determined that there were 47, that of
14 those some 17 were letters to the editor.

15 That of the remaining 30, eight or so dealt
16 with -- well, actually eight dealt with health effects of
17 radiation. And of those eight, four were presentations
18 to the Congress or the NRC.

19 And our last questions had focused on 294,
20 295, 296 and 303 and peer review which those documents go,
21 if any.

22 Is that a fair summary?

23 A Well, you're taking the set of -- It was
24 294, 295, 296 and --

25 Q 303 was the other one.

12-4 1 A Well, you skipped 299. But the -- which was
2 a peer review paper. And the items that you have here
3 are, in fact, testimonies -- it's true -- testimonies
4 before Congress which are not peer reviewed by Congress.

5 I think if any extenuating comment is re-
6 quired in this case, I believe that transmission of informa-
7 tion to the Congress of the United States, so that the
8 latest and most reliable information on radiation hazards
9 can be used by Congress for the formulation of policy on
10 various problems of this kind is something which as a public
11 health scientist, I feel it is my responsibility to carry
12 out.

13 And since these are Congressional hearings,
14 I believe that they are sufficiently important to include
15 in bibliographic -- in a set of bibliographic references,
16 which is essentially a list of items that are available in
17 one way or another in print.

18 Q Is it -- Does that alter your testimony,
19 your statement that you've just made as to whether or not
20 294, 295, 296 and 303 were subject to peer review?

21 A No. I believe I have made it clear --

22 Q They were not --

23 A -- that this is testimony that is not
24 peer reviewed. But it is published, and it should be
25 included in the bibliography.

12-5 1 Q Then let me pick up: Of the remaining four
2 items which we've narrowed it down to, 325 -- that, I
3 understand, is still not published?

4 A I believe that 325 is the material which I
5 previously had indicated is a photocopy of the galley
6 for an article which is slated for publication this
7 month.

8 Now, I'm not really avoiding your question,
9 but I would have to say in the interest of accuracy, that
10 sometimes scientific journals do not appear exactly on
11 their publication dates.

12 So I have not seen a copy of this specific
13 journal. It will be out sometime -- well, it's probably
14 out, but I don't know for a fact that it's out.

15 And this was a peer reviewed item.

16 Q You say that Item No. 325 has undergone
17 peer review prior to publication?

18 A Yes.

19 Q Who conducted the peer review, not by name,
20 but this was a peer review done by Yale Journal of Biology
21 and Medicine?

22 A Well, I can't remember the name of the
23 editor. I have in my files extensive correspondence. This
24 is, in fact, an example of an article which was extensively
25 peer reviewed and, in fact, approved by the peer review in

12-6 1 this case because it was done by the editor and editorial
2 staff and others.

3 And in this case -- I might just add on this
4 point -- that the items that I added to this list -- that
5 is, Appendix 2, where I have listed all of the positive
6 studies that I am aware of involving low-level radiation
7 hazards in populations actually exposed to low-level
8 radiation, that this list was added after I submitted my
9 original paper, because in one sentence I had said that
10 there are this very large number of publications that have
11 found these results.

12 And the editor asked me if I would mind list-
13 ing them. So I did.

14 So that certainly counts as peer review. And
15 rather constructive peer review.

16 Q It is your testimony that the document
17 identified as No. 325 in your bibliography has undergone
18 peer review, and is about to be published or may have been
19 by now?

20 A Yes.

21 Q And that that peer review was done under the
22 auspices of the Yale Journal of Biology and Medicine?

23 A Yes.

24 Q Is this the same article, when it appears in
25 print, that you presented at a Yale symposium?

12-7 ✓

1 A Well, subject to the changes that were in-
2 volved, which were fairly extensive in the peer review
3 process -- that is to say, when it was presented, it was
4 an oral presentation.

5 Q Uh-huh.

6 A There's quite a substantial difference
7 between what is acceptable as an oral presentation and
8 what is appropriate for the Yale Journal as a written
9 document.

10 So the two have a lot in common, but there
11 are things that are added and a few things that are re-
12 moved from the other material. Mostly additions.

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13-1 1 Q And it is your testimony that Item No. 299
ge 2 was subjected to peer review before publication?

3 A Item 299 had a varied characteristic from
4 peer review, and let me just elaborate slightly on that
5 because I believe it is pertinent to the review process
6 in journals that I referred to earlier.

7 When this article was submitted to the
8 editor, he said that he would consider it if I would
9 allow a critique by members of the radiation protection
10 community of the article.

11 I said, "That's fine with me if you will
12 allow me an opportunity to respond to the critique in the
13 same issue."

14 This is a kind of peer review process. It's
15 not the standard peer review.

16 In other words, the editor had named to me
17 the reviewers, which is not customary. They were Vicey
18 and Land.

19 Under the circumstances, I agreed to this
20 arrangement. The arrangement was not carried out to the
21 letter.

22 They published my article and they published
23 the critique of the article, but they would not publish
24 my response in that issue.

25 So I was essentially confronted by having no

13-2
1 opportunity to reply.

2 Q Did you never get an opportunity to respond?

3 A I had asked for something like equal space.
4 The critique of my article was longer than the original
5 article, and I felt that to adequately respond to such a
6 lengthy critique of my article, I should be given something
7 like that space, or half the space, or something like this.

8 The editor said, "No, you can only have so many
9 words," and it was, I felt, impossible to do, and it
10 wouldn't be published in the same issue, either.

11 So I did not regard this as an opportunity to
12 respond.

13 Q Did the editor describe to you why he was
14 taking this position?

15 A Well, I think we had some correspondence on
16 this. You mean, why he dealt with the paper in this
17 way, particular way.

18 It's not uncommon, I might say, for this to
19 be made a prerequisite of publication or a barrier to
20 publication.

21 In almost every case, that an article
22 dealing with health hazards came out in the literature with
23 positive findings, there was an arrangement of some kind for
24 a member of the radiation protection community, defending
25 the radiation-is-harmless doctrine, to respond to that

13-3 1 original article, sometimes in the form of editorials or
2 sometimes in the form of publication of an article.

3 I might say that this is not standard practice
4 of peer review in ordinary science. I do not have this
5 problem in publishing, except in this area and except with
6 members of the radiation protection community.

7 It is a very unusual situation where peer
8 review has been distorted into a process for the suppression
9 instead of the improvement of information, unfortunately.

10 Q Distorted into suppression; is that your
11 opinion about this set of conditions?

12 A Well, it's based on a very large number of
13 specific case examples that I could not cite from memory,
14 but which are in the literature where, among other cases,
15 the studies which were done on the children who were
16 downwind from the Big Smokey and other tests, when that
17 was published there was a counter-article or a critique
18 published along with it.

19 In the case of Mancuso's article there have
20 been -- you know, when he publishes, there has been his
21 kind of co-publication or editorial commentary.

22 In the case of the girl that we're talking
23 about right now, the editor saw fit to intervene with
24 editorial comments which were completely unwarranted.

25 They were printed along with the article, but

13-4 1 that would never be done ordinarily. That's very unusual.

2 Q The two remaining documents that we haven't
3 talked about which, at least from my review, appear to
4 involve health effects, are 289 and 309.

5 Were those two documents subjected to typical
6 peer review prior to their publication?

7 A The "Journal of Medicine" is a reviewed
8 journal.

9 Q And this report was in fact reviewed?

10 A Yes.

11 Q And 309?

12 A That's "Investigative Radiology" --

13 Q Yes.

14 A -- which is a peer-reviewed journal, and
15 a journal that would certainly not allow reporting of any data
16 that would not strongly support the conclusions if the
17 conclusions are that there are serious hazards.

18 In fact, the conclusions in this particular
19 article are, in a sense, the first report of primal
20 synergism.

21 The article was reviewed and in this case
22 there was a critique to the article published along with
23 it.

24 This particular critique, which did not happen
25 to be by a member of the radiation protection community,

13-5 1 but by an honest scientist, was in fact quite flattering
2 and not the kind of critique I generally get.

3 Q. What discipline was the honest scientist that
4 you've referred to?

5 A. Pardon?

6 Q. What was his discipline?

7 A. He was a statistician.

8 You know, peer review, since you've raised
9 the question of discipline, in theory would mean that my
10 papers would not be reviewed by persons such as
11 Leonard Hamilton, but by a person who is my peer, an
12 epidemiologist and biostatistician.

13 Now, I'm a Fellow of the American Statistical
14 Association. I'm a Fellow of the American College of
15 Epidemiology.

16 If the review of my work were by my peers, it
17 would be by Fellows of the American Statistical Association
18 or the American College of Epidemiology, or persons of
19 corresponding rank and stature in these areas.

20 The critiques that have been made of my work
21 have not been made by persons with these characteristics.

22 Q. Has Dr. Land ever critiqued any of your work?

23 A. Yes. I mentioned him.

24 Q. Well, would you say that he is not a person
25 of equal stature, that is in the epidemiology or

13-6 1 biostatistic area?

2 A I would say it very strongly.

3 Q You would say he is not?

4 A I would say he is not.

5 Q You would say he does not have education in
6 those areas?

7 A I would say that Dr. Land has been involved
8 with the studies of high-level radiation that were
9 involving the Japanese A-bomb studies, on the actual
10 individuals exposed to the A-bombs. He has done a long
11 series of studies in this area.

12 They are not particularly good studies. In
13 fact, they are seriously defective. However, they came out
14 with the right answer from the standpoint of the radiation
15 protection community, which was that the levels were very
16 low, and these are the quantities that are used in the
17 BEIR Report.

18 Now, Land has never, to my knowledge, done
19 a study comparable to the ones I'm citing in which you
20 look at populations of human beings that are actually
21 exposed to low-level radiation.

22 Now, if you want to find out what happens to
23 people who are exposed to low-level radiation, you look
24 at the people who are exposed.

25 Now, you don't look at people who get a

13-7 1 hundred or a thousand times that dose and then try to guess
2 what it might be at low levels.

3 As far as I'm concerned, Land has not made
4 a serious contribution or a lasting contribution. He has
5 supplied the kind of information which is used in the
6 official radiological protection journals and things of
7 that sort; but I don't regard him as a peer.

8 Q Do you regard Dr. Rothman of the Harvard
9 School of Public Health?

10 A Rothman is more of a peer.

11 Q What about Dr. Oppenheim, Indiana University;
12 do you recognize that name? Oppenheim?

13 A I'm very bad on names. I don't remember that
14 name. You know, I have vague recollections of
15 Oppenheimer, but I don't think that's the same person.

16 I should think that you would want to ask your
17 witnesses to state where they are Fellows of the American
18 Statistical Association or of the American College of
19 Epidemiology in order to show that they are peers of mine.

20 Q How about Sir Richard Dowl; do you recognize
21 that name?

22 A Yes.

23 Q Would you say he's a peer of yours?

24 A That's a very interesting question. At
25 one time, yes, though not lately.

13-8 1 Actually, Dowl and Hill were a team.
2 Bradford Hill was the statistician and Dowl was a
3 physician, and they were an effective team in the smoking/
4 lung cancer area where I was working with Ernie Winder and
5 Mort Levin many years ago.

6 At that time I felt, certainly, he was a
7 peer of mine; but actually, the brains of that team was
8 the statistician.

9 Q Is that generally your view of all of these
10 studies?

11 A No. It just happens that Bradford Hill
12 is a really sharp person and he wrote the best textbook
13 in elementary statistics for many, many years.

14 So no, I don't believe that all statisticians
15 are better than anybody else, and I don't believe that
16 all epidemiologists are better than anybody else, and I
17 don't believe that my specialty is better than anybody
18 else's specialty.

19 I simply believe it's more relevant to the
20 subject of this hearing.

21 Q What about Malcom Pike?

22 A Pike is a --

23 Q Do you recognize that name?

24 A Yeah.

25 Q Is he an epidemiologist?

13-9 1 A Well, yes. As a matter of fact, he's somewhat
2 structured like Land in a way, but not in this country,
3 I believe.

4 I think there has always been like two or
5 three persons in England or in the United States who are
6 sort of the designated hit men.

7 For a long time, whenever any paper came out,
8 Land critiqued it and, you know, it was a very negative
9 critique.

10 He did Mancuso; he did a number on Najerian;
11 he did a number on me. Everybody who came out with
12 positive results got the benefit of a hatchet job from
13 Dr. Land.

14 Q What do you mean by "positive results"?

15 A I mean results which show that in a group
16 exposed to low-level radiation there was excess disease
17 of one kind or another, deaths or disabilities or excess
18 health hazard.

19 Those are positive. If they find nothing
20 in the evidence, it's negative.

21 I should maybe make a point, for instance,
22 of a letter I wrote to "Health Physics" that illustrates
23 this.

24 The actual evidence there is deaths before
25 age 21 of the children of persons who were exposed to

13-10

1 the A-bomb -- or not city, actually, another group -- at
2 various dose levels.

3 Now, most of the studies I'm talking about
4 make at least some effort to deal with an estimate of some
5 kind or a response to the exposure to some designated
6 levels or low levels of ionizing radiation.

7 In some cases, maybe not accurately measured,
8 but by inference, or one way or another.

9 So these are the kinds of studies I'm talking
10 about which are done by epidemiologists.

11 The other kinds of studies which are
12 traditional in the radiation protection community are not
13 this class of studies at all.

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1 BY MR. BLAKE:

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bm
2 Q Let me ask you, while you term that actual
3 studies of radiation levels, whether or not you have ever
4 conducted a study of actual radiation levels around a
5 nuclear power plant?

6 A No.

7 Q You referred earlier on several occasions
8 to the fact that evaluations, calculations of releases
9 and resultant doses are near arithmetic to you.

10 A Are you asking for a response there?

11 Q -- and --

12 A Do you want me to answer that or what?

13 Q -- in fact, I believe you had characterized
14 them as Mickey Mouse.

15 A All right.

16 Q Mickey Mouse arithmetic. Is that correct?

17 A That's correct.

18 Q Your view is, however, that your statistical
19 work regarding populations, I take it, is not Mickey
20 Mouse arithmetic; is that correct?

21 A That's correct.

22 Q But you have never evaluated the doses sur-
23 rounding any nuclear power plant?

24 A I have not -- You know, I'm not a professional
25 anti-nuke. I don't go chasing around the country, you

1 know, looking for plants to find hazards with or something
2 of that sort.

3 The only time I would deal with radiation
4 doses as dosimetry is indirectly as, for example, in the
5 paper that we were talking about, the Japanese A-bomb
6 exposure data, those are retrospective dosimetry cal-
7 culations of the persons who were in the study.

8 I am taking the numbers directly from the
9 report in "Science" of these persons. These are, pre-
10 sumably, done in a different way, because there's a --
11 you know, hypothetically at least there's a ground
12 zero and a bomb and so forth, and they have distances of
13 the persons from the bomb for their purposes of getting
14 estimates of exposure.

15 The Portsmouth Naval Shipyard, the exposures
16 that are in that study, are again not measured by me,
17 but I am taking them from Admiral Rickover's records of
18 the actual badge doses in most cases -- or in some cases
19 they are other measurements, but badge dose primarily,
20 let's say -- for the nuclear workers exposed at that
21 plant.

22 If I recalculate the data on Big Smoky that
23 is in the -- from the Center for Disease Control study,
24 where they have assessed the dosimetry for the individual
25 in that study of myleoma leukemia, you know, I am again

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1 using the assessments that they are making there.

2 Q You're using the data generated by other
3 people, but you reassess it or relook at it in your
4 statistical --

5 A Well, specifically on the -- yes, on radia-
6 tion, I've --

7 Q That's your general approach in the radiation
8 area --

9 A -- made no claim -- and make no claim -- to
10 being involved with the actual measurement of radiation
11 in the dosimetry sense.

12 Q Have you ever received an award for scholar-
13 ship for work in any of the radiological sciences or in
14 connection with your work -- statistical work related to
15 radiation?

16 A Well, you know, people in the areas who are
17 concerned about nuclear hazards, you know, write me cita-
18 tions and things like that. But I wouldn't count that.

19 Basically, no.

20 Q Have you ever been appointed to any scientific
21 committee or standard-setting body on radiation standards?

22 A Well, you know, of course, that I was on the
23 Portsmouth Naval Shipyard study. I'm not --

24 Q This is the Oversight Committee --

25 A That's the Oversight Committee.

1 Q -- with Dr. Hamilton?

2 A I was one of the three persons who were
3 appointed by Congress -- it was myself, Kazie Morgan
4 who I do respect, a firstrate man, and Tom Ankuso, who
5 decided that he'd never get to do data, and it wasn't
6 really worth sticking around and then come out with a
7 negative study, which, of course, they did.

8 Then the Radiation Protection Community and
9 the Atomic Industrial Forum decided that they had to have
10 equal say. So they added some more members to represent
11 them.

12 I believe you know some of them. And there
13 were also a few who were added, sort of neutrals, to the
14 Committee.

15 In the end it had a much larger number of
16 persons on it. So that's how I got appointed.

17 I was appointed directly as a result of my
18 testimony in 1978 -- February 1978 -- that's mentioned in
19 here in the -- and so were the others, because they had
20 also testified at the hearing.

21 Q This was an NRC hearing --

22 A No, this was a Congressional hearing, which
23 has a -- what is a serial number -- I can't ever remember
24 that serial number.

25 149 -- Oh, here it is. 95-179.

14-5 1 Incidentally -- I don't know whether you're
2 familiar with the volume. That's a big, thick book. It
3 has lots and lots of additional material in it. And just
4 to clarify my previous statement: In addition to the
5 testimony I gave, in cross-examination and so forth, there
6 was allowed entry of materials of a scientific nature.
7 I took advantage of that and essentially put the paper in
8 that way.

9 Q I see. And that wasn't subject to any peer
10 review, I take it?

11 A No, no. That was --

12 Q You were just allowed to put it in --

13 A -- subsequently submitted for peer review
14 and got into the complicated machinery we've talked
15 about.

16 Q Your appearance at the Yale Symposium which
17 led now to this most recent publication --

18 A Uh-huh.

19 Q -- was it a condition of appearing there
20 that your work would be published?

21 A Well, I -- you know, I had kind of hoped that
22 the participants at the Symposium would perhaps have their
23 work published. I mean, it was an incentive for me to go
24 to the Symposium.

25 But I really went because I think they had six

14-6
1 people, and I was the only one presenting a report on
2 positive hazards and figured, you know, they needed a
3 token scientist at that meeting.

4 Q You mean token scientist in that the others
5 at the Yale Symposium were not scientists in your view?

6 A Yes.

7 Q Could you provide me the names of the other
8 five who were at that meeting who, in your mind, are not
9 scientists?

10 A You mean can I name them now, or can I pro-
11 vide you at a later date with a list?

12 Q Well, why don't you start now by just giving
13 me whoever it is that you remember.

14 A Actually Leonard could help me.

15 THE WITNESS: What's his name at Argonne?

16 JUDGE WOLFE: Doctor, from your own recol-
17 lection.

18 THE WITNESS: I'm sorry.

19 You know, I know them pretty well. I'm
20 really bad on names, but -- I can't produce his name.
21 He's very well known. He has witnessed with me several
22 times as a matter of fact at the hearings, and I --
23 I cannot produce his name, I'm sorry to say.

24 You know, I could look up the list and see
25 who was there and who ...

14-7 1 BY MR. BLAKE:

2 Q The other five individuals who appeared with
3 you at the Yale Symposium who you've referred to as non-
4 scientists, you're unable to recall their names?

5 A Well, they're not in my field. One was a
6 guy who was talking about -- it was more or less pro-
7 motional material as far as I was concerned.

8 Most of the persons -- There were --
9 I was the only person, as far as I was concerned, who
10 presented a new scientific study -- new scientific data
11 at that meeting that I heard anyway.

12 I missed a couple -- I think one session or
13 so.

14 The Radiation Protection Community goes
15 around regularly and gives the same talk over and over
16 again at different meetings. I don't do this. I don't
17 like to talk about the same thing twice.

18 So I had prepared new material.

19 Q Were you one of the initial invitees at
20 that Symposium?

21 A No.

22 Q How does it happen that you attended?

23 A Well, again I'm bad on names -- but now I
24 can't even remember names of people who I know pretty
25 well. Goffman, I think, was originally --

1 Q Dr. John Goffman?

2 A I believe, but I can't -- I'm not certain.
3 It was one of these people in this group who was invited
4 and who agreed to go, and then when he saw the line-up of
5 persons, he said, "I won't attend unless you make it
6 even." You know, like three on three or -- but not five
7 on one.

8 So he -- sort of at the last minute said that
9 he didn't want to go. And so he suggested me, and they
10 called me up and said, "Would you please come so we can
11 have some balance at the meeting?"

12 And I said, "Well, it's only five to one.
13 That's pretty good odds," so I came.

14 Q Five to one being the one -- you the scientist
15 against the other five who were non-scientists?

16 A Right.

17 Q What does DNA stand for?

18 A Well, I'm not sure exactly what you want for
19 an answer. But --

20 Q Well, I'd like what the term stands for.

21 A All right.

22 The term is the name for the double helix
23 genetic material in the literature that's used as the
24 name for the genetic material, generally speaking now.
25 Rather than speaking about genetic material, people

say DNA.

1 I mean, there's a chemical involved, but
2 they're not really referring to the chemical. They're
3 referring to the double helix as a genetic material.

4 Q Do you know what those letters stand for?

5 A I always get mixed up on these chemical
6 names.

7 It sounds strange. I can't remember exactly,
8 and I don't want to take a stab.

9 I don't believe there's any question as to
10 what it is. There's a point I might make about names
11 and definitions.

12 The meaning of DNA is determined not by the
13 formal formula for it, it's really determined by the way
14 it's used in scientific discourse, so people don't refer
15 to the entire chemical in scientific discourse very much
16 anymore, because -- it's just simply an abbreviation.

17 Now, as far as in scientific discourse,
18 which is what matters, its use is that it refers to this
19 double helix which is the basis for the genetic code.
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15-1 1 Q In your view, would it be unimportant to
ge 2 understand the chemistry in order to understand what in
3 fact happens in the system?

4 A Well, the answer to that is for certain
5 studies, of course, in the sciences the detailed chemistry
6 matters.

7 In a way in which I am speaking of genetic
8 damage, I really use DNA as a way of avoiding a lot of
9 confusion which exists in speaking about genetic damage.

10 It's simply a more specific thing to refer to.

11 In other words, when you talk about genes in
12 general, this is somewhat vaguer and people can argue
13 about things like genetic and semantic facts and things
14 like this.

15 Q Do you profess to understand the genetics at
16 that level or in fact what DNA is or --

17 A In the biochemistry, no, I don't know the
18 chemical structure of DNA.

19 Q Nor what role it plays?

20 A Oh, that's another question.

21 Q No. Let me understand you.

22 You don't know what the chemical is, but you
23 do know the role that it plays?

24 A For my work, what matters is the role that
25 the structure plays. Now, the chemicals that are in this

15-2 1 structure, code for enzymes for instance, if you want to
2 get information on what is coded for what, then you have
3 to see a biochemist, not me.

4 If you want to know what happens when you
5 put a break into the structure, what matters functionally
6 is that, for instance, the damage --

7 Q Would I come to you to find that out, a
8 biostatistician?

9 A No, this is general knowledge, not statistical
10 knowledge. In other words, the way in which --

11 Q But you have the knowledge?

12 A I think it's general knowledge, not uniquely
13 for me. I think everybody is fairly aware of the fact
14 that there's a complex chemical structure, that a lesion
15 in the chemical structure can miscode for an enzyme.

16 What matters to me is that the miscoding for
17 the enzyme would be -- which is misinformation in the
18 genetic code, is reproduced by cloning, and then becomes
19 something which can be a threat to the total organism,
20 resulting in cancer or leukemia or something of this sort,
21 as a result of the misinformation.

22 What is important is not the details of
23 biochemistry, because if you go to a museum or anything
24 like that, you see that it's a very complicated molecule.

25 If you shoot at it, as it were, with a rifle

15-3 1 like radiation or something of this sort and put a lesion
2 in it, you'd knock out a little piece of it.

3 What piece you knock out is a random event,
4 and so it doesn't, for my line of argument, matter exactly
5 what the chemical structure is.

6 It conveys information. The importance of
7 the structure is it conveys information; that the radiation
8 damage puts misinformation in; when this is cloned, then
9 you get health effects.

10 That's really what matters in this process.
11 The details of the individual chemical structure does not,
12 from my perspective.

13 Q From your perspective, that is, in order to
14 support your thesis, you need not understand the
15 biochemistry --

16 A That's correct. Right.

17 Q -- of the system?

18 A I don't know that I want to get into a
19 dissertation on this, but in science there are a lot of
20 levels at which you can understand a given thing.

21 Like DNA, you can understand it at the
22 biochemical level or even below that.

23 Then you can understand it at the biological
24 level or at levels coming above that where you are dealing
25 with human disease.

15-4 1 I think that as far as understanding the
2 cancer process, for instance, this is fairly clear.

3 As far as details of that cancer process,
4 fine details like you're talking about, the chemical
5 structure or something, you know, this is not all that
6 clear. But you know the general process, not the fine
7 detail, and that tells you how the hazard works.

8 That's why there's a latent period. I
9 mean, you need to know this much to understand why you
10 analyze data in certain ways.

11 I need to have that much information to analyze
12 the data. I need to know what a latent period is and why
13 it is.

14 I don't need to know what the particular
15 chemical break is.

16 Q Let me refer you, Dr. Bross, to your answer
17 to Question No. 15.

18 A Uh-huh.

19 Q The fourth line of that answer -- I'm sorry,
20 I don't have page numbers, but if we can just go through
21 your testimony by referring to the question numbers.

22 A That's fine with me.

23 Q This is Question 15, and in the fourth line
24 of that you refer to, at the beginning of that line,
25 "Low-level nuclear radiation."

15-5 1 A Yes.

2 Q Do you mean to distinguish by some method
3 nuclear radiation from other forms of radiation?

4 A Well, at the NRC hearing in 1978 it was
5 stipulated, because I was presenting testimony on diagnostic
6 X-rays, that for the purposes of the kinds of studies
7 that we were doing, that these rads and rems, for instance,
8 are interchangeable, and that these different types of
9 radiation that we're talking about are essentially similar
10 enough that we can talk about a single as opposed to a lot
11 of different things.

12 In other words, I believe that stipulation
13 should apply here, too.

14 Q That is, that the forms of radiation that
15 we're talking about in the emissions from Waterford 3
16 are such that we need not distinguish between rad and rem?

17 A For the most part. You can always find, you
18 know, occasional exceptions, but most of the radiation
19 would be essentially similar, and going back and forth
20 between rads and rems and so forth, which I may do
21 automatically in some of my testimony, I'm not talking
22 about different things. I'm talking about the same thing.

23 Q What is an exception?

24 A Well, you can have problems. For instance,
25 in Japan, where they had the A-bomb --

1 Q I'm talking about Waterford 3.

2 A Oh, well, I'm not referring to Waterford 3.

3 I'm saying there are some exceptions, but
4 for the most part, the nuclear radiation and diagnostic
5 X-ray will be similar.

6 Q Are there any exceptions for Waterford 3 in
7 its releases?

8 A I imagine so. I don't know.

9 Q You don't know?

10 A The main point is that --

11 Q Is nuclear radiation -- Do you use that
12 term now or is it just in that one context at the NRC
13 hearing that this nuclear radiation term --

14 A Well, the issue comes up now and then as to
15 whether we're talking about the same thing or something
16 different when we talk about X-rays and particulate
17 radiation.

18 There are differences, obviously. Particulates
19 are not the same thing as waves.

20 Therefore, the key issue which is involved
21 here is what is a prime risk factor, and that's the dosage
22 measured either one way or the other with, as I say, some
23 exceptions which may exist, which I am putting in primarily
24 just to make sure that I don't overstate the case.

25 These things, the risk is basically the

15-8 1 exposure, rads or rems, and the health effects are similar.
2 Not necessarily identical, but the primary determinant of
3 the health effect will be the rads and the rems.

4 Then you can have other determinants, other
5 factors.

6 Q In this same answer, you've classed doses in
7 the range between 100 millirem and 10 rem in what you
8 refer to as the one-rad range.

9 Elsewhere you refer to the one-rad range, and
10 I take it you're talking about this range of doses?

11 A Well, the answer to that is, you know, it is
12 not a hard and fast range in any of these things.

13 I'm trying to distinguish between background
14 radiation, which generally speaking starts at about 100
15 millirem and runs down, which is somewhat outside of the
16 range, and a higher level of radiation, which, say, at
17 therapeutic ranges can be much higher, or else in weapons
18 exposures.

19 What I'm trying to do is make the words
20 "low-level ionizing radiation or the one-rad range" as
21 specific as possible so we know fairly well that we're
22 not talking about background radiation necessarily. We're
23 not talking about high-level radiation necessarily.

24 So in other words, I think it's just for
25 purposes of clarity. I don't want to give the misimpression

15-9

1 that there's some sort of, you know, number there, that
2 there's a break in the scale or anything of that sort.
3 There isn't.

4 Q Is this classification scheme yours?

5 A Well, I think it's basically a matter of
6 convenience. People use different ranges, but this is
7 what I thought I would specify to avoid possible confusion.

8 Q Do others refer to the one-rad range?

9 A I --

10 Q Have you ever seen anybody else refer to the
11 one-rad range?

12 A Well, people refer to ranges. I don't know
13 whether they refer -- I think because the NRC's testimony
14 is generally involving five rem, it's more customary to
15 talk, maybe, about that range.

16 But it would be again an order of magnitude
17 up or down from whatever was the central number.

18 Q Have you ever seen anybody else refer to the
19 one-rad range?

20 A I do not recall a specific instance of it,
21 but on the other hand, I couldn't say that I've never
22 seen it, because it wouldn't strike my attention.

23 You are asking a flat question. I really don't
24 know whether I've seen it for certain or not.

25 Q You don't recall ever having seen anybody else --

15-10
1 A I don't recall. That's true. No, I
2 couldn't name --

3 Q -- refer to the one-rad range?

4 A -- you a person who --

5 THE REPORTER: Hold it. I'm sorry, I can't
6 get but one of you at a time.

7 At this point I have no question or no
8 answer.

9 MR. BLAKE: Let me start with the last one
10 if I can.

11 BY MR. BLAKE:

12 Q You do not recall ever having seen anyone
13 else refer to the term one-rad range?

14 A I can't give you a name, no. I can't
15 recall any particular person who made such a reference. I
16 cannot recall such a reference and give you a name.

17 Q Do you recall any references to the term,
18 ever having seen it in anybody's paper, other than your
19 own?

20 A I don't recall, no.

21 - - -

16-1
b
1 BY MR. BLAKE:

2 Q Are you aware that it is common for in-
3 dividuals to talk about doses and in so doing classify
4 doses over two orders of magnitudes?

5 A I'm sorry, I don't quite -- You mean --
6 Are you really referring to the width of the range?

7 Q Yes, sir.

8 You refer to effects or impacts associated
9 with the one-rad range.

10 A Right. Well, in this area, you see, you're
11 really on a log scale, if you want to deal with -- if you
12 want to stay on the scale over the kind of range, for
13 instance, of numbers that would be discussed at a hearing
14 like this, which range all the way from way below back-
15 ground to possibly two numbers -- if you're talking about
16 BEIR report numbers -- they're in 200 or 300 rads.

17 So that's a very wide range, and you usually
18 work on a log basis. And, therefore, a log number up or
19 down would be -- the center point might differ, but
20 people use -- you know, an order of magnitude up or down
21 as the sort of thing which you break off on this kind of
22 a scale.

23 In other words, it's a factor of ten up or
24 down, or some persons might want to make it five. But it's
25 that sort of log scale that you're working on.

16-2

1 Q Are the effects or the impacts that are as-
2 sociated with a dose of 100 millirem essentially the same
3 as those associated with 10 rads or 10 rem?

4 A In my view, there is no break in the scale.
5 I gave this as a matter of precision in speaking, if I
6 could.

7 And the purpose of this is not to indicate
8 that there is any kind of abrupt break in that scale. The
9 As you get down towards 100 millirem, you're getting cer-
10 tain effects that are not changing when you hit a
11 hundred -- 100 millirem.

12 And, similarly, when you're going up, they
13 don't suddenly change when you hit 10. It's not that kind
14 of a break. It's simply a convenience for speaking about
15 it.

16 Q You would expect to see the same effects
17 associated with 10 rads of radiation as you would with
18 100 millirads or 100 millirem?

19 A Are you asking about the dose response curve;
20 is that the thrust of your question?

21 Q I'm asking you whether or not you would ex-
22 pect to see the same effects or impacts with either of those
23 two doses which are different by two orders of magnitude.

24 A Oh, the answer to that is the -- qualitatively,
25 the effects are not necessarily different. But

16-3
1 quantitatively they would be different.

2 In other words, in terms of the scale we're
3 talking about, the person who had a higher exposure than --
4 if a person had a rem instead of 100 millirem, he would
5 have a higher risk, according to what seems to be happen-
6 ing in our figures.

7 But that doesn't extend indefinitely. And
8 if you get very high doses, the curve goes back down.
9 And this is shown in the data that I presented on the
10 Japanese A-bomb children.

11 The risks that you see in the persons with
12 gonadal doses over 10 rem and the risks that you see for
13 the parents with gonadal doses under 10 rem are not
14 actually that different.

15 In fact, the curve goes -- appears to go
16 down after 10 rem.

17 Q What is the curve exactly that you're
18 describing, the curve --

19 A This is called a dosage response curve.

20 Q Yes. But in your own words, what does that
21 mean? Does that mean a dose effectiveness or a dose
22 impact, or a -- How would you exactly describe what's
23 happening in that curve?

24 A Well, if you -- I think maybe the diagram
25 shows it more clearly. In other words, you have some sort

1 of measure on the Y-axis -- in this case it's percent
2 mortality for children who were -- the children of parents
3 exposed to given gonadal doses.

4 The gonadal dose is on the X-axis in this
5 graph, and that's usual, the dosage is on the X-axis.
6 So that, for instance, just for purposes of reference,
7 NIC means "Not incicity." That meant that there was no evi-
8 dence that they were exposed to the A-bomb.

9 Q This is the first control group that you're
10 referring to?

11 A This is the control group.

12 Then you get to groups where you have zero
13 to nine rem for one parent or the other --

14 Q I'm familiar with your graph. What is your
15 point?

16 A Well, the point is that as you go up -- you
17 know, the X-axis is a scale which goes up. As the scale
18 changes, the Y-axis shows the effect of the response --
19 in this case the deaths at -- under 21.

20 For instance, in this case the control is
21 somewhere around six -- a little more than six, and in the
22 case of the subgroup where both parents were exposed, it
23 goes up to around seven.

24 Now, a general dosage response curve may have
25 different X-axis labels or Y-axis labels, but the X-axis

16-5
1 label is a dosage of some kind -- measured some way, and
2 the Y-axis is a health effect -- for my testimony at
3 least, as measured here it's percent mortality. But it
4 could be the risk of lung cancer, as in Portsmouth Naval
5 Shipyard data, or some other variable that would go up
6 with dosage or would be related to dosage.

7 So, in other words, it specifies a relation-
8 ship. And the reason I say dosage response curve rather
9 than line --

10 Q Is it your opinion --

11 A -- is it's---

12 Q I'm sorry. Is it your opinion that the Ports-
13 mouth Naval Shipyard data shows this -- demonstrates this,
14 that at higher doses it drops off?

15 A The Portsmouth Naval Shipyard data is --
16 does not actually go down. Actually here I would prefer
17 to say --

18 Q You say it does not?

19 A It doesn't go up, rather than say flatly
20 it goes down, because the confidence intervals tend to be
21 somewhat overlapping here.

22 But there is no evidence of the linear re-
23 lationship that is the basis for all of the calculations
24 that are made by the -- generally by the Radiation
25 Protection Community, and in this specific case for

16-6 1 Waterford 3.

2 Q Did the Tri-State data demonstrate that it
3 tailed off at higher doses?

4 A No, actually it doesn't show a tailing off.
5 It doesn't increase very much, though.

6 The -- What's probably happening is it's
7 quite relatively flat, as far as can be judged by the
8 data. In other words, what isn't the case is that it's
9 going up linearly. That you can say.

10 What is the case is a little harder to say.
11 It could be just leveling off, or it could be actually
12 going down. It may not actually go down until you get to
13 higher doses than we have in the study.

14 Although in this case, the Japanese data,
15 it's not shown in this particular --

16 Q So the Japanese data, in your view, has shown
17 that effect --

18 A The Japanese data showed --

19 Q -- while the Tri-State data did not demon-
20 strate it?

21 A Well, most of the data I'm talking about,
22 the upper limit of the actual exposures tends to be around
23 10 rem. There are occasionally cases higher, but the bulk
24 of the series will be inside that level, because that's
25 what I'm talking about -- lower level radiation or

6-7 1 diagnostic x-rays, generally speaking, in that lower
2 range. And nuclear radiation, for that matter, at Ports-
3 mouth, too, is mostly under 10 rem.

4 So you don't have a clear sharp body of
5 data out where maybe you'd like to see it, exactly like
6 50 rem, or .5 rem. So you can't be -- I don't want to
7 sound too cocksure about what the actual point of turn-
8 around is. And all I would prefer to say is it goes up
9 for a while at very low doses and then seems to level off
10 somewhere around 10 rem.

11 Q Are you familiar with the term "Gy" symbol?

12 A No.

13 Q How about Sb?

14 A That was "Gy" you said?

15 Q Yes.

16 A I don't ... It doesn't ring a bell.

17 Q Are you familiar at all with the current
18 doses which are used in the treatment of cancers?

19 A In the treatment of cancer? To some extent.
20 That's not my primary area of interest.

21 In the treatment of cancer, the doses, of
22 course, are completely different from what we're talking
23 about. In the studies that I've conducted, or been
24 responsible for the data management, the use of 5000 rads
25 or more is not all that unusual.

16-8
1 That's completely out of the range we've
2 been talking about entirely.

3 Q And completely out of the range of doses
4 which you have studied?

5 A Well, see, I mentioned that -- These are
6 doses in studies that I've run involving therapeutic
7 effects, but not here looking at the other effects.

8 In other words, when you're giving doses of
9 5000 rads, your object is to destroy the tumor cells --
10 I mean really destroy them, and prevent the cells from
11 reproducing and so forth.

12 So you are creating a situation that's way
13 beyond the kind of -- It's done by genetic damage and
14 not frying the cells. But you're producing such a heavy
15 amount of genetic damage in the DNA that, you know, nothing
16 is viable.

17 That's how these things work at that very
18 high dose. But that, you know, is the therapeutic applica-
19 tion of radiation technology. And the kinds of things
20 that we're talking about, presumably, do not get --
21 well, you couldn't get health effects so easily from cells
22 that got that kind of dosage -- not from those cells
23 themselves.

24 I mean, they're dead.

25 Q Have you ever been involved in any clinical

16-9
1 work of this type?

2 A Well, I am Director of Biostatistics at Ros-
3 well Park.

4 Q Right.

5 A Since 1959 when the very first collaborative
6 clinical cancer research work started in solid tumors, I
7 was involved in the studies. They were in my department,
8 centralized in my department and managed by my department,
9 and at the present time what sort of the -- you might
10 say, second or third generation of that, is still in my
11 department for the genitological group that is
12 studying, among other things, high doses of x-rays for
13 the treatment of genitological cancer.

14 So in that sense, I've had involvement there.
15 And, of course, my involvement with clinical studies
16 generally goes back to Sloan-Kettering where I did
17 the very first study ever done in this country -- first
18 collaborative clinical trial ever done in this country on
19 leukemia, which was involved around -- sometime in the
20 early fifties, 1953 or 1954, I think -- under way.

21 So I've been involved in clinical studies
22 rather deeply for -- since '50 or -- 1950 or so.

23 Q Do you have a number of doctors, that is,
24 M.D.'s who work for you as head of Biostatistics --

25 A No, no.

16-10

1 Q -- who do this clinical work for you?

2 A. No. Doctors don't work that way. They don't
3 take orders from a--

4 Q I may have misunderstood --

5 A -- non-physician. That's just not done.
6 I mean, I guess -- Let me clarify that point.

7 Q Please.

8 A. There is a statistical unit -- Doctors
9 treat the patients. I don't go near patients to treat
10 them, of course. It would be criminal and fatal for the
11 patient, I suspect.

12 But in any case, I don't have hands-on --
13 any hands-on contact, of course, with patients. In
14 fact, it would be somewhat illegal for a person with my
15 background and training as a statistician to have this
16 kind of operational involvement with an actual patient
17 being treated.

18 The doctors are a collaborative study. They
19 run themselves -- and the statistical section keeps asking
20 them for data -- getting their data most of the time, or
21 trying to get it, and then centralizing it at Roswell
22 Park -- or there are a lot of collaborative studies in
23 this country besides the ones at Roswell.

24 And then these data are analyzed statistically
25 to see what, if anything, the treatments they're being

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given contribute to the survivorship of the patient.

That's an entirely -- of course, I don't want to confuse the issue here at all. That's totally unrelated, therapeutically -- therapeutic studies are not related to the studies that I've been talking about. You can see them in my bibliography, but they're -- you know, I'm not brining those in as evidence that I'm clinically oriented or -- you know, doctoring.

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17-1 1 Q You state in your response to Question No.
2 16, there are, and you have it in quotes, "indicator
3 diseases."

4 Are the indicator diseases that you're
5 talking about those which you've enumerated in that
6 answer, in your opinion? That is, asthma --

7 A Yes, these are typical.

8 Just for the record, I could clarify one
9 point. From time to time, we made minor changes in that
10 list, because we felt we had more, stronger indicators,
11 but that's essentially the list that we used in the study.

12 Q Dr. Bross, you've been very careful to point
13 out that you have no involvement in clinical work, and
14 that you have no background in the medical sciences, and
15 that you're not involved in treating or diagnosing patients.

16 What is it that qualifies you to describe
17 these particular diseases as indicator diseases?

18 A Well, let me explain what the word means and
19 then I think that this will be clarified.

20 When we first looked at the Tristate Survey
21 data, which is extremely rich data, which has something
22 like 150 different fields, kinds of information in the
23 question schedule so that it's extremely complex and
24 detailed data, we were looking for factors other than
25 radiation itself, per se, you know, which might be

17-2 1 involved in leukemia, which might clarify the situation
2 as far as leukemia.

3 Q Excuse me just for a second.

4 Who is "we" at this point?

5 A I think what we have sort of forgotten, if I
6 refer back to my earlier testimony, when I became the
7 director of biostatistics and the acting head of
8 epidemiology for seven years and had responsibility for the
9 Tristate Survey data, at that point we actively began a
10 re-analysis of the data which had only been partially
11 analyzed.

12 Q Who is "we"?

13 A This is, at that point, both the members of
14 the Biostatistics Department and myself, and the remaining
15 members of the Epidemiology Department.

16 Saxon Graham had taken off for the State
17 University of Buffalo with some of the data, and
18 Mort Levin had gone down to Hawkins, and so I got, as it
19 were, the responsibility for doing something with this
20 department and with this data.

21 So "we" refers to the staff I had at that
22 time.

23 Q Pardon?

24 A It refers to myself and my staff of the
25 Biostatistics and then Epidemiology Departments.

17-3 1 Q It refers to statisticians who worked for you
2 at Roswell Park at the time?

3 A Well, actually, around that time I got a
4 grant from the National Cancer Institute for a study of
5 biometric methods in cancer research and I added extensively
6 to my staff at that point. I would say they were
7 statisticians and epidemiologists, but there was also a
8 physician.

9 Q On your staff?

10 A Yes.

11 Q So doctors do work for you?

12 A Well, let me put -- you have me in a
13 contradiction, but it's not really a contradiction.

14 Q No, I'm sure.

15 A The problem is, he was an Italian physician
16 and he had an Italian M.D., but an Italian M.D. is no
17 good in this country. So he could not practice clinical
18 medicine.

19 So he was interested in epidemiology and he
20 worked for me. Under ordinary circumstances, unless a
21 doctor -- you know, if a doctor isn't in practice, that
22 might happen, but that doesn't happen ordinarily.

23 It's a special situation.

24 Q So it was statisticians and epidemiologists
25 who were working for you at the time that you're now

17-4 1 referring to?

2 A Yes, and this physician, Dr. Viadana, who is
3 now in, I think, Milano, in the Epidemiology Department
4 there. I can't quite recall.

5 Q Go ahead, please.

6 A Well, that's the other member, the medical
7 member of the department.

8 Of course, I had available to me as a member
9 of an institute, Roswell Park Memorial Institute, the
10 option of talking to persons from the staff on any of these
11 questions.

12 For instance, in my bibliography, there's a
13 whole series of papers on pathology, which were done
14 by Viadana and myself and the chief of pathology,
15 Dr. Pickford.

16 I'm not a pathologist, but Dr. Viadana knows
17 a lot about it, and Pickford, of course, is the head of
18 the department.

19 So I would work that way. I would get the
20 information from persons who were knowledgeable. I don't
21 claim or want to appear to claim to be knowledgeable in
22 all areas, but I just get the information I need for my
23 operation from persons who know what they're doing.

24 Q Let me see if I understand.

25 When you first started using the term

17-5 1 "indicator diseases," the term was developed by individuals
2 who worked for you at Roswell Park?

3 A. Actually, this work was work that I did with
4 Dr. Viadana.

5 Q. With whom?

6 A. Dr. Viadana.

7 Q. Dr. Viadana, the Italian doctor --

8 A. Yes, he is the Italian physician --

9 Q. -- whom you were talking is now in Milan?

10 A. Henry Viadana.

11 JUDGE WOLFE: Just a moment now. Here we
12 go ahead.

13 THE WITNESS: Sorry.

14 JUDGE WOLFE: One at a time, please.

15 BY MR. BLAKE:

16 Q. Is Dr. Viadana the Italian doctor of whom
17 you were earlier talking who is now in Milan?

18 A. Yes, and we were at this point trying to find
19 predictors that might tell us something about when
20 leukemia might be more likely, and that was the reason
21 for the name "indicator diseases."

22 Now, we screened a very large number of
23 diseases looking for ones which might give us some kind
24 of a prediction on when a patient -- when a child would
25 get leukemia.

17-6 1 The diseases that came out of this study,
2 which was, incidentally, also done for adults, and the
3 adult study was also with Dr. Viadana in this case, where
4 we could find certain disease conditions reported in the
5 medical history of the case prior to the occurrence of
6 leukemia.

7 In fact, usually more than three years or
8 five years prior to the occurrence of the clinical
9 diagnoses of leukemia.

10 So we are not talking about pre-leukemic
11 diseases. We're talking about diseases that occurred in
12 the most cases substantially before the occurrence of the
13 leukemia.

14 Now, the interesting thing that developed
15 there and one that's very important from the standpoint of
16 determining health risks, since you have made a point about
17 indicator diseases (it's an important point), that, as
18 it says, there's a much higher risk of developing
19 leukemia.

20 Now, the reasons why this would happen, why
21 there would be these kind of predictors, would go back to
22 the kind of function of DNA that I was referring to.

23 That is to say, if you have genetic damage in
24 the DNA that's cloned and reproduced in the child or
25 adult, then you have a population of cells which carry

17-7 1 misinformation.

2 Now, these cells may be in the host defense
3 system. For instance, blood-forming cells.

4 If that's the case and they are carrying
5 misinformation, then the ordinary processes that would
6 occur -- for instance, the feedback mechanism that stops
7 the production of white blood cells when the need has
8 vanished. You need something to start up the production
9 if there's an infection or something, and then you need
10 to shut it off.

11 Now, the shut off of the machinery would be
12 presumably handled through an enzyme system, although we
13 don't know all the details of that system.

14 Now, the point about indicator diseases is
15 the same genetic damage that has produced these diseases,
16 which generally speaking represent failures of the body's
17 host defense system to react effectively, can also be
18 producing the leukemia itself; or in the case of adults,
19 the diseases like heart disease, which we reported earlier,
20 can be early manifestations which are going to reflect the
21 same genetic damage or similar genetic damage to what is
22 actually producing the subsequent leukemia in the adult.

23 Now that means that the co-occurrence of
24 diseases is very important to our understanding. It
25 means probably that there's pre-existing genetic damage

17-8 1 of these groups that are very much more prone to get
2 leukemia under conditions where they are radiated.

3 I think it is important to understand why
4 the health effects of low-level radiation have been
5 so badly misunderstood in recent years.

6 The whole population, as it were, is not
7 entirely vulnerable. It is only that fraction which
8 probably had some pre-existing genetic damage which can
9 be added to by the radiation.

10 So this is very pertinent to this particular
11 discussion, and the indicator diseases allow us to get
12 a much better handle on the dosage response curve.

13 For instance, they give a very clear dosage
14 response curve for the Tristate Survey in the paper in
15 the "American Journal of Public Health," and in the paper
16 in the "Journal of American Medical Association," and
17 also the one in "Investigative Radiology," and other
18 papers on the children.

19 These do not show with the kind of growth
20 statistical analysis that have been done earlier and which
21 people generally do.

22 It was a sophisticated statistical analysis
23 that brought these facts out, but it was the scientific
24 basis for that analysis, the co-occurrence of diseases
25 from the genetic damage produced that allows the statistics,

17 9 1 as it were, to work.

2 That's a little long explanation for what the
3 indicator diseases are, but we do feel it's a very
4 important aspect, because in order to protect the
5 population you have to protect, as it were, the weakest
6 members of the population; that is to say the most
7 vulnerable people.

8 Q I understand that this definition was
9 derived now based on your answer in about the '66 time
10 frame? It was done by --

11 A Close to '66, but I think it was a few years
12 after that maybe.

13 Q '66 or a few years after, it was arrived at
14 without the involvement of any licensed physicians; is
15 that correct?

16 Were there any M.D.'s involved --

17 A Well, I believe you are talking about a
18 physician with an American medical license when you say
19 "licensed physician"?

20 Q -- in this, other than your Italian doctor?

21 That's correct. Any physician licensed in
22 this country who was involved in your definition of
23 indicator diseases?

24 A No. It was with Henry Viadana that I was
25 working.

17-10 1 He didn't have an American license, but he
2 was a good doctor.

3 Q I see, and what are your qualifications to
4 judge that?

5 A Well, he went on later to actually get a
6 training in pathology and do very successfully before he
7 went back in epidemiology, so I think he was a very good
8 man.

9 Q How did you generate your understanding of
10 the medical terms which you used in describing indicator
11 diseases?

12 A I'm trying to get the thrust of your
13 question. You mean how did I know what an allergy was?

14 Q Sure.

15 A Something like that. Is that what you are --

16 Q And genetic damage, which you referred to,
17 and host defense system, which you've referred to, each one
18 of which we're going to go through with you.

19 I'm trying first to find out where you come
20 by your knowledge, since you've taken no courses in the
21 subject.

22 A Well, of course, you know, I've been in the
23 medical environment since 1949 at John Hopkins for three
24 years, where I gave courses, and Cornell University
25 Medical College, where I taught in the Medical School,

17-11 1 and --

2 Q You taught medical courses at either Hopkins
3 or Cornell?

4 A No, no. Of course it's in the area of
5 statistics and epidemiology.

6 And at Sloan-Kettering Institute, where I've
7 worked with a lot of persons who were physicians, like
8 Dr. Winder I mentioned, and quite a few other persons at
9 Sloan-Kettering.

10 And, of course, I worked at Roswell with
11 physicians, Tom Dowl, breast surgery, or John Pickering
12 who is a pathologist, or people who are experts in a
13 particular area or doing a study in a particular area
14 that I have to get involved with.

15 In other words, I've learned enough
16 vocabulary to be able to talk to the people, and you
17 are talking about, essentially, vocabulary.

18 Basically, you know, I learned it from their
19 usage of the words, how the words are used.

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bm

1 BY MR. BLAKE:

2 Q Would you say that your understanding of
3 the vocabulary, as you've referred to it -- with respect
4 to terms like "host defense system" or "infectious diseases"
5 or "indicator diseases," or "genetic damage" are similar
6 in level of knowledge to your knowledge of DNA?

7 A Well, if you're referring to the function of
8 DNA, of course, I feel I have sufficient knowledge. If
9 you're referring to the names, defining what DNA letters
10 stand for, or what exactly the symptoms for pneumonia or
11 something of this sort are, the answer is: I don't have
12 that kind of medical knowledge.

13 And it is, in my view, sufficient for me to
14 know that somebody who does have this kind of information,
15 you know, has said this person has such and such, like
16 leukemia.

17 I could not diagnose leukemia. I would not
18 attempt to diagnose leukemia. It's a very difficult
19 task.

20 The data in the leukemia registry that was
21 used in the Tri-State Survey was generated by licensed
22 physicians, giving diagnoses of leukemia, who were re-
23 viewed by licensed physicians, who concurred with those
24 diagnoses.

25 So in dealing with a problem, as you may have

1 noticed is my pattern with dealing with dosimetry -- you
2 know, there are certain things which I accept from co-
3 workers or from persons who are working in the area that
4 is involved in the study, and is not, you know, my pro-
5 vince.

6 Q You would not attempt -- I think you just
7 said -- to diagnose leukemia. Would you attempt to define
8 leukemia?

9 A Well, defining it is -- you know, my position
10 on definitions is one you have not encountered before, be-
11 cause I'm also -- as you may have noticed in some of the
12 papers -- involved with linguistics.

13 And in my view, words mean what the users of
14 the words -- how they use them. That's what determines
15 what the words mean.

16 So formal definitions are, to my way of
17 thinking, not informative in most cases. And the way in
18 which -- if I could communicate -- the problem is com-
19 munication. And I can communicate if I have a reasonably
20 good idea of what a doctor means by leukemia, or a doctor
21 means by myeloid leukemia, even if I'm not personally
22 capable of making a differential diagnosis.

23 Q So you're not prepared either to diagnose
24 leukemia, nor to define what leukemia is -- its beginnings,
25 its ends, what it is?

18-3

1 A I can describe the leukemia process, and the
2 reason I can do that is a little different from anything
3 we've talked about.

4 I've indicated from time to time that I have
5 been interested in mathematical models -- mathematical
6 systems for prediction, which are -- however, in my view
7 there are certain requirements for mathematical models
8 which completely distinguish them from what I have re-
9 ferred to as Mickey Mouse arithmetic.

10 A mathematical model must be thoroughly
11 tested before you put credence in it. Now, we have --
12 in conjunction with my colleague, Dr. Bloominson of my
13 department -- who is still in my department --

14 Q I'm sorry. I didn't catch, I didn't hear --

15 A Dr. Leslie Bloominson, who is in my department,
16 developed various theoretical models and tested these
17 models against the actual data for a variety of con-
18 ditions.

19 Now, one of the models involved here --
20 involves the system in the white cell development in the
21 human body. And this is a mathematical model of how
22 white cells are called -- how you generate more white
23 cells when you need them in infection and so forth.

24 They --

25 Q I'm sorry. I still didn't hear it. How

18-4
1 you generate more white cells --

2 A. When a person gets an infection, they need
3 to have something to counter the infection. This is a
4 host defense system. You know, this is what keeps us
5 alive.

6 The host defense system involves the blood
7 system -- parts of it. There are other parts of the host
8 defense system. The white cells are involved in protecting
9 the human being from dying from the effects of infection.

10 And to do that you generate more white cells
11 until the infection is over. Then you shut them off, so
12 that there is a feedback machinery that operates in this
13 system.

14 The way in which I got involved is this is --
15 since you have asked about the clinical side -- Our
16 studies of chemotherapeutic agents led us to this because
17 the chemotherapeutic agents for cancer, generally speak-
18 ing, have the effect of producing profound depression
19 in the white cell count.

20 And in order to understand what was happening
21 to patients who were receiving very heavy doses of drugs
22 and to try to develop a dosage schedule which would avoid
23 putting patients in critical conditions by getting their
24 white count too low, we developed a mathematical model
25 for the hemostatic system, which had that function.

1 Now, that model can serve also as a model --
2 Now, this isn't just a verbal model. This is completely
3 developed and, in fact, computerized model -- that will
4 describe the process that will lead to leukemia if you
5 say somewhere the feedback mechanism fails.

6 And then, instead of the white cells coming
7 back down like they should after challenge -- actually
8 what happens, I guess I should say, is that the white
9 cells go down to a very low level. And that triggers
10 the development of more white cells.

11 But it overshoots in the model and in the
12 real world. And something has to cut off that overshoot
13 at some point. But it doesn't come in at the right time
14 and the right way. So, therefore, the persons have this
15 imperfection.

16 This is, as far as I'm concerned, a process
17 explanation for leukemia.

18 Now, I regard this as a more adequate ex-
19 planation of what goes on in the disease for present
20 purposes, because the failure of the feedback is directly
21 related probably to some inadequacy in the informational
22 system in the genetic structure.

23 Therefore, this is the kind of information
24 about leukemia which is pertinent to this hearing, although
25 it's not pertinent to treating a patient necessarily.

18-6
1 Q And the gentleman who described this --
2 developed this is a statistician or epidemiologist?

3 A Well, actually he was originally a mathe-
4 matical biologist.

5 Q He is not a medical doctor or clinically
6 trained?

7 A No, I've indicated that my department as such
8 consisted of persons, with the exception of Dr. Viadana,
9 who were from mathematics or computers, or for epi-
10 demiology or biostatistics or persons who are involved
11 in doing studies of this kind.

12 Q Are you aware that the medical community --
13 or in the medical community there is a thesis that the
14 diseases which you have identified as indicator diseases
15 are actually pre-leukemic; that is, the initial stages
16 of leukemia?

17 A Well --

18 Q Are you aware? Yes or no.

19 A I am aware of this, and I have commented
20 earlier on this specifically. You may not remember my
21 testimony.

22 Let me remind you: I said specifically
23 that --

24 Q Are you aware --

25 A -- this was the case, that the --

1 MR. BLAKE: Judge Wolfe --

2 JUDGE WOLFE: Yes.

3 MR. BLAKE: May I continue to ask questions,
4 please, of the witness? There will be an opportunity for
5 redirect to the extent counsel doesn't think I give the
6 witness an opportunity to sufficiently expand on his
7 answers.

8 Quite frankly, I think I've been overly
9 generous, at least to date.

10 JUDGE WOLFE: I will let the witness finish
11 his answer.

12 THE WITNESS: Well, the reason I felt I could
13 answer this is because I had mentioned in advance the
14 timing of the occurrence of these indicator diseases and
15 of the leukemia, indicating that there was a substantial
16 time period of three or more years -- generally five
17 years -- between the occurrence of the indicator diseases
18 and the occurrence of the leukemia.

19 Now, pre-leukemic diseases are not unknown.
20 That is to say, there are diseases which are somewhat like
21 leukemia that occur prior to leukemia. But this is pre-
22 leukemic.

23 That is to say, within a year or a year and
24 a half, something like that. Three years. -- of the
25 diagnosis of leukemia.

18-8
1 So, therefore, I'm perfectly aware that
2 the medical community, as he puts it, have raised this
3 as an issue. It is a false issue, and I have already
4 taken care of it.

5 JUDGE WOLFE: All right. Doctor, when counsel
6 asks you a question, answer it directly. If you have
7 been asked what you think is the same question before
8 and you have given an answer that you think has been to
9 your mind satisfactory, nevertheless, you must answer the
10 question, absent objection by opposing counsel.

11 So just answer the question. Answer it maybe
12 five times over, unless I step in or opposing counsel
13 steps in -- your counsel, I should say.

14 All right.

15 THE WITNESS: Well, I would like to
16 apologize if I misspoke. It's a natural reaction, and I
17 will try to curb it.

18 JUDGE WOLFE: It's all right.

19 Yes.

20 MR. JONES: Your Honor, if I might suggest,
21 in view of the fact that we've been proceeding for some-
22 thing over an hour and a half at this point, I'd like to
23 move for a brief recess.

24 JUDGE WOLFE: All right. We'll recess until
25 five minutes of four.

(A short recess was taken.)

19-1 1 JUDGE WOLFE: All right.

ge 2 BY MR. BLAKE:

3 Q Dr. Bross, let me re-establish where we were
4 prior to Mr. Jones asking for the break.

5 At that point, as I understood your
6 testimony, it was that the concept of indicator disease
7 had been developed by you and statisticians who worked for
8 you in concert with an Italian doctor not licensed in
9 this country, who was also involved in the concept in
10 the time frame '66 or shortly thereafter; but that no
11 members of the medical community in this country were
12 involved in it.

13 Is that correct?

14 A In the development of the set of diseases
15 that was listed as indicator diseases, the criteria were
16 statistical criteria for prediction, and this is a
17 mathematical process rather than a medical process, to
18 see what predicts what.

19 Q And you've agreed with me that generally
20 members of the medical community in this country regard
21 these diseases as pre-leukemic, rather --

22 A I certainly did not agree with you.

23 Q I'm sorry.

24 A I thought we -- I'm sorry, too, because I
25 thought we had straightened that out with the extra

19-2 1 discussion that we had.

2 No, the medical community as a whole, which I
3 won't speak for, which I don't know anyone who can speak
4 for, so far as I know does not have a firm opinion as to
5 what the indicator diseases are. So there's no reason to
6 think that all diseases that are listed here are going to
7 be called pre-leukemic.

8 Q In other words, you and the group, your
9 group, identified these diseases as indicator diseases,
10 but some members of the medical community regard them
11 as actually pre-leukemic, that is, the initial stages of
12 leukemia? Would you agree with that?

13 A No. The situation is that there is something
14 called pre-leukemic disease. That's an entity.

15 Q That's a what?

16 A That's an entity. In other words, the
17 term "pre-leukemic disease" refers now to a class of
18 diseases, or symptoms really, symptom paths or syndromes.

19 These are an entity are by themselves,
20 okay?

21 Now, the list of diseases that I have given
22 here for the indicator diseases are other disease entities,
23 which doctors would not identify. They are other
24 diseases, and whether some persons have claimed or not
25 that these are pre-leukemic diseases is determined by the

19-3 1 time frame and not by medical opinion.

2 But pre-leukemic diseases, they immediately
3 predate the diagnosis of leukemia.

4 Q I see, so you are quarreling with my use of
5 the term "pre-leukemic disease"?

6 That is, a pre-leukemic disease in your
7 opinion is one which immediately precedes the onset of
8 clinically observable leukemia?

9 A That's a current usage of the word, yes, as
10 far as I know.

11 Q Would you characterize pre-leukemic as a
12 medical expression or an expression of statistics?

13 A Well, the condition refers to somewhat vague
14 complaints that may or may not be diagnosed as pre-leukemic
15 at the time, but maybe post hoc --

16 Q Would you --

17 A -- are considered pre-leukemic.

18 In other words, it's the time frame very
19 often that determines what you call pre-leukemic.

20 If leukemia didn't occur, they wouldn't
21 call it pre-leukemic.

22 Q Would you characterize the term "pre-leukemic"
23 as a medical term or as a term of statistics?

24 A The language here of all the diseases is
25 medical, so --

19-4

1 Q Including the term --

2 A -- this is a medical term.

3 Q Including the term "pre-leukemic"?

4 A Right. All the diseases, this is part of the
5 vocabulary of a physician. It's not part of the
6 vocabulary of a statistician, unless he's dealing with
7 medical problems and has some sort of joint vocabulary
8 for communication.

9 Q If a doctor or several doctors or a class of
10 doctors refers to these diseases as pre-leukemic, would
11 you quarrel with their characterization?

12 A I indicated to you that in order for
13 something to be pre-leukemic, there's a time frame
14 involved.

15 Pre-leukemic means prior to leukemia.

16 Now, if it's shortly prior to leukemia, under
17 ordinary usage; we're talking about diseases that are
18 back five years or ten years, and if someone calls them
19 pre-leukemic, he's simply not using the term correctly.

20 Q You've referred elsewhere in your testimony,
21 Dr. Bross, to a cloning --

22 A Yes.

23 Q -- theory, and a period of 32 doubling times.
24 What time frame would you associate with
25 that period, that is, closing of 32 times, that it might

19-5

1 take?

2 A. Well, these estimates vary somewhat with the
3 condition, but for the solid tumors, for the tumors which
4 would require, for instance, 32 doubling times to become
5 somewhat palpable or detectable, the period would be
6 roughly of the order -- each doubling time would take
7 about a half year.

8 So we are talking about the 32, about 15
9 or 16 years, that sort of time frame.

10 Q. And at what point in this doubling would you
11 refer to -- at what point in this extended number of
12 years would, in your opinion, the tumor actually exist?

13 A. Well, that is a sort of semantically tricky
14 question.

15 In one sense, when the initial damage is
16 produced and the cloning starts, the process starts.

17 In another sense, nothing is going to be
18 picked up medically until it becomes large enough to
19 produce some kind of effect on the host.

20 This means that -- It becomes a diagnosed
21 tumor at, say, something of the order of 32 doubling
22 times, or it could be more, because they can be missed for
23 a while and can be 34 or 35.

24 In other words, at some time after 32 it
25 becomes detectable, and it can be called clinically a

19-6

1 tumor or a cancer.

2 Q Would you say, Dr. Bross, that with regard
3 to the tumor that we've been talking about, that it didn't
4 exist until it was detectable; that is, until it was at
5 the 32 cloning period?

6 A Well, that's why I said you are raising a
7 semantic point, because it's a continuous process, and
8 the fact that the tumor is discovered, the first time
9 it's discovered it becomes a clinically discovered tumor,
10 that people would, say, speak of it as a tumor, but it
11 existed prior to that.

12 Doctors refer in the ordinary usage to the
13 period prior to the actual detection as tumor. It doesn't
14 change from one thing to another at detection.

15 For instance, specifically, mammography is
16 basically -- the object of mammography is an attempt to
17 get the tumor detected before it has metastasized, that
18 is, spread throughout a given area or the body.

19 Therefore, people would talk about the tumor
20 as existent in the person before it was actually found.
21 They would say it was discovered on mammography, say, but
22 they don't regard it as coming into existence at that
23 point, because in order to be discovered it has to be
24 pretty large to be picked up by the mammogram as a shadow.

25 The reason we are talking about these numbers,

19-7 1 like doubling times, is because you have to have a certain
2 mass in order to detect by palpation or another detection
3 system.

4 Q Wouldn't you say, regardless of whether or
5 not it was detectable, that the tumor in fact existed
6 many years prior to the time that it was detectable?

7 A Well, as I say, if you take that line, you
8 could say it started -- it goes all the way back to the
9 time the cloning starts.

10 Q Well, let me analogize back to leukemia.

11 A Yeah. Here we've been talking --

12 Q At some point in time leukemia is clinically
13 observable and identifiable as leukemia.

14 Does it take some time for leukemia to develop
15 to a clinically observable and identifiable stage?

16 A Yes.

17 Q And during the period of time of its
18 development to that stage, could there be in fact preceding
19 stages which are evidenced by other symptoms in the human
20 body?

21 A Well, you have presumably a pathology
22 developing and there could be symptoms which would not be
23 recognized as leukemia directly, and which would be called
24 pre-leukemic.

25 However, the detection -- you have to have a

19-8 1 certain point before it would be probably diagnosed
2 thoroughly as leukemia.

3 Q Is that period until the time when it would
4 be observed or identified as leukemia, could that consume
5 some period of years?

6 A Probably not. It has to have a certain -- in
7 other words, the way in which the situation for leukemia
8 comes to light is a little different than for solid
9 tumors, and the effect is that you have to have a
10 reasonably large -- the reason you need cloning is you
11 need a reasonably large cell population that has the
12 misinformation in it in order to have a clinically
13 detectable effect.

14 So you could have effects showing up shortly
15 prior to the time that you might be able to detect it as
16 leukemia, and this would be your pre-leukemia.

17 But that would be in the time frame I
18 mentioned.

19 Q Dr. Bross, is it your opinion that from the
20 initiation or onset of leukemia, observable or identifiable
21 or not, until the point in time when it is clinically
22 detectable or observable, that period of time is very
23 short?

24 A For leukemia?

25 Q Yes, sir.

19-9 1 A We're talking about probably doubling or
2 latent periods running maybe seven, fifteen, twenty years.

3 In some cases leukemic doubling times are
4 such that the disease is not manifest until maybe twenty
5 years.

6 In other words, the cloning has to go on.
7 The doubling time is a convenient way of describing the
8 process of how it's going, but in any of these processes,
9 we're dealing with biological processes, they don't
10 necessarily run in the simple way that physical processes
11 run.

12 In other words, the process may be checked
13 temporarily by one means or another so that -- you know,
14 it isn't automatically that it's going to come at a
15 particular time, 15 years or whatever. There's a range.

16 Q So in fact, you would agree that with
17 respect to leukemia, the pre-leukemic stages, albeit not
18 yet clinically observable and identifiable as leukemia, may
19 involve periods of years?

20 A Well, a year or two, as I indicated.

21 Q I thought you just said seven years?

22 A No, no. The latent period is seven years.

23 In other words, if you go all the way back, not
24 to the time when you can pick up any kind of symptoms, but
25 to the time when the process starts with presumably a

19-10

1 misinformation in the DNA, that point in time is seven
2 years.

3 The pre-leukemic doesn't start then. You
4 still have to have, even before you get clear symptoms,
5 you know, some fair amount of the cloning.

6 The cloning has to be fairly substantial
7 before it can affect the whole organism.

8 - - -

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1 BY MR. BLAKE:

2 Q But you would not refer to that entire
3 period from the initial onset or initiation as pre-leukemic?

4 A No.

5 Q At what point in the cloning would you start
6 referring to it as pre-leukemic, Dr. Bross?

7 A Well, as I indicated -- but I will repeat,
8 as the Judges have asked me to -- that the period of
9 time could be most likely a year, year and a half or
10 two years -- something of that order of magnitude.

11 And that when we're dealing with conditions
12 which occurred five years earlier or seven years earlier,
13 this isn't what we're talking about.

14 Q And in children you'd say a period of a year
15 and a half or two years, but not five years, that you might
16 see pre-leukemic conditions?

17 A I believe that would be in conformity with
18 ordinary usage of the medical profession of the word
19 "pre-leukemic."

20 Q Your testimony is that the indicator diseases
21 are not pre-leukemic, but that if you have such a disease
22 and have been subjected to irradiation, for example, in
23 utero, then you may be more susceptible to leukemia? Is
24 that a correct --

25 A Well, you've got the time frame a little

20-2
1 twisted here.

2 Q I see.

3 If you had --

4 A The indicator diseases come after the --

5 Q Let me finish and see if I ...

6 If you have exhibited an indicator disease
7 and then are subjected to some level of radiation, it is
8 more likely that you will develop leukemia than one --
9 than an individual who is also subjected to that same
10 amount of radiation, but who has not exhibited symptoms
11 of the indicator disease. Is that correct?

12 A No.

13 Let me try to clarify the point --

14 Q No, let me try one more time. In your
15 application of the term "indicator disease," is identi-
16 fication of the indicator disease necessary prior to
17 the point in time when a radiation dose is provided to an
18 individual?

19 A No, please let me clarify this.

20 Q Please. Go ahead.

21 A The point about this is that the radiation
22 is delivered substantially earlier. In other words, let's
23 say it's in utero radiation that's involved. And the
24 indicator diseases may be a reflection of a reaction to
25 that condition.

20-3

1 But it is not -- we're studying children who
2 were irradiated after they had the indicator diseases.
3 That's not the -- I don't know whether it's clear now.

4 Q I thought that's what I had said initially.
5 Let me see if I now understand it correctly.

6 Is it your position that given a certain number
7 of individuals who have been irradiated in utero, who are
8 not in fact conceived, born -- some of whom exhibit
9 symptoms which you've referred to of indicator diseases,
10 it is your opinion that those individuals who exhibit the
11 indicator disease symptoms will later have a greater
12 probability of developing clinically observable leukemia?

13 A Yes.

14 Q -- than will those who have not exhibited
15 the disease symptoms?

16 A Right.

17 Q Would that naturally follow if, in fact, the
18 disease symptoms were pre-leukemic stages?

19 A I'm not sure what that question is saying.
20 The --

21 Q If you were to agree with me for the moment --

22 A You mean the pre-leukemia would be also
23 caused by the radiation?

24 Q No, I'm not going to that for the moment.

25 A That, presumably, would happen because -- you

20-4
1 know, it could be an earlier stage of leukemia. But that's
2 not what we're talking about.

3 In other words, pre-leukemia would be very
4 high risk, but it wouldn't count.

5 Q Assuming for the moment, Dr. Bross, that that
6 element of the medical discipline which believes diseases
7 such as asthma, urticaria, eczema, et cetera, are
8 actually the initial stages of leukemia -- that is, pre-
9 leukemia -- wouldn't it naturally follow that individuals
10 who exhibit symptoms of those diseases would later on
11 develop clinically observable symptoms of leukemia?

12 A Well --

13 Q -- if you give me the first, would you agree
14 with the second?

15 A The point that I think maybe is not being
16 clear here is that all of the diseases that are listed as
17 indicator diseases are reasonably frequently encountered
18 in children. In other words, the children -- a lot of
19 children have asthma.

20 That does not mean that all of the children
21 who have asthma are going on to develop leukemia, not
22 by any means. It means that the risk of leukemia will be
23 higher in that group. But the absolute risks of leukemia
24 are very low.

25 So even if you increased the risk by a factor

20-5
1 of two or a factor of five or a factor of ten, the actual
2 absolute risk is still very low.

3 The -- If these things were in fact true
4 pre-leukemias, if all these cases were pre-leukemic, then,
5 of course, the risks would be enormous in that -- you know,
6 children with asthma would go on to develop leukemia.

7 Pre-leukemia is a disease that precedes
8 leukemia. So, in other words, instead of there just being
9 a high risk, you know, you'd have the kids who had asthma
10 going on to leukemia.

11 That doesn't happen.

12 Q That assumes that leukemia develops at the
13 same rate and continuously in all people; is that correct --
14 what you've just stated?

15 A No. What I was saying does not involve that
16 concept. It's simply that if it's truly pre-leukemic,
17 it's followed by leukemia. And so if the asthma is truly
18 pre-leukemic, then it's not just a higher risk, it's just
19 going to occur with leukemia.

20 So that if these diseases were in fact the
21 same thing as pre-leukemic diseases, you know, you would
22 have in this group -- not a tenfold risk, but you would
23 have a hundredfold or much higher risk than that.

24 In other words, it would be almost like if
25 you got the disease, you'd go on and get the leukemia. That's

20-6
1 what pre-leukemic means.

2 That's why -- you know, if you're going to
3 talk about pre-leukemia, that's what 't means.

4 Q Can you give me an indication of something
5 which is pre-leukemic, but is not leukemia?

6 A Well, you're now asking me for medical testi-
7 mony. I can give you an impression that among the dis-
8 eases that are likely to be considered pre-leukemic would
9 be something like a form -- or some forms of anemia
10 and the -- you know, this is the kind of thing perhaps.

11 Q In your view, exhibiting symptoms of anemia
12 would be pre-leukemic, but would not be leukemia?

13 A Well, you asked me for an example of some-
14 thing that a doctor would regard as possibly pre-
15 leukemic, and I gave you an example.

16 I don't -- You know, I'm not saying that
17 that is pre-leukemia. I'm saying that's something that
18 somebody might call pre-leukemic.

19 Q Is there anything that you would call pre-
20 leukemic?

21 A Well, I'm not testifying as a physician. And
22 the -- you know, you can't really have it both ways. If
23 you want me to testify as a statistician, I'd be pleased.

24 If you want me to testify as a physician, I
25 can't do it.

20-7 ✓
1 Q Dr. Bross, is there anything that you would
2 regard as pre-leukemic?

3 A You mean certainly pre-leukemic? I don't
4 know. I cannot really say that I know of anything that
5 I know is in that category, absolutely or -- you know, I'm
6 not speaking as a physician, so I really can't say.

7 Q So you would knock some things out as not
8 being pre-leukemia -- some types of diseases, such as
9 asthma, urticaria, eczema, pneumonia, dysentery and
10 rheumatic fever and refer to those as indicator diseases,
11 but there is no disease or symptom which you would call
12 pre-leukemic?

13 A What I'm saying is pre-leukemic is a time
14 frame reference. If the diseases occur very shortly
15 before the leukemia, then it can be pre-leukemic.

16 If the diseases we're talking about -- like
17 these that we're dealing with here -- occur substantially
18 before the occurrence of leukemia, then I wouldn't call
19 them pre-leukemic.

20 It's a time frame question. It's not a
21 diagnostic symptom question.

22 Q Is it your view, Dr. Bross, that individuals
23 who have been irradiated in utero will exhibit a greater
24 susceptibility for the indicator diseases than individuals
25 who have not been irradiated in utero?

20-8

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A. Well, the answer to that question involves the mechanisms that I have talked about.

In other words, if there is pre-existing genetic damage, then you are going to have -- let's say -- exposure to x-ray and it's going to produce -- it's going to be more likely to produce both, both the indicator disease and the subsequent leukemia.

In other words, it is a kind of enriched series you're dealing with. Because of that, you are, in a certain sense, picking up more persons who are in this susceptible group to start with than in the persons who subsequently show a history that does not include any of the indicator diseases.

- - -

21-2
1 THE WITNESS: Now, that's what co-
2 occurrence is all about.

3 BY MR. BLAKE:

4 Q Is the answer yes to my question?

5 A Well, I have attempted to give you an answer
6 to the question. I at this point don't really see
7 exactly where you're driving so maybe you can rephrase
8 it.

9 Q You mean you didn't understand my question?

10 A Well, I thought I gave you an answer to your
11 question.

12 I thought I understood a question -- I
13 gave an answer to a question that I understood, and I
14 thought it was a reasonably coherent answer. It fits in
15 with the statements I've been making previously, with my
16 testimony and with the issues before this hearing.

17 I thought to the best of my knowledge I had
18 answered your question.

19 Now, apparently, I did not answer your question
20 in your view. I'm really trying to get some clue as
21 to what you are driving at that was not in my answer.

22 Q Let me try again. Is it your opinion that
23 individuals who are irradiated in utero are more likely
24 than those who are not to develop diseases which you have
25 characterized as indicator diseases?

21-3

1 A This is the relative frequency now not of
2 leukemia, but just of the indicator diseases, per se?

3 Q That's correct.

4 A The effects are not overwhelming. You know,
5 it isn't like the risks are enormously higher, as some of
6 the risks are when you bring in a combination or co-
7 occurrence of the diseases.

8 I don't think that the risks are, the
9 risks of indicator diseases are greatly changed by the
10 occurrence specifically of the radiation. In other
11 words --

12 Q Is your answer no?

13 A It's -- Well, I won't say there's absolutely
14 no difference, but there's not a major difference, yes.

15 Q There's no statistically significant, meaning-
16 ful, observable difference?

17 A These are small differences. They're not
18 really significant -- probably not significant in most
19 cases.

20 Q Is it your opinion that individuals who
21 exhibit symptoms of the diseases which you have identified
22 as indicator diseases are more likely than people who
23 do not exhibit symptoms of those diseases to later exhibit
24 clinically detectable symptoms of leukemia?

25 A Well, this is the point -- and I have to

21-4
1 separate and answer in two senses. In the first case, if
2 there isn't also history of radiation exposure in the
3 child which had the indicator diseases, then this doesn't
4 seem to affect greatly the risk of leukemia.

5 It's when you have the combination of a
6 reported exposure to radiation early on, or in utero,
7 and the indicator diseases also that you have the increased
8 risk.

9 Is that clear?

10 In other words, there are two groups here:
11 Those who don't have any radiation, those who do and they
12 do not behave the same way.

13 Q Is your opinion that people who have both
14 been irradiated in utero and exhibit what you've referred
15 to as an indicator disease, that that class of people is
16 more likely to later exhibit leukemia?

17 A That's correct.

18 Q -- than people who did not either exhibit
19 the indicator disease symptoms or --

20 A That's correct.

21 Q -- weren't irradiated in utero.

22 Is that shared by members of the medical
23 community?

24 A I'm sorry. Would you -- Did you say
25 "shared"?

21-5
1 Q Is your opinion shared, endorsed, accepted,
2 by members of the medical community?

3 A As far as I know, there are people who accept
4 these views and people who don't. And the persons who
5 have connections with certain groups, such as the
6 Radiation Protection Community, certainly do not share
7 those views.

8 There are a lot of doctors now who do believe
9 in the fact that there are susceptible groups, and that
10 the susceptible groups which are sort of indicated by
11 the occurrence of these diseases in conjunction with
12 a prior exposure to x-ray do get more leukemia and are
13 the groups that have to be protected from a public health
14 standpoint.

15 So there is a fair amount of medical
16 opinion in agreement with the basics that I've stated.

17 Q Are there publications by medical doctors
18 that you're aware of which refer to the concept of indi-
19 cator diseases, as you have expressed it here?

20 A Well, most of these refer to the idea of a
21 susceptible subgroup. This is in the literature quite a
22 bit.

23 And, of course, that's linked to the notion
24 that I brought in. Indicator diseases are a way, which is
25 why they're called indicator diseases in this sense, of

21-6
1 being able to get to -- not identifying specific individuals
2 in the susceptible subgroup, but as it were, an enriched
3 series where there are more susceptibles in that series
4 than in the persons who don't have the indicator
5 diseases.

6 The idea of a susceptible subgroup which was
7 first, I guess -- prior to any of these papers that we've
8 been talking about so far -- came out quite early in the
9 game, I guess -- is, as far as I know, accepted by members
10 of the medical community.

11 Q So you are reading the literature as saying
12 susceptible subgroup where that term is used, to be an
13 endorsement of your use of the term "indicator diseases"?

14 A Well, I'm saying the purpose of using in-
15 dicator diseases analytically, scientifically and for
16 statistical purposes was to try to get a handle on the
17 susceptible subgroups.

18 Q How is it that you identify susceptible
19 groups prior to birth? That is, is there a method in your
20 view of identifying susceptible individuals prior to
21 birth?

22 A Unfortunately, there is not. And that's
23 essentially why we have to resort to a somewhat indirect
24 method of trying to get a handle on the group.

25 Q Are we talking here about problems with

21-7

1 infants, problems with children, when we talk about
2 leukemia and in utero radiation and indicator diseases?

3 A As far as the Tri-State Survey goes, the
4 actual data really doesn't start until after infancy.

5 Q After --

6 A After early -- In other words, the early
7 infancy period is not included in that data. It's the
8 period from -- I believe one year to 14 years that is in
9 the data.

10 They were not infants.

11 Q In your study of the numbers of individuals
12 who exhibited clinically observable symptoms of leukemia,
13 who previously had exhibited symptoms of the indicator
14 diseases, were those numbers who in the end demonstrated
15 leukemia, exhibited clinically observable leukemia?

16 A I'm sorry. I just don't -- This question
17 I don't -- You're talking about numbers --

18 Q Uh-huh. I want to know --

19 A I'm not sure what you mean by numbers. Do
20 you mean --

21 Q Let me try again --

22 A -- indices --

23 Q Let me try again. Are you aware of data
24 which suggests that there is any distinction as a function
25 of in utero radiation between the numbers of children

21-8
1 who develop leukemia, all of whom have exhibited symptoms
2 of your indicator diseases?

3 A Well, you're talking about a difference and --
4 you know, I -- one of the groups that you're mentioning
5 seems to be those who have indicator diseases and leukemia
6 and radiation. I'm not sure who you're comparing it
7 with now -- with those who don't have any of these -- or
8 don't have indicator diseases and x-rays.

9 The answer is yes if that is the case --

10 Q Those that exhibit the indicator disease that
11 were not irradiated.

12 A The risks of leukemia are not substantially
13 increased. If they don't have radiation, they just have
14 the indicator disease --

15 Q Right.

16 A That doesn't seem to produce much. What
17 produces the major effects is when you have the combina-
18 tion -- the co-occurrence of the diseases and the exposure.
19 You have to have all three, in a sense. Maybe that's why
20 these questions have been hard to follow.

21 There are three factors here.

22 Q Let me refer you to your answer to Question
23 No. 17. Let me insure that you have the right corrections
24 to this, as a result of the Board's order.

25 Question No. 17 now should read, Dr. Bross,

1 "How does additional annual radiation exposure relate to
2 the background radiation exposure?"

3 That's Question 17.

4 A Uh-huh.

5 Q And your answer is unaffected by the Board's
6 ruling. I will say that because the last time we
7 talked, you had indicated you had some changes which were
8 not related to the Board's order.

9 Could we agree that the average life span
10 of individuals in this country is on the order of 70
11 years?

12 A Well, I take it you're talking about life
13 expectation?

14 Q Fair enough.

15 A The life span -- There's a difference
16 between life span and life expectation. The life span is
17 sort of the biblical three score and ten that you've just
18 mentioned.

19 That hasn't been greatly changed.

20 - - -

22-1

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1 Q So we can agree that the average length of
2 time that people live in this country is about 70 years?

3 A No, because --

4 Q We can't agree on that --

5 A Well, that's a different question. Let
6 me just make -- I'm not arguing that it's an immense
7 difference, but for purposes of making this crystal clear,
8 life span and life expectation are two different concepts
9 that you mixed in the same question.

10 As far as life span goes, that's really the
11 thing that hasn't changed much. It's still around the
12 Biblical life span, and the life expectation is the thing
13 people mostly talk about, which does show gradual shifts
14 upward.

15 But 70 years, this is for general discussion,
16 you know, not a specific number for a particular purpose;
17 that's fine with me.

18 Q Could we agree that there is average natural
19 background of radiation in the United States of somewhere
20 in the neighborhood of 100 millirem per year?

21 A I think that's stated in the question, yes.

22 Q Can we agree that the natural background
23 radiation levels in the Denver, Colorado, area are higher
24 than the average in the United States?

25 A Yes.

22-2 1 Q Can we agree that they are greater than 150
2 millirem per year?

3 A The problem of the background doses which
4 you're dealing with here is actually dealt with in some
5 detail in a paper in "Health Physics," in a letter in
6 "Health Physics," which is cited, and I --

7 Q Dr. Bross --

8 A -- will answer your question that the answer
9 is yes, and the paradoxes are explained in that article.

10 Q Dr. Bross, as I understand your response
11 to Question No. 17, you would say -- You have indicated
12 in your response to Question 17 that with radiation
13 increments of 50 millirem per year this might be taken as
14 roughly equivalent to aging 50 percent faster per year?

15 A This is a very rough equivalent. The idea
16 is to show basically that -- This is not intended as an
17 absolute or flat, unconditional type of statement. It's
18 a very rough way of looking at these figures.

19 In other words, what does 50 extra millirem
20 mean? It's essentially increasing the dosage per year for
21 an individual by 50 percent.

22 If the dosage of radiation actually -- we get
23 radiation from multiple sources, so not just from
24 background.

25 If the dosage is increased by 50 percent, and

22-3 1 background radiation were the sole factor, then it would
2 be true that the radiation would show this increase, yes.
3 But there are a lot of other factors.

4 Q Is it your testimony that if excess radiation
5 to the public is 50 millirem per year, this might be
6 taken as roughly equivalent to aging 50 percent faster
7 per year?

8 A What I'm saying is that's a rough estimate --

9 Q Is that your testimony?

10 A Well, I'm giving you testimony as a sort of
11 indicator of a way to look at numbers.

12 If you mean that I am stating this as a
13 scientific fact or that this is taken literally as this,
14 no, I don't. That's not my testimony.

15 That's not my intention, anyway.

16 Q Well, I can't see any other intention in
17 the testimony. Dr. Bross, other than what I'm reading.

18 Are you changing the number or saying that
19 50 percent faster is really not the right number or it's
20 a range of numbers?

21 A Well, if you want -- I've given it very rough.
22 If you want to make a very carefully phrased statement,
23 it will be a very long statement.

24 For instance, it would say, if the only
25 radiation exposure were background radiation, this would

22-4 1 be the case; but, of course, that doesn't happen to be
2 true in this country or other countries.

3 So this is a very, very rough or crude way of
4 looking at it. I'm not saying more than that.

5 Q If I added "other radiation exposures," this
6 effect would not occur?

7 A It would be washed out. That's why -- as
8 explained in the "Health Physics" testimony, I was dealing
9 with the question of background radiation, attempting to
10 give some kind of clarification to what background
11 radiation, relative to possible releases in the range,
12 which is eliminated from the question, how this would
13 relate to the background radiation.

14 In a very rough way, this gives some idea of
15 how it might relate.

16 In fact, as I pointed out in the article in
17 "Health Physics," because of these other effects that
18 come in pretty well wash out.

19 It doesn't come up this way. You don't
20 see a doubled risk in Denver and you don't see a reduced
21 risk in New Orleans because of the background radiation,
22 because that's not the only radiation exposure and the
23 other factors come in and sort of diminishes effect.

24 Q What are the other radiation exposures which
25 most people in Denver or other parts of the country

22-5 1 receive, other than natural background radiation?

2 A. Well, there's a long list of them.

3 Q. I see, and what are they?

4 A. Well, they include medical exposure.

5 Q. And how much would you have that add to the
6 average per year?

7 A. Well, these average numbers for medical
8 exposures are, again, numbers which I don't deal with.

9 I'm just saying that the average -- there are
10 these other sources, and because of these other sources,
11 you don't see in the vital statistics which are used in
12 these comparisons the differences that you would see if
13 only background were involved.

14 If you like, on this particular question, I
15 would rephrase my answer to improve the record or whatever
16 you'd like on this.

17 It was intended to give an idea of what 50
18 rem meant in terms of background, because the background
19 radiation, if that were the only radiation, would be
20 what would account, say, for the increased risks in
21 leukemia in populations which were not exposed to radiation
22 technologies.

23 Q. What additional radiation would you add to
24 the average member of the public other than some amount
25 of medical radiation and natural background?

22-6

1 A Well, there's a long list, like in travel.

2 Q In travel, did you say?

3 A Yes.

4 Q And how much would you add for the average
5 person for that?

6 A As I say, I do not -- These numbers are
7 all calculated. They are in -- the radiation protection
8 community gives long tables of these numbers, and I don't
9 happen to think those tables are particularly informative.

10 What's true is there are a lot of other
11 factors, but when we start adding estimates and individual
12 numbers, you know, I'm not proposing to do that.

13 Q How many papers do you believe exist in your
14 bibliography which make reference to medical irradiation?

15 A I didn't count them. There are quite a lot.

16 Q Quite a lot?

17 A Yeah.

18 Q Twenty, thirty, eighty?

19 A I don't know. I didn't count the number
20 specifically in my bibliography for medical radiation.

21 Q And you do not know what people receive on
22 average in the United States from medical irradiation?

23 A What I'm telling you is that the average
24 numbers that are given are not numbers which I would be
25 prepared to testify about.

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22-7 1 I don't believe the numbers. For instance --
2 I'll give you a for instance.

3 I'm aware that there are such numbers. I
4 do not want to testify as to those numbers.

5 For instance, I think someplace or another in
6 the testimony there's talk about 70 millirem average from
7 medical radiation.

8 I don't know whether that particular number I
9 remember is correct or not, but it's the kind of number
10 that you're trying to get me to talk about.

11 I don't believe this kind of number means
12 anything, because what it amounts to is there are a lot
13 of people that are getting doses of medical radiation which
14 are, of course, in the rad range for diagnostic purposes,
15 and they are getting much larger doses which are in the
16 therapeutic radiation range.

17 Now, if you also include people who don't get
18 X-rays and so forth and average it all up, you may get to
19 a number like 70 millirem; but to me, that doesn't mean
20 anything, because in fact, that isn't what a person gets.

21 That's just one of these average numbers which
22 are used, as far as I'm concerned, erroneously.

23 Q Well, aren't we talking here about average
24 numbers?

25 Isn't your 50 millirem a year, isn't your

22-8
1 50 percent aging factor? Aren't we talking about the
2 average effects to people in your answer here?

3 A. All I'm doing in this is to show that a
4 50 millirem dose, in addition to background, is not
5 something which would be completely negligible.

6 That seems to be the thrust of the testimony.

7 I don't want to say exactly how much the
8 actual 50 millirem addition to the total radiation
9 exposure of a person is going to contribute.

10 Q. Now, Dr. Bross, can you agree with me that
11 the average person in the United States, his greatest
12 component of exposure is natural background; would you
13 agree with that?

14 A. Well, the answer is no.
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1 BY MR. BLAKE:

2 Q Would you agree that it's -- if it's not
3 the greatest component, that it's 25 percent?

4 A Well, you were getting into the specific
5 questions that I dealt with in the letter in health
6 physics dealing with the paradoxes of background radia-
7 tion.

8 And if you would like my complete answer to
9 these questions, it's all given there. I am not testifying
10 here or now -- I think the line of questioning indicates
11 that this is a great point I'm making. It's not a great
12 point I'm making.

13 It's simply a matter of giving a person some
14 idea of how 50 millirem compares to background. That's
15 all.

16 Q That's what I'm trying to come to understand.
17 I look at the testimony; I see there the statement with
18 respect to excess radiation of 50 millirem be taken
19 roughly as equivalent to aging 50 percent faster per
20 year. That's the statement in the testimony.

21 What I'm trying to understand is: What does
22 that really mean, and how could I see evidence of this?
23 And when I start asking you about what is natural back-
24 ground, can you expect to see this exhibited anywhere by
25 virtue of differences of natural background, you say it is

23-2
1 lost in the sea of all radiations which people receive,
2 and, therefore, you don't really see this effect at all.
3 Is that correct?

4 A. Yes.

5 Q. So this effect in your view exists, but you
6 cannot see it?

7 A. It's a hypothetical effect because it deals
8 with background radiation by itself, which isn't a real
9 situation.

10 In other words, this question may not be
11 phrased as perfectly as it might. It is basically dealing
12 with radiation background as -- just background radiation
13 as the sole exposure, how it would be -- what 50 percent
14 would mean in that respect.

15 The figures on the -- before we had a lot of
16 other radiation in the environment, the relationship to
17 age, which again is very rough -- it's something like
18 that the risk of leukemia would go up with age in a
19 specific ratio all of the time.

20 And that's essentially -- in those days when
21 that was the only source of radiation or practically the
22 only source of radiation -- the background radiation --
23 it was equivalent to aging.

24 And if you like, I will correct the statement
25 to say that if you want to take all of the sources of

23-3
1 radiation and deal with the modern current situation of
2 multiple exposures, then, of course, you are dealing with
3 something much more complex than this simple picture.

4 Q Except that we can't do that because you don't
5 know what people are generally exposed to. Hasn't that
6 been your testimony? You don't know what the average
7 exposures are to people either from medical radiation,
8 from technological radiation sources of one sort or
9 another, from travel and televisions; isn't that your
10 testimony?

11 A Well, you're asking me do I know what these
12 exposures are -- you were asking me specific questions
13 about numbers. And I'm saying I'm not giving you those
14 numbers because I don't believe in those numbers.

15 But there are not -- I mean there are a lot
16 of other factors involved and background radiation today
17 really is not an issue.

18 Q It's not an issue in general, or it's not an
19 issue in this proceeding? Is that what -- What do you
20 mean that background radiation is not an issue.

21 A Well, I believe that that's a matter of public
22 knowledge, that there are a lot of sources of radiation.
23 I'm not quantifying them. I'm saying qualitatively, yes,
24 there are a lot of sources of radiation.

25 I'm refusing to give you quantitative numbers

23-4
1 that I don't believe in.

2 JUDGE FOREMAN: Mr. Blake, I would like to
3 take the privilege of stepping in for a second with a
4 question. Maybe I can clarify this, and then all of us
5 would go ahead because I think Dr. Bross is answering
6 as well and as honestly as he can.

7 There seems to be a conceptual difference
8 here. So, Dr. Bross, I just want to ask you a question.

9 THE WITNESS: Surely.

10 JUDGE FOREMAN: If that clears it up, okay;
11 if it doesn't, then we can go ahead.

12 In this answer, you are indicating that an
13 index of aging attributable to natural background is a
14 tenfold increase in leukemia.

15 THE WITNESS: Yes.

16 JUDGE FOREMAN: And if one added a 50-milli-R,
17 then one group would be increasing -- or accelerating that
18 increase in leukemia as an index of aging?

19 THE WITNESS: That's correct. And only with
20 the proviso that, you know, we're really just talking
21 about background radiation -- say, hypothetically back
22 before we have these contaminating factors.

23 At that point in time there was this very
24 close relationship between aging and the background radia-
25 tion exposure. It was more or less going up proportionately.

23-5
1 And I'm saying -- and I perhaps did not make
2 it sufficiently clear, and I should have, I recognize
3 this -- that in those terms if you add 50 millirem per
4 year to the 100 millirem, then it would have the same
5 effect in a sense as accelerating the aging process, or
6 it would tend --

7 JUDGE FOREMAN: The aging process is mani-
8 fested by the rate of increase in leukemia?

9 THE WITNESS: Yes.

10 JUDGE FOREMAN: I guess that's all I can
11 add. I don't know whether that is helpful.

12 MR. BLAKE: That's helpful, Dr. Foreman.
13 Let me shift to the other statement since Dr. Foreman
14 has specifically raised the tenfold increase in leukemia
15 statement.

16 BY MR. BLAKE:

17 Q Taken literally, Dr. Bross, would that state-
18 ment mean that you would expect to see in the public
19 incidences of leukemia increase tenfold with each ten
20 years of life? That is, folks between -- cases of
21 leukemia diagnosed between -- in people aged 10 to 20 --
22 10 to 19 would be tenfold of those diagnosed at ages
23 0 to 9 or 0 to 10?

24 A Yes. These are the age-specific leukemia
25 rates over time, which is simply another way of saying

23-G
1 what you've said. That's what I'm referring to.

2 Q And, indeed, a hundred times greater between
3 20 and 29, and a thousand between 30 and 39, et cetera?

4 A Yes. I'm beginning to wonder whether I made
5 a mistake, and I should have said twofold. I'm not
6 sure. My memory is a little bit unclear on this point.

7 I don't actually -- since you're making this
8 a major issue -- recall specifically the age-specific
9 rates. But the important point that is involved is that
10 it goes up -- it goes up -- the age-specific rates go
11 up with time in this way so that you have some rough
12 correspondence to aging.

13 Q I see. That --

14 MR. BLAKE: I wish you had jumped in a lot
15 earlier, Dr. Foreman, because you've cut this one down a
16 lot.

17 BY MR. BLAKE:

18 Q You're not proposing anything close in your
19 testimony to the numbers which you've indicated in here?
20 You're not really proposing that there is a tenfold in-
21 crease in leukemia with each decade of life, or that you
22 could expect to see this by virtue of a 50-millirem in-
23 crease in background?

24 A I think it's possible that in answering this
25 question I was relying -- unwisely -- on my memory about

23-7
1 the actual rate at which the leukemia goes up.

2 And I can't -- I don't remember the actual
3 age-specific tables.

4 The point that I was making was really not
5 dependent on the actual numbers. It's simply that in
6 terms of the disease, there is this very rough relationship
7 between the duration and presumably the extent of back-
8 ground radiation exposure and the risk of leukemia, which
9 actually the figures are in my -- are in that letter that
10 I cited in "Health Physics."

11 And I think I was mistakenly trying to avoid
12 going back to that reference. I should have.

13 But the point is simply that there is a kind
14 of correspondence between leukemia risks and age and,
15 presumably, the background exposure which is presumed
16 constant with age or was at one time.

17 Q Is there anything in the statistics of
18 leukemia incidence as a function of age which would support
19 your tenfold increase statement, or anything close to
20 it -- nine, eight, seven, six, five, four, three, two?

21 A Yes. There is a definite increase, yes.
22 In other words, it's supported -- I can't remember
23 whether I have misquoted the actual number that I had
24 originally given in the other paper, but there is very
25 definitely in the statistics -- especially the earlier

23-8
1 statistics, this kind of relationship.

2 Q I can agree with you, Dr. Bross, that there
3 are greater incidences of leukemia observed in people aged
4 80 than are observed in people aged 10.

5 A Yes.

6 Q But are you aware of any statistics that
7 support anything close to --

8 A To what I've said here --

9 Q -- to what you've said here in your testimony?

10 A Yes, yes. Leukemia --

11 Q Yes?

12 A -- statistics do this. Let me add another
13 codicil, since I guess in the interest of accuracy I should
14 say that we really -- if I had put all the if's, and's
15 and but's in, it would have been a complicated statement.

16 But one of the statements I should have put
17 in is that since childhood leukemia and adult leukemia are
18 really somewhat different diseases, the statement really
19 refers to adult leukemia.

20 It, generally speaking, refers to -- let's
21 say -- what would happen from 20 to on out. It will --
22 If you want to be very literal, there are a lot of other
23 things that I have to say.

24 For instance, in the actual age-specific
25 statistics, this relationship begins to get lost at very

23-9
1 high ages. That's for several reasons, because for,
2 among other things, the figures are beginning to lose
3 numbers in those age groups, so that the numbers get
4 kind of erratic at the top end of the scale.

5 But insofar as the numbers, say, between 20
6 and 50 or that sort of range -- 20 and 60, where the age-
7 specific leukemia rates are given, they show this kind
8 of direct relationship to age.

9 Q Isn't it -- and you assigned this at least
10 in part to the existence of natural background?

11 A Well, if we were talking about leukemia
12 prior to the existence of radiation that has been put into
13 the environment, then, presumably, that would be the
14 primary factor, that the natural background would be the
15 factor that would have that effect on the leukemia
16 rate. That's why it would go up that way.

17 Q And you assign it as -- Did you assign it
18 in part to a cumulation or cumulative effect, which is
19 occurring on the individual? Is that involved in this?

20 A Well, the way that background radiation works,
21 as I see it in terms of the discussion that I've been
22 giving, is that you are exposing the persons to constant
23 radiation, but that the risk is going up because you're
24 taking more shots, in a sense.

25 Therefore, as you take more shots, you

1 increase the risk of the event occurring. It's that
2 kind of cumulation.

3 Q I see.

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24-1 1 Q I see, so the probability, if you will, of
ge 2 this shock you are referring to is the same at any point
3 in time, but the fact the longer you live, the greater
4 has been your total exposure, not in terms of radiological
5 exposure, but rather, in a profile; and, therefore, the
6 greater the chance or the risk that you will --

7 A Yes, that's correct.

8 Q -- take on leukemia or otherwise....

9 A Yes.

10 Q And also reflected in that, I take it, is
11 the latency period which may be involved with the earlier
12 initiation of leukemia, but which is not observed, therefore
13 detected and therefore reported until later years?

14 A Well, if you have a latency period on this
15 curve, if you can sort of visualize a straight line --
16 let's say, if there was no latency, it would just go
17 straight up, but since there's a latency, it sort of
18 starts at a later point.

19 It has moved or shifted over, and let's say,
20 does not really start going up very fast until after you
21 get into the thirties and forties.

22 But that's a shift of the curve, not a real
23 difference of the point that -- in a certain sense
24 background radiation, at least in the old sense, was
25 proportional to age and the risk of not just leukemia, but

24-2 1 other diseases, shows this relationship.

2 Q Which again, I take it, is no more than just
3 the fact that you are exposed for a longer period of time
4 to the same probability at any point in time?

5 A Right.

6 Q And, therefore, over all, there's a total
7 greater risk?

8 A Right.

9 JUDGE WOLFE: Mr. Blake, would this be a
10 good time to recess? It is now 5:15.

11 MR. BLAKE: Fine.

12 JUDGE FOREMAN: May I add just one comment?

13 JUDGE WOLFE: Yes.

14 JUDGE FOREMAN: Dr. Bross, in view of the
15 quantitative uncertainties of your numbers and some of
16 the problems in developing a concept, is this worth
17 pursuing any more as an addition to the points that you
18 wish to make in your testimony, or can you say enough has
19 been said?

20 THE WITNESS: As far as I am concerned, I will
21 be perfectly happy to drop the question.

22 I put it in solely as a kind of way of showing
23 a little bit what the relationship, since there were
24 discussions on background and what additions to background
25 were, to try to clarify that point.

24-3

1 I've succeeded in messing it up, and it is
2 not in any sense essential to my testimony. It was just
3 a clarification.

4 JUDGE FOREMAN: Mr. Blake, I don't want to
5 interrupt your cross-examination, because you have points
6 to make.

7 But you might consider that statement in your
8 pursuance of questioning. I'm not saying you shouldn't,
9 but note that he has said that.

10 MR. BLAKE: I have. Thank you, Your Honor.

11 JUDGE JORDAN: May I just say one thing.

12 There is also a little unclarity in my mind
13 as to -- well, you recognized there was uncertainly about
14 the tenfold increase, whether it was tenfold or twofold;
15 but there is also a question in my mind as to whether it is
16 a geometric increase each decade of life?

17 THE WITNESS: It's going up geometric.

18 JUDGE JORDAN: It's a geometric increase.

19 THE WITNESS: I'm sorry. I apologize. I
20 was trying to bring in an answer, and I should have
21 checked with my paper, but I didn't.

22 JUDGE JORDAN: No, I'm not asking you what
23 the number is, but you do believe it's geometric?

24 THE WITNESS: Yes.

25 JUDGE JORDAN: All right. That's all I need

24-4 1 to know. Thank you.

2 MR. BLAKE: Judge Wolfe, Mr. Jones has
3 pointed out to me that you used the term "recess." It
4 never occurred to me that we're going to stop for the day.

5 Is that what you had in mind?

6 JUDGE WOLFE: Yes.

7 MR. BLAKE: Stopping for the day?

8 JUDGE WOLFE: Yes. We run from 9:00 to 5:00,
9 unless -- and I've gone a little bit over because you
10 were in the middle of pressing your cross-examination.

11 So we will recess until 9:00 a.m.

12 MR. BLAKE: Would you entertain a request to
13 continue?

14 JUDGE WOLFE: I would entertain, but not
15 particularly be entertained.

16 (Laughter.)

17 JUDGE WOLFE: I see you, Mr. Jones.

18 MR. JONES: Chairman Wolfe, Mr. Blake has
19 discussed this matter with both myself and Dr. Bross at
20 the last recess, and we had advised him that based upon
21 his estimate at that time that he felt that he should --
22 and I'm not trying in any sense hold him to that estimate --
23 be able to complete his cross-examination of Dr. Bross
24 this evening by extending for a bit.

25 Therefore, on that premise, we told him

24-5 1 that we had no objection to continuing.

2 However, we are completely at the Board's
3 disposal.

4 MR. BLAKE: I guess I should add at this
5 point now that I'm another hour and a half or two hours
6 down the pike, it is apparent to me that I would not
7 finish this evening, assuming that we took a break and
8 then came back and went until 6:30 or a quarter to 7:00.

9 I don't think that would allow me to finish.

10 JUDGE WOLFE: Well, no one advised me
11 earlier, and at most this evening, without prior notice,
12 all we could proceed to would be until a quarter of 7:00.

13 And you still have another hour or more
14 of cross-examination.

15 MR. BLAKE: Yes, sir.

16 JUDGE WOLFE: And then we have Mr. Turk.
17 What is the expectation of the parties, that
18 we will be finished with Dr. Bross tomorrow?

19 MR. BLAKE: It is still my expectation we
20 will be finished with Dr. Bross tomorrow.

21 MR. WOLFE: Mr. Turk, on your cross-
22 examination?

23 MR. TURK: It's difficult for me to predict
24 at this time how long the cross-examination will take.

25 It will be a greater amount of cross-examination

24-6 1 than I have had of other witnesses in the past.

2 My rough estimate would be on the order of
3 four hours.

4 (Bench conference.)

5 MR. TURK: I should say it might be less, and
6 it might be a little bit more.

7 JUDGE WOLFE: All right. The Board will
8 accommodate all concerned then.

9 In order to be fairly assured that Dr. Bross
10 can be excused tomorrow, we will take a ten-minute
11 recess, and we will proceed to a quarter to 7:00.

12 All right.

13 (Recess taken.)

14 - - -

JUDGE WOLFE: Back on the record.

During the off-the-record conference with Counsel, it's been agreed that instead of proceeding until a quarter of 7:00, we will proceed until 6:00 o'clock.

All right. Back to you, Mr. Blake.

BY MR. BLAKE:

Q Dr. Bross, referring now to your response to Question No. 18, did the -- were you first aware of the typographical error today between "reasonable" and "measurable"?

A I believe that's the first I heard about it.

Q But does it alter at all your answer to the question? The same answer?

A It seems to be essentially the same question. I wouldn't change my answer because of that change.

Q And in your answer as written, you refer in the fourth line to the "new risk estimates."

A Yes.

Q What new risk estimates are you referring to there?

A Well, I think the simplest way to answer the question is to contrast new and old, because that's what new refers to; it's the opposite of old, as it were.

25-2 1 The old risk estimates that have been the
2 basis for the BEIR Reports and other official reports
3 for the Federal Inter-Agency Task Force are based on two
4 classes of data, primarily. There may be a little
5 exception.

6 There are some animal studies that were
7 involved in the estimates, but primarily, the data that
8 was involved involved persons who were exposed to risks,
9 or exposed to levels of radiation which were of the order
10 of a hundred or more times the levels that would be
11 involved in the one-rad range.

12 The basic data that was involved there came
13 from persons who were exposed to medical X-rays, therapeutic
14 medical X-rays, which ranged in dosages from some of the
15 studies in the 100-rem range, some a little below that, but
16 many of them in the range of about 350 rem or rads, which
17 I'm using interchangeably, although the radiologists
18 always refer to rads and the health physicists to rems.

19 The data that is involved in that, plus the
20 data from the Japanese A-bomb studies of persons who were
21 exposed to dosages which were really quite high, and in
22 that same range, like three or four hundred rem.

23 So these studies all deal with dosages that
24 are far above the levels that we want to be talking about
25 in considering low-level radiation hazards for this kind

25-3 1 of a hearing.

2 In order to go from dosages at those very
3 high levels to estimates of what the risks would be at
4 levels much, much lower, it was necessary to use assumptions
5 about the dosage response curve that we had earlier
6 mentioned.

7 The commonest assumption, though not the only
8 assumption, was the linear hypothesis or linear
9 extrapolation, which is equivalent, which means that if
10 for instance you find health risks at 300 rem are visible
11 and there's a certain amount, that you divide by the
12 300 to get the estimate from the linear hypothesis of the
13 dose effect relationship at one rem or at five rem or at
14 low doses.

15 So in other words, this is the old risk
16 estimates, all based on this class of data and on these
17 assumptions; and what I'm contrasting here, and when I
18 refer to new risk estimates are those estimates which are
19 based on persons who are exposed actually to low levels of
20 radiation in the general range under ten rem, and who were
21 studied in biostatistical epidemiological studies for the
22 health effects from either deaths from specific causes or
23 leukemia.

24 So these two classes of data are entirely
25 different.

25-4 1 The new studies have in general a number of
2 scientific and technical advantages over the old studies,
3 which I have listed in detail in Chart A of my paper, and
4 it's entitled, "Comparison of New Data on the Portsmouth
5 Shipyard Workers with the Data Used in Official
6 Reports (Interagency, BEIR, ICRP, etc.)," which are the
7 old data.

8 So if you want to see in a certain sense the
9 answer to what's new data and what's old data as I'm
10 referring to it here, the thing that's labeled BNS
11 data and the characteristics of this data that are listed
12 in the table are those for the new data; and the official
13 report in the column labeled "Official Reports," those
14 are the characteristics of the data that's the old data.

15 Q Now, help me, Dr. Bross, with the table
16 that you are referring to. Do you have an exhibit number
17 on the paper?

18 MR. JONES: Your Honor, let the record
19 reflect that the witness is referring to Joint Intervenors'
20 Exhibit 25?

21 THE WITNESS: I'm sorry, I didn't know the
22 number, but it's this table if that's any help. It's
23 the last page.

24 There's one more difference between the old
25 data and the new data, which is that the old data was

25-5 1 collected and analyzed, in general, for the first BEIR
2 Report for the most part, with minor changes in later
3 reports; whereas the new data has mostly but not entirely
4 been reported since 1978, and the data I'm talking about
5 since 1980.

6 BY MR. BLAKE:

7 Q I see, so the new risk estimates which you
8 are referring to here are based on the Portsmouth Naval
9 Shipyard worker data?

10 A No, not exclusively. In other words --

11 Q Is that what PNS stands for in Chart A?

12 A Yes, PNS is Portsmouth Naval Shipyard Workers,
13 but I was using this -- What I'm saying is, this isn't
14 the only new data.

15 The new data has these characteristics in
16 general that are listed in that column.

17 The old data has in contrast the characteristics
18 that are listed in the column labeled, "Official Report."

19 The new data that I'm referring to, more
20 specifically, if you would like to have as definite a
21 specification on this point as possible is in the appendix
22 of the same paper, which I've forgotten -- is it 25,
23 I believe?

24 In the section labeled "Appendix II,
25 Biostatistical Studies of Populations Exposed to Low-Level

25-6 1 Ionizing Radiation Where Positive Health Effects Appear
2 in the Data (By Type of Exposure)," these studies would
3 be -- which are separated into three categories, medical
4 X-ray, nuclear weapons and occupational exposures, these
5 studies will reflect the new data for the most part.

6 There are some old studies there, but most
7 of the studies that are listed here, let's say, in the
8 late '70's and in the '80's.

9 So these studies give rise to completely
10 different estimates of the health effects, which do not
11 involve linear extrapolation.

12 Q I'm looking now at two pages which are a
13 series of reports, or at least references, in Appendix II.

14 It is a portion of these studies which
15 include the information which provide the basis for the
16 new risk estimates?

17 A Yes. The new risk estimates -- not all these
18 studies produce new risk estimates, but the new risk
19 estimates come from this list almost entirely, I believe,
20 from studies that are on this list.

21 These studies have this different
22 characteristic. So if we refer to new and old estimates,
23 that's what I'm referring to in my testimony.

24 Q Do you have them identified in your copy and
25 could you quickly indicate which ones you are actually

25-7 1 referring to, as opposed to all of them? If you have not,
2 then let's not take the time to --

3 A. Well, I would have to go down the list
4 almost item by item if you want a specific response to
5 this.

6 Most of the studies that I'm referring to
7 are basically studies of the Hanford data, the Portsmouth
8 data and the federal studies such as the Center for
9 Disease Control study of Big Smokey veterans, and the
10 Portsmouth study, and of course the studies that I cite
11 in my testimony.

12 Q. Maybe you and I can get together with
13 Mr. Jones quickly afterwards, and we'll not take the time
14 on the record at the moment.

15 It may be that we can do it more quickly.

16 A. Okay.

17 MR. JONES: We would have no objection to
18 that, Your Honor.

19 JUDGE WOLFE: All right. Fine.

20 BY MR. BLAKE:

21 Q. Are these new risk estimates which you refer
22 to in your testimony your estimates of risk?

23 A. Well, the ones I'm quoting for me are
24 estimates that I made, but not all of the new risk
25 estimates were made by me.

25-8 1 They were made by others. Mantuso and others
2 have made risk estimates. There are from the different
3 studies risk estimates possible, and other people have
4 made them besides myself.

5 Q Are these new risk estimates which you've
6 made or which Mantuso has made subscribed to by ICRP?

7 A No.

8 Q NCRP?

9 A No.

10 Q BEIR?

11 A No.

12 Q UNSCEAR?

13 A No.

14 Q Any other committee, council, agency?

15 A No. These estimates have been ignored by
16 the radiation protection community, which would cover all
17 the agencies you've mentioned.

18 In other words, none of the -- For example,
19 specifically, BEIR III does not really deal with this
20 kind of material in its estimates.

21 It does not use this. It sometimes attacks
22 these papers or otherwise tries to disparage them, but it
23 does not use the new data to make estimates.

24 Q Is this new risk estimate your 1980
25 reassessment?

25-9 1 A No. Actually, the estimates I'm referring to
2 here primarily are coming a little later and involve a
3 little bit newer data, namely what is in this paper here,
4 and particularly the other estimates of doubling dose
5 follow up the estimate that I originally gave to the NRC
6 in 1978, the estimate for myeloid leukemia in men by
7 rem doubling dose.

8 Q You have also sponsored as an exhibit here
9 "1980 Reassessment of Health Hazards of Low-Level
10 Ionizing Radiation."

11 A Yes, I -- I don't know what you mean by
12 sponsored quite, but I wrote it --

13 Q Well, you wrote it and it appears as an
14 exhibit in the proceeding.

15 A -- or talked about it and presented it. Yes.

16 Q Is it based on your new risk estimates?

17 A No. No. In a way, the new risk estimates in
18 this paper essentially supersede the earlier paper that
19 I gave in Germany.

20 In other words, these are more recent
21 estimates. These are newer estimates, although they are
22 in line with the estimates that I cited earlier.

23 As far as I'm concerned, my testimony is
24 based, in my questions and so forth, on this latest
25 publication.

6-1
bm
1 BY MR. BLAKE:

2 Q I see. And it supersedes what we have
3 identified as Exhibit 26, the 1980 Reassessment?

4 A Yes, there's some minor amount of overlap.
5 It covers somewhat different terrain in some cases, but
6 the essential thing you're talking about -- the estimates --
7 are superseded and are in here.

8 JUDGE WOLFE: And when you say "in here,"
9 Doctor, you mean --

10 THE WITNESS: In this --

11 JUDGE WOLFE: -- in Joint Intervenors --

12 THE WITNESS: -- 25.

13 JUDGE WOLFE: 25. All right.

14 BY MR. BLAKE:

15 Q Does it also supersede a 1981 Reassessment
16 which you made?

17 A What I did for a while -- until this paper
18 was published -- was make a reassessment more or less
19 annually to try to keep up with the literature, which is
20 fairly -- which comes out fairly fast.

21 So there were a lot of references in this
22 set which are not in the earlier sets. But they are
23 essentially updates.

24 In other words, they updated each other. And
25 this is the latest update.

1 Q Is this latest update -- Joint Intervenors
2 Exhibit 25 --

3 A Yes.

4 Q -- does it differ from your 1981 Reassessment?

5 A Only in the sense that it adds more material
6 effects.

7 Q But it's essentially the same thesis, same
8 theme, based on the same information, but now you've added
9 more --

10 A Yes.

11 Q Referring to your answer to Question No. 19,
12 you refer in the last line of that answer to 30 studies.

13 A Yes, which are the ones listed.

14 Q Are these the studies that you've identified
15 in Exhibit 2 and about which we're going to talk --

16 A Uh-huh.

17 Q -- further?

18 A That's correct.

19 Q I'm sorry. Appendix 2, not Exhibit 2.

20 JUDGE FOREMAN: While Mr. Blake is thinking,
21 would you tell me which journal this was the galley
22 of. Where was this published?

23 THE WITNESS: This is the "Yale Journal
24 of Biology and Medicine."

25 JUDGE FOREMAN: Thank you.

26-3

1 BY MR. BLAKE:

2 Q In your answer to Question 19, you indicate
3 that the BEIR III Report is unacceptable to you. And as
4 I understand your testimony today, it's because they've
5 ignored this type of data, that is, from lower-dose
6 data, and rather have relied on high-dose, or what you
7 refer to as the old risk estimate theory and extrapolation
8 down based on the linear/linear concept? Is that a fair
9 summary?

10 A That's a fair summary, if I could just add
11 one comment on that. The -- "Ignored" is a word, but it's
12 not maybe exact because in some cases they took the
13 trouble to attack individual studies in these reports.

14 So in that sense, you know, they had looked
15 at them in that sense; and they had made a series of nega-
16 tive comments of one kind or another concerning the
17 studies.

18 But it is correct to say ignored in the sense
19 that the actual data was utilized in any way in BEIR
20 III for the risk estimates.

21 Q You've used the term "attack." There's a
22 difference of opinion between you and the BEIR Committee
23 members; is that correct?

24 A Well, in my view -- I believe I get the thrust
25 of your question. In my view, what should have been done

26-4
1 in the BEIR III study was to take advantage of all of the
2 data which has come in since BEIR I.

3 Actually BEIR II and BEIR III are almost --
4 there's just a year's difference between those two. BEIR
5 I was carried out -- in fairness to the persons who pre-
6 pared BEIR I, I think they made a conscientious effort
7 to use the data which I've referred to as old data, and
8 which was in those days virtually the only data they had
9 available to work from.

10 In the BEIR II Report the question about
11 linear hypotheses and so forth became a very hot issue.
12 There was agreement in a certain sense that they would not
13 consider the new data. So it wasn't considered.

14 But there was a lot of disagreement in BEIR II
15 on the linear hypothesis. It ended up with another report
16 that came out about -- maybe only a short time later, a
17 year later or so, which attempted to paper over the
18 differences between the members of the BEIR Committee
19 itself.

20 In my view, the weakness of the BEIR Report
21 is that they should have taken the newest and best data
22 that was available for their estimates. And this was not
23 done.

24 Q Would you regard your position with respect to
25 BEIR III, or what maybe you would describe as an

1 inadequacy in BEIR III as an attack on BEIR III?

2 A What I've just said?

3 Q Yes.

4 A Well, if you like, it is --

5 Q No. Would you?

6 A -- the negative assessment of BEIR III as
7 a scientific publication, and I would -- you know, I'm not
8 fussing about the word "attack," but basically it's an
9 extremely negative criticism -- if you want to make it
10 more politely.

11 But I really don't see any reason to mince
12 words. I don't agree with this report. It's a terrible
13 report. And in that sense, you know, I'm attacking it.

14 I'm not attacking the people. I'm attacking
15 the results.

16 Q Is there any distinction between the BEIR III
17 Committee's difference or negative appraisal of your work
18 and your negative appraisal of BEIR III's work? Is it
19 the same? If one is an attack, the other is an attack.
20 If one is a negative appraisal, is the other a negative
21 appraisal?

22 A No.

23 Q No?

24 A The actual effort made by BEIR III are attempts
25 to simply discredit this. Now, that's both an attack, but

26-6
1 it is also an effort to completely discredit the work that
2 was done.

3 Now, my purpose is not primarily to change
4 the assessment that was made of the old data, which I
5 think could simply be replaced by the new data. I'm not
6 saying we should not have a consideration of the old data,
7 but it's simply obsolete.

8 I'm not in that sense going through the same
9 kinds of criticisms of individuals and of the studies
10 that are being made. I'm not trying to reject the
11 old studies for the reason that they're old, but simply
12 because there are better data available now.

13 That's to me at least quite a different kind
14 of criticism than individual attacks on each individual
15 study.

16 Q So yours is a professional difference of
17 opinion with them, but their difference with your work,
18 you would characterize as an attack?

19 A No, it's not really so much a professional
20 difference of opinion. I'm saying, you know, this is what
21 they should have done and didn't do, rather than, you know,
22 this is what was done and it's terrible, or something of
23 that sort.

24 Q Is your opinion of the BEIR III Committee's
25 report and their work influenced at all by that Committee's

1 expressed conclusions about your statistical work?

2 A Well, the truth of the matter is that, although
3 it might have been customary to circulate these things
4 beforehand, I didn't really see any of this very much be-
5 forehand.

6 I had talked to Radford who was the Chairman
7 of BEIR II a little bit about this. I had some informa-
8 tion.

9 But as far as I'm concerned, it is not the
10 critique of our work which is my critique of BEIR III.
11 It is the fact that they didn't use the data that now
12 exists.

13 It is -- Actually I didn't -- I expressed
14 my views about the failure of BEIR III to do this before
15 I even saw most of the things that they have actually
16 said or written.

17 In fact, I don't seriously -- you know, I
18 don't spend a lot of time reading those things. I get a --
19 They say the same thing over and over again. So I
20 don't respond to criticism in this way, like answering
21 it or anything of that sort.

22 Q Are you generally familiar, or have you spent
23 enough time looking at the BEIR Committee Report so that
24 you're generally familiar with the type of people who serve
25 on the BEIR Committee?

26-8
1 A Well, I know Radford. And I know a couple of
2 the people who -- I guess they put on as chairman to replace
3 him, but if you're asking for names, I'll have trouble.

4 In general, I had some personal contact of
5 one kind or another, not necessarily in the preparation
6 of the BEIR III operations where I didn't see people,
7 but prior to that with most -- with some at least of the
8 persons on that committee.

9 Q Would you say there are in fact renowned
10 biostatisticians on the BEIR Committee?

11 A Well, they don't have representation of
12 persons who in my view are outstanding statisticians or
13 in my view are outstanding epidemiologists, although some
14 of them like Radford is someone who I would certainly
15 accept as a peer.

16 But most of the persons on the Committee --
17 the predominance of that Committee consists of persons who
18 are not either statisticians or epidemiologists. There's
19 only a couple who could come anywhere close.

20 Q Edward Radford you would qualify as a peer
21 of yours, but not as an outstanding scholar in the field?

22 A Well, I suppose it's impolitic to make
23 a personal judgment of persons at an open hearing where
24 it would go into print. But I'm afraid that I would have
25 to say that we both served on the Committee, and we talk

27-1

1 to each other and so forth.

2 I don't -- I think Radford is a very
3 sincere person. But he's not, in my view, the kind of
4 person who can do the statistical analyses that I think
5 are called for.

6 Q And there is no one, in fact, on that
7 Committee who in your view is capable of doing the type
8 of work which is called for --

9 A Well, I can't remember every single person on
10 the Committee. But the bulk of the members of the Com-
11 mittee are persons who -- for instance, radiologists,
12 I believe, and health physicists -- persons who have long
13 associations.

14 Q I'm talking mostly about the epidemiologists
15 or the biostatisticians.

16 A I think that the person associated with the
17 Japanese A-bomb data -- but I actually can't remember the
18 name of the person ... but I think he took over for
19 Radford.

20 And I -- you know, I respect the man.

21 Q Gilbert Bebee?

22 A Yes.

23 Q -- from NCI?

24 A That's it.

25 Q He is a respectable epidemiologist in your

27-2
1 view?

2 A Well, I have dealt with Bebee on occasions.
3 And I -- you know, I don't have the same negative
4 attitude, let's say, towards him that I would have
5 towards other members of the BEIR Committee who are in my
6 view completely unqualified.

7 JUDGE WOLFE: All right. We'll now recess
8 until 9:00 a.m.

9 (Whereupon, at 6:02 p.m. the hearing was
10 recessed, to reconvene at 9:00 a.m., Wednesday, March 31,
11 1982 in the same place.)
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NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

In the matter of: LOUISIANA POWER & LIGHT COMPANY (WATERFORD)

Date of Proceeding: March 30, 1982

Docket Number: 50-382-OL

Place of Proceeding: New Orleans, Louisiana

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Mary L. Bagby

Official Reporter (Typed)

Mary L. Bagby

Official Reporter (Signature)