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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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In the Matter of: :
:
HOUSTON LIGHTING & POWER :
COMPANY :
:
Allens Creek Nuclear Generating :
Station, Unit 1 :
:
----- x

Docket No. 50-466

Bates College of Law
University of Houston
Houston, Texas

Wednesday,
January 21, 1981

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

APPEARANCES:

Board Members:

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

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I N D E X

<u>WITNESSES</u>	<u>DIRECT</u>	<u>CROSS</u>	<u>REDIRECT</u>	<u>RECROSS</u>	<u>BOARD EXAM.</u>
Reginald L. Gotchy and F. S. Sanders					
By Mr. Black	3240				
By Applicant		----			
By Intervenors					
By Mr. Doherty		3245			
By Mr. Schuessler		3326			
By Mr. Doggett		3388			
By Dr. Marrack		3419			

WRITTEN LIMITED APPEARANCE STATEMENT OF

Laurence G. Cowles

PAGE NO.

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P R O C E E D I N G S

9:05 a.m.

1 JUDGE WOLFE: It is 9:05.

2 We'll resume the hearing.

3 Making their appearance this morning are Mr.
4 Newman and Mr. Copeland for Applicant; Mr. Black for the
5 NRC Staff and Mr. Doherty.

6 It's my understanding we will proceed this
7 morning with the Staff's direct testimony relating to
8 radioactivity in the cooling lake with regard to Bishop
9 Contentions 12 and 21.

10 Mr. Black.

11 MR. DOHERTY: Dr. Wolfe --

12 JUDGE WOLFE: Yes.

13 MR. DOHERTY: There are two problems.

14 I think, first of all -- I don't want to sound
15 like Bobby Fischer, but the lighting has suffered over
16 night.

17 JUDGE WOLFE: The what?

18 MR. DOHERTY: The lighting. It's out. It's
19 going to be difficult to see witnesses, I think, to some
20 extent.

21 Is there anyone here who can do that?

22 The other thing is that last night, as we went
23 off the record, there were several exchanges -- I don't
24
25

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1 think they were desirable. I would wonder if the content
2 ought to be on the record.

3 JUDGE WOLFE: What exchanges?

4 MR. DOHERTY: Well, they took place about here.

5 Mr. Scott addressed you, I believe; Applicant
6 addressed the conversation.

7 It was at the very end of the immediate closing,
8 and I'm concerned about what that was; and it wasn't on
9 the record, and about its general content and emotional
10 level.

11 (Bench conference.)

12 JUDGE WOLFE: Were you in the hearing room at
13 the time, Mr. Doherty?

14 MR. DOHERTY: Yes, sir.

15 JUDGE WOLFE: Do you recall what the conversation
16 was about?

17 MR. DOHERTY: Not the content of the conversation.
18 But there were several sentences. I was out of hearing
19 range.

20 JUDGE WOLFE: As I recall, Mr. Scott said that
21 he hoped in light of the fact that what he termed, I
22 guess, as concessions or permissions for the witnesses --
23 the Applicant's witnesses: Armstrong, Tischler and
24 Schlicht -- be allowed to leave and return on Thursday,
25 and the fact that Staff, out of time, would be permitted

1 to put on its direct testimony, would be taken into con-
2 sideration by the Board in viewing -- or in allowing
3 similar treatment, as I remember.

4 Perhaps the Applicant and Staff's counsel can
5 help me out here.

6 That similar allowances and permissions would
7 be extended to the Intervenors.

8 There was some dialogue, I think by Mr. -- or
9 some statement by Mr. Copeland -- that any delay in the
10 case was certainly, at least in part, attributable to the
11 fact that Mr. Scott was not in attendance on Friday. And
12 this resulted in delay.

13 There was some interchange. This was off the
14 record.

15 I don't think it's important because I don't
16 pay -- the Board doesn't pay much attention to these dia-
17 logues between representatives and counsel or these internal
18 squabbles.

19 The Board has said time and time again that the
20 parties should get together and try to work things out
21 between themselves.

22 And further, we make our own conclusions and
23 are not swayed one way or another by arguments over
24 scheduling.

25 We are drawing our own conclusions, and we are

1 not persuaded one way or another.

2 Is there anything that I left out, Mr. Black, or
3 Mr. Copeland, Mr. Newman, with regard to any statements
4 after the recess yesterday evening?

5 MR. COPELAND: Nothing that I would consider
6 of any importance, Your Honor.

7 JUDGE WOLFE: I think Mr. Doherty's statement is
8 well taken that once the record is closed, at least for
9 that evening, there be no further dialogue or statements
10 unilaterally, or any dialogue which is not on the
11 record.

12 Obviously, I didn't think that this was important
13 enough to even relate this morning, which I have related.

14 All right. Mr. Black.

15 MR. BLACK: Thank you, sir.

16 The Staff would like to call as witnesses
17 Dr. Gotchy and Dr. Sanders to the stand.

18 JUDGE WOLFE: In the meantime, is there someone
19 in the audience who would please go downstairs to the
20 office and check on the legitimacy here.

21 MR. BLACK: Well, they're coming to the witness
22 stand, Mr. Chairman, I received a phone call last night
23 from Intervenor Bishop, who indicated to me that he would
24 not be here this morning, possibly this afternoon.

25 He would not be here all day Thursday, and

1 possibly Friday.

2 And he apologized for that, but indicated to
3 me that he relied somewhat on the tentative schedule we
4 had set forth before, and he had made business appointments
5 and what have you that could not be changed.

6 And he just wanted to have me convey that mes-
7 sage to the Board.

8 So I'm doing that.

9 JUDGE WOLFE: Yes.

10 Well, we've taken Mr. Bishop out of the alpha-
11 betical sequence after having shown good cause, and having
12 gone into the business arrangements.

13 I don't think that we'll extend that further
14 to Mr. Bishop.

15 Mr. Doherty, are you in contact with Mr. Bishop?
16 Or would you be in contact with Mr. Bishop and state to
17 him --

18 Well, first: Will you be in contact with him?

19 MR. DOHERTY: I have his work phone. I think
20 that probably is the best we can do. I will attempt to
21 call him as soon as I get a chance.

22 JUDGE WOLFE: I suggest you call him and say that
23 we're not going to be persuaded anymore by other business
24 arrangements as a showing of good cause.

25 If we get to -- if we complete the -- whatever

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1 examination has to be had and the Board questions to the
 2 panel of three of Applicant's witnesses, and he is not
 3 here to resume his cross-examination, the witnesses will
 4 be excused; and he will have waived his right of cross-
 5 examination.

6 In case you don't contact him or are unable to
 7 contact him and tell him exactly that, would you report
 8 back to me as soon as you have been unable to contact
 9 him; and I will ask Mr. Black or Applicant's counsel to
 10 attempt to deliver that message to him.

11 So let me know as soon as you're unable to
 12 contact him, or as soon as you have been able to contact
 13 him.

14 MR. DOHERTY: Certainly.

15 MR. BLACK: Could I ask that these witnesses
 16 be sworn?

17 JUDGE WOLFE: Yes.

18 Would you rise, please, and raise your right
 19 hands.

20 Whereupon,

21 REGINALD L. GOTCHY

22 and

23 F. S. SANDERS

24 having first been duly sworn, were examined and testified
 25 as follows:

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1 JUDGE WOLFE: Please be seated.

2 The witnesses' names again?

3 MR. BLACK: Dr. Gotchy is to the left and Dr.
4 Sanders is to the right.

5 DIRECT EXAMINATION

6 BY MR. BLACK OF WITNESS GOTCHY:

7 Q Dr. Gotchy, do you have before you a document
8 entitled "NRC Staff Supplemental Testimony of Reginald L.
9 Gotchy Relative to Radioactivity in the Cooling Lake"?

10 A I do.

11 Q Has this testimony been prepared by you or under
12 your control and supervision?

13 A Yes.

14 Q Do you have any corrections or additions to this
15 testimony?

16 A Yes, I have some.

17 Q Would you name those off, please.

18 A On the first page, my title is radiobiologist
19 rather than radiologist.

20 On page four in the middle of the long answer,
21 beginning with the line "using the cooling lake," the
22 next sentence, "In general, radiation doses calculated" --
23 and there's a misspelled word there -- "by the staff are
24 intended to apply to maximum individuals." "An average
25 adult" should be stricken.

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1 JUDGE WOLFE: Would you state that again, Mr.
2 Gotchy?

3 DR. GOTCHY: Yes. It will now read: "Radiation
4 doses calculated by the staff are intended to apply to
5 maximum individuals."

6 And the next sentence should read: "Specific
7 persons could [other than "will"] receive somewhat
8 higher or much lower doses," and the rest of it is as
9 said.

10 JUDGE WOLFE: Was any change made to the first
11 sentence of that answer?

12 DR. GOTCHY: No, sir.

13 JUDGE WOLFE: Well, as written, I think --
14 Well, that's all right.

15 DR. GOTCHY: On page five, the second answer,
16 the third line, which reads, "and an assumed daily con-
17 sumption," that should read "2.0 liters" instead of
18 "1.2 liters."

19 On the next page, the first answer, the first
20 line. That should read: "The Staff's calculation of
21 annual maximum individual doses."

22 That's all.

23 BY MR. BLACK OF DR. GOTCHY:

24 Q As corrected, do you adopt this testimony as
25 your testimony in this proceeding?

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A. Yes, I do.

MR. BLACK: Judge Wolfe, we would like the testimony entitled "NRC Staff Supplemental Testimony of Reginald L. Gotchy Relative to Radioactivity in the Cooling Lake," as well as an attached statement of professional qualifications, to be incorporated in the record as if read and constitutes evidence on behalf of the NRC Staff.

JUDGE WOLFE: Any objection?

MR. NEWMAN: No objection.

JUDGE WOLFE: There's no objection.

All right. The testimony of -- the written testimony of Dr. Gotchy and the attached professional qualifications will be incorporated into the record as if read.

(See attached pages.)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)	
HOUSTON LIGHTING & POWER COMPANY)	Docket No. 50-466
(Allens Creek Nuclear Generating Station, Unit 1))	

NRC STAFF SUPPLEMENTAL TESTIMONY OF
REGINALD L. GOTCHY RELATIVE TO RADIOACTIVITY IN THE COOLING LAKE

[Bishop Contentions 12 and 21]

- Q. Please state your name and position with the NRC.
- A. My name is Reginald L. Gotchy. I am employed at the U.S. Nuclear Regulatory Commission as a Senior Radiologist in the Radiological Assessment Branch.
- Q. Have you prepared a statement of educational and professional qualifications?
- A. Yes. It is attached to this testimony.
- Q. What is the purpose of your testimony?
- A. The purpose of my testimony is to respond to Bishop Contentions 12 and 21 which state as follows:

Bishop Contention 12

Water containing radioactive materials will seep out of the cooling lake at Allens Creek and into the Evangeline Aquifer, which supplies drinking water for area residents. Applicant has not accurately estimated the amount of radioactive materials that will be ingested by area residents due to this contamination of their drinking water by this seepage.

Bishop Contention 21

The cooling lake at ACNGS will contain radioactive material, and the amount of radioactive material will increase over time, presenting an unacceptable hazard to humans.

Q. Will the routine power operation of ACNGS result in the release of fission and activation products to the cooling lake?

A. Yes.

Q. Has the NRC Staff estimated the probable nuclide releases to the lake.

Q. Yes. In accordance with 10 C.F.R. §50.34a, an applicant for a permit to construct a nuclear power reactor is required to include a preliminary description of the design of equipment to be installed for keeping levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology and the economics of improvement in relation to benefits to the public health and safety and other societal and socioeconomic considerations and in relation to the utilization of atomic energy in the public interest.

Appendix I to 10 C.F.R. Part 50 provides numerical guidance on design objectives for light-water-cooled nuclear power reactors to meet the requirement that radioactive materials in effluents released to unrestricted areas be kept as low as is reasonably achievable.

To meet the requirements of 10 C.F.R. Part 50.34a, the applicant has provided designs of radwaste systems and effluent control measures for keeping levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable within the requirements of Appendix I to 10 C.F.R. Part 50 and the requirements of the Annex to Appendix I dated September 4, 1975, elected in lieu of performing a cost-benefit analysis as required by Sect. II.D of Appendix I. In addition, the applicant has provided an estimate of the quantity of each principal radionuclide expected to be released annually to unrestricted areas in liquid and gaseous effluents produced from normal operation including anticipated operational occurrences.

The Staff's detailed evaluation of the radwaste system and the capability of these systems to meet the requirements of Appendix I are presented in Chapter 11 of Supplement No. 2 to the Safety Evaluation Report. The quantities of radioactive material calculated by the Staff to be released from the plant are also presented in Chapter 11 of Supplement No. 2 to the Safety Evaluation Report and in Sect. S.5.4 of the FSFES with the calculated doses to individuals and the population that will result from these effluent quantities.

At the time of the operating license, the applicant will be required to submit Technical Specifications which will establish release rates for radioactive material in liquid and gaseous effluents and which provide the routine monitoring and measurement of all principal release points to assure that the facility operates in conformance with the requirements of Appendix I to 10 C.F.R. Part 50.

Q. How did the Staff calculate the radiation dose that an individual would receive from liquid effluents in the cooling lake?

A. After the quantities of radioactive material that will be released to the cooling lake are calculated, estimates of radiation doses to man via the most significant pathways from cooling lake activities are calculated based on conservative assumptions regarding the dilutions of effluent gases and radionuclides in the liquid discharge and man's activities using the cooling lake. In general, radiation doses calculated by the staff are intended to apply to an average adult. Specific persons will receive higher or lower doses, depending upon their age, living habits, food preferences, or recreational activities. The basic features of the calculational models and the suggested parameters for the estimation of radiation doses to man from effluent releases are set forth in Regulatory Guide 1.109, "Calculation of Annual Dose to Man From Routine Releases of Reactor Effluents For the Purpose of Evaluating Compliance With 10 C.F.R. Part 50, Appendix I."

Q. What represents the potentially significant exposures pathways to the population from activities at the cooling lake?

A. The specific pathways that were considered by the Staff are (a) drinking water from the lake, (b) eating fish and other invertebrates from the lake, and (c) various shoreline activities including boating and swimming in water containing radioactive effluents.

Q. Will the Allens Creek cooling lake be used as a drinking water supply?

A. No. However, for conservatism individual doses via this pathway are evaluated at the 40-year cooling lake equilibrium concentrations using standard dose models and an assumed daily consumption of ^{-2.0} 1.2 liters.

Q. Do the dose calculations assume a buildup of radionuclides.

A. Yes. Doses from shoreline activities result primarily from the buildup of radionuclides such as CS-137 deposited on the shore. These radionuclides are initially mixed with the effluent and then settle out of the water. Deposition along the shore will result in the greatest potential for individual exposure and this buildup is calculated in the models.

Q. Does swimming in the water result in a dose higher than the dose from shoreline activities?

A. No. Swimming does not result in a higher dose because of the smaller concentration of radionuclides in the water and the higher shielding effect of the water.

Q. What was the result of the Staff's calculation of radiation doses to man from liquid effluents in the cooling lake?

A. The Staff's calculation of annual individual doses from liquid effluents in the cooling lake at equilibrium is set forth in Table S.5.13 of the FSFES and Table 11.4 of Supplement No. 2 to the SER (March 1979). These tables show that the maximum annual dose to the total body from all liquid effluent pathways is 1.4 millirems per year from the proposed Allens Creek unit. The annual dose to any organ from all liquid effluent pathways is 1.8 millirems per year.

Q. Do these calculated maximum dose commitments to an individual from ACNGS operation comply with the requirements of 10 C.F.R. Part 50, Appendix I?

A. Yes. As indicated in Table S.5.14 of the FSFES, the above calculated doses are well below the Appendix I design objectives of 3 millirems/yr/unit to total body and 10 millirems/yr/unit for individual doses to any organ from all liquid effluent pathways.

Q. Has the Staff calculated the amount or effect of contamination on local drinking water supplies if radioactive materials would seep out of the cooling lake?

A. No. The Staff has not done any such calculations because the effect of radioactive contamination on local drinking water supplies will be insignificant. Since the annual calculated dose to assumed individuals drinking water directly from the cooling lake are well below the design

objectives set forth in Appendix I, any dose received by an individual drinking water from a contaminated drinking supply such as a well, would also be within the Appendix I design objectives and, therefore, acceptable. In fact, however, the dose received by an individual drinking contaminated well water, if contamination does occur, would have to be much less than the calculated dose to an individual drinking cooling lake water directly. This reduction would result from the following physical mechanisms: (1) ground water would additionally dilute the radionuclides in the cooling lake; (2) radionuclides would be partially leached out (i.e. removed) as they moved from the lake to the ground water; and (3) depending on the travel time to the nearest drinking water supply, the radionuclides would undergo radiological decay. Thus, these factors would combine to reduce individual doses to even less than the calculated drinking water doses of 0.1 mrem/yr to the total body and any organ doses of this magnitude are regarded as insignificant.

Q. Will the radionuclides increase over time as a result of buildup in the cooling lake?

A. Yes, but the buildup of these radionuclides over time has been evaluated and included in the calculations of doses.

Q. Since the calculated doses associated with the operation of ACNGS are within the Appendix I design objectives, what does the staff conclude with respect to the health risks?

A. Based on current health effects models, the Staff concludes that health risks to present day populations from cancer (less than 1 predicted), and to future populations from genetic effects associated with the normal operation of ACNGS at Appendix I levels are insignificant relative to naturally occurring events. Therefore, radioactivity in the Allens Creek cooling lake does not represent an unacceptable health hazard.

DR. R. L. GOTCHY

Professional Qualifications

My name is Reginald L. Gotchy. I am a Senior Radiobiologist on assignment with the Radiological Assessment Branch in the Office of Nuclear Reactor Regulation. In this capacity, I am responsible for coordinating the technical review and evaluation of the environmental radiological impact of nuclear facility operations.

I received a B.S. in Zoology from the University of Washington in 1958, an M.S. in Radiation Health from the Colorado State University in 1966, a Ph.D. in Radiation Biology from the Colorado State University in 1968, and attended the University of Washington Graduate School 1958-1959 as an AEC Radiological Physics Fellow.

I have 19 years of professional experience in health physics, industrial hygiene, radiation physics, radiation biology, environmental sciences, project coordination of research and development programs, and development of AEC and NRC standards. This experience has included operational and safety responsibilities, and review and coordination of facility operations under contract to the AEC. I have been employed by the Lawrence Radiation Laboratory, the U.S. Public Health Service, Reynolds and Electrical Engineering Company, the AEC Nevada Operations Office, and the NRC Office of Standards Development prior to my assignment in the Office of Nuclear Reactor Regulation in 1975. I was an adjunct professor of Radiation Health Technology at the University of Nevada, Las Vegas (1969-1972).

I am a member of Sigma Xi (Research Society of North America), the American Nuclear Society, the Health Physics Society and the International Radiation Protection Association, and the Radiation Research Society. I am a past member of the American Association for the Advancement of Science and the American Industrial Hygiene Association.

I am certified by the American Board of Health Physics, and served as a member of the Panel of Examiners (1972-1976). I remain active in the development of examination questions and updating my professional standing by periodic post-graduate work and training.

1 BY MR. BLACK OF DR. SANDERS:

2 Q Dr. Sanders, do you have before you a document
3 entitled "NRC Staff Supplemental Testimony of F. S.
4 Sanders Relative to the Aquatic Ecology of the Proposed
5 Allens Creek Cooling Reservoir" and attached statement of
6 professional qualifications?

7 A Yes.

8 Q Has this testimony been prepared by you or under
9 your control and supervision?

10 A Yes.

11 Q Do you have any additions or corrections to this
12 testimony?

13 A One revision on page 13. I referred to Richmond,
14 Texas as located upstream from Allens Creek. It is, in
15 fact, downstream.

16 Q And that is located approximately in the middle
17 of the page; is that correct?

18 A About ten lines down, yes, sir.

19 Q As corrected by you, do you adopt this testimony
20 as your testimony in this proceeding?

21 A Yes, I do.

22 MR. BLACK: Judge Wolfe, the NRC Staff would
23 move to incorporate the testimony of Dr. Sanders into the
24 record as if read and his statement of professional
25 qualifications to constitute evidence on behalf of the NRC

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Staff.

JUDGE WOLFE: How about Attachment B?

MR. BLACK: And Attachment B.

JUDGE WOLFE: Any objection?

MR. NEWMAN: No objection, Your Honor.

MR. DOHERTY: No objection, sir.

JUDGE WOLFE: The written direct testimony of Dr. Sanders, including Attachments A and B thereto, will be incorporated into the record as if read.

(See attached pages.)

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

IN THE MATTER OF)
HOUSTON LIGHTING & POWER COMPANY) Docket No. 50-466
(Allens Creek Nuclear Generating)
Station, Unit 1))

NRC STAFF SUPPLEMENTAL TESTIMONY OF

F. S. Sanders

RELATIVE TO THE AQUATIC ECOLOGY OF THE
PROPOSED ALLENS CREEK COOLING RESERVOIR

(TEXPIRG CONTENTIONS 2 and 4, Griffith 4, and McCorkle 2)

- Q. Please state your name and position with Oak Ridge National Laboratory.
- A. My name is Frank S. Sanders and I am employed by ORNL as an aquatic ecologist assigned to the Environmental Impacts Program of the Environmental Sciences Division.
- Q. Have you prepared a statement of educational and professional qualifications?
- A. Yes.

Q. Is that statement attached to this testimony?

A. Yes. See Attachment A.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to respond to the following contentions:

Due to the smaller proposed cooling lake size and its changed location with respect to the original design, the cooling lake will be useless as a viable recreational fishery because:

1. The new dike location fails to include the nearby north bluff area as a fish spawning habitat and fails to capture the freshwater runoff occurring in this area;
2. Chlorine releases into the lake will kill significant numbers of fish;
3. Sewage discharges from Wallis, Sealy, and the nuclear power plant will cause excessive algal growth in the lake;
4. Heavy metals will concentrate in the lake and in the fish making them inedible; and
5. Thermal (cold) shock will kill large numbers of fish when the plant shuts down during the winter.

Furthermore:

6. Even if the cooling lake is approved by the Board, the Board should require that it be redesigned to be more of an environmental benefit and less of an environmental burden. Specifically, the dam (levee) should be extended northward to a

point just east of its present northeast corner so that the additional runoff can go into the lake and so that the north bluff area can be a viable fish spawning area.

Q. Have you participated in the review and assessment of the environmental impacts associated with the construction of the Allens Creek Nuclear Generating Station (ACNGS)?

A. Yes.

Q. What has been the nature of that review and assessment?

A. I have reviewed the Sections of the Allens Creek Environmental Report Supplement (ER Suppl.) that contain information and analysis on the ecology of Allens Creek, the Brazos River, and the proposed cooling lake. I also have conducted an independent review of various federal and state government reports and open literature scientific publications that are relevant to the aquatic ecology of the ACNGS site and have consulted recognized experts in Texas reservoir ecology.

Q. As a result of this independent review and analysis, did you prepare any sections of the Final Supplement to the Final Environmental Impact Statement (FSFES) pertaining to the construction and operation of ACNGS?

A. Yes, I prepared S.2.4.2, S.4.3.2, S.5.3.1.2, S.5.3.2.2, and parts of S.6 of the FSFES.

Q. In response to the above-listed contentions, what is the general scope of this supplemental testimony?

A. My supplemental testimony will address the six contentions listed above by clarifying or expanding the information presented in the FSFES.

1. Need for additional fish spawning habitat and freshwater inflow to sustain a viable recreational fishery in the cooling reservoir.

Q. What is the loss of shallow water spawning habitat (water depth of 10 feet or less) associated with the new cooling reservoir design in comparison to the original design?

A. Re-location of the levee so that a 5120-acre lake will be formed instead of a 8250-acre lake will result in the loss of the shallow backwater spawning habitat of the north bluff area. The only substantial shallow section remaining under the 5120-acre design will be the flooded arm of Allens Creek at its confluence with the cooling reservoir. The steep-sloped brush area along the southern perimeter of the reservoir also will provide some shallow spawning habitat.

Q. Will the Allens Creek confluence function as a viable spawning area for fish?

A. Possibly not. It may not be a viable spawning area because of the high silt load that should be deposited in this area during winter and spring creek flows. Inflowing silt would interfere with spawning behavior and egg survival because of gill abrasion, low dissolved oxygen, rapid burial of nests, etc.

Q. Will the cooling lake, then, be without any significant shallow-water spawning habitat?

A. Yes. However, the rip-rap dike area extending along the entire inner perimeter of the lake may function as spawning habitat to some extent because some fish (mainly sunfishes) will undoubtedly try to spawn there. The steep-sloped bluff area on the south perimeter should provide some brushy spawning habitat for crappie.

- Q. Will freshwater inflow also be lost as a result of relocation of the reservoir perimeter?
- A. Yes, a small amount of freshwater inflow and associated silt, nutrients, etc. will be lost by not including the north bluff area in the lake drainage.
- Q. Will the loss of shallow-water spawning habitat preclude the development of a viable recreational fishery in the cooling reservoir?
- A. No, if a viable fishery is defined by the fish yield to fishermen. Catchable fish can be successfully maintained in a cooling reservoir by both put-and-take and put-grow-and-take fishery management methods in the absence of successful spawning within the system. Another potential fishery management approach is to use the proposed settling basins as rearing ponds for juvenile fish during early growth periods. Other available management options are detailed in the Allens Creek Fishery Management Plan (1980) and the Inland Fisheries Operational Plan (1980) for the state of Texas. Introducing juvenile fish of migratory species into the cooling reservoir should be successful because of the large, abundance forage fish food resource (principally shad) that is expected to be present in the lake. These management options should allow both bass and catfish to be maintained in the reservoir. Crappie should develop by natural reproduction into a viable seasonal fishery.
- Q. What is the effort required to sustain a fishery by any of these methods?

A. It is my understanding, from conversations with fishery ecologists in the Texas Department of Parks and Wildlife (TDPW), that one successful year class every 3 years, occurring either from natural reproduction or from artificial stocking, is sufficient to sustain a quality recreational fishery in Texas warmwater reservoirs.

Q. Has this level of stocking been successful elsewhere?

A. It is my understanding that once-in-three year stocking is a common successful fishery management practice in the state of Texas.

Q. Will the loss of freshwater inflow associated with the redesigned lake perimeter affect the recreational fishery?

A. There should be no affect from the loss of freshwater dilution because the reservoir concentration cycle is not expected to exceed a factor of two which will not allow deleterious conditions to develop such as high dissolved solids (FSFES, Sect. S.4.3.2.3). Furthermore, productivity in the lake will not be limited by silt or nutrient inflow from the north bluff area.

Q. What is your conclusion regarding the potential effects of the redesigned lake perimeter on sustaining a viable recreational fishery?

A. My conclusion is that because recreational fisheries in other thermally-loaded reservoirs have been established and because of the legal mandate of Texas Department of Parks and Wildlife to provide a recreational fishery, a viable fishery can be established and maintained. Because Allens Creek will be a unique ecological system, successful fishery management will evolve over time through

a process of monitoring the quality of the fishery and applying the flexible management options available to TDPW. Thus, a viable recreational fishery can be maintained in the absence of successful spawning within the cooling reservoir itself, and in the absence of freshwater runoff from the north bluff area.

2. Chlorine discharges into the lake will kill significant numbers of fish.
 - Q. How much chlorine has been proposed for discharge into the cooling lake?
 - A. The applicant has proposed an intermittent discharge of 2.2 mg/l of total residual chlorine (TRC) during two 15 minute periods a day, consisting of 0.2 mg/l free residual chlorine and 2.0 mg/l combined residual chlorine. Under these conditions, approximately 1525 lbs of chlorine per day will be discharged into the 5120 acre lake (FSFES, P.S.5-14).
 - Q. Has a chlorine minimization study been proposed to decrease this discharge commensurate with adequate biofouling control?
 - A. Yes, the U.S. Environmental Protection Agency has issued a National Pollution Discharge Elimination System permit for ACNGS that requires a chlorine minimization study. Such a study is supported by both the NRC staff and the applicant.
 - Q. What is the expected end result of such a study?
 - A. On the basis of past experience, it is expected that the ACNGS will be able to operated efficiently (i.e., have adequate chlorine biofouling control) with less than the proposed releases given above (U.S. EPA, Fed. Reg., Oct. 14, 1980, pages 68328-68355).

Q. What will be the potential effect of chlorine on the reservoir fish?

A. TRC has been demonstrated to have both an acute and chronic effect on fish. Such effects are a function of the exposure concentration, the duration of exposure, and the life-stage and physiological conditions of the fish being exposed. Exposure concentration is a function of the amount of chlorine released and its subsequent chemical interaction with the reservoir water.

Q. What will be the expected TRC concentrations in the cooling reservoir as a result of chlorine biofouling control activities?

A. Because the amount of chlorine to be released will depend upon the results of the minimization study, we cannot accurately predict the concentrations of TRC that will enter the cooling reservoir. We can assume that much of the released chlorine will combine with ammonia in the eutrophic lake waters and form mono-, di-, and tri-chloramines. The toxicities of these compounds are apparently of the same order of magnitude as free chlorine but the chloramines are more persistent. How persistent is unknown, but a very conservative calculation presented in Attachment B shows that TRC should decay within 5 days after its release into the cooling reservoir. The maximum water circulation time along the lake perimeter is calculated to be approximately 65.7 days and the minimum circulation time along the interior dike is calculated to be approximately 12.3 days (ER Suppl., P. SH-138 and SH-139). A comparison of these calculations reveals that substantial portions

of the lake should be free of TRC concentrations that are above the chronic effect threshold. The outer lake perimeter should be especially free of TRC.

- Q. Where in the cooling lake do you anticipate chlorine impacts to occur?
- A. Acute effects on fish may occur in the vicinity of the discharge canal during intermittent chlorination events. However, the overall loss to the lake fishery should be minor because of the small proportion of the fishery present in this area. Even during winter when some preference for the discharge canal area may be shown by fish, the entire lake will be warm enough to prevent major fish concentrations in this area and subsequent fish kills affecting a substantial portion of the fishery. Chronic TRC stress should not cause significant problems because refuges should exist along the lake margins where TRC should be below the chronic effect threshold.
- Q. Will TRC stress act in combination with heat stress during summer high temperature months (July and August) to cause deleterious effects on the fishery?
- A. Combined TRC and heat stress during the July and August thermal maximum may present some problems. The expected result of TRC is to further stress the fish during these months, thereby causing reduced growth. However, chronic effects only are expected. In any event, little fish growth during summer months (or negative growth associated with weight or condition loss) is expected because of the high summer water temperatures which will be present in the ACNGS cooling reservoir.

Q. What is your conclusion regarding the probable impacts of chlorine released into the cooling reservoir?

A. Due to: a) the probable reduction in chlorine discharge resulting from the chlorine minimization study, b) the probable availability of refuges along the lake margins where TRC levels will be below the chronic effect threshold, and c) the large dilution factor in the cooling reservoir, TRC discharges are not expected to cause problems in maintaining the lake recreational fishery. Some local problem areas may be present, however, especially in the vicinity of the discharge canal area when fish congregate in the thermal plume or during heat stress periods in the months of July and August.

3. Sewage discharge from Wallis, Sealy, and the ACNGS will cause excessive algal growth in the lake.

Q. What is the amount of municipal sewage to be discharged into the cooling lake from the above sources?

A. Approximately 8 acre-feet per year of sewage from the ACNGS is expected to be released into the discharge canal (Fig. S.3.2, FSFES). Wallis will discharge all of its municipal sewage into a small southern arm near the confluence of Allens Creek and the cooling reservoir. The amount of this discharge will be roughly 168 acre-ft/yr assuming a population of 1500 in year 1985 (calculated from current 1980 population of 1127 discharging 104,000 gal/day of sewage; Wallis sanitary engineer, pers. comm.). From Fig. S.2.3 (FSFES), the area-capacity curve for the cooling

reservoir, the lowest lake volume (lake level at 113 M.S.L. which should occur less than 5% of the time) will be 60,000 acre-ft. Thus, under very conservative assumptions, the sewage discharge from Wallis will only account for approximately 0.3% of total lake volume without any consideration of water turnover in the reservoir. Water inflows from Allens Creek, the Brazos River, and direct precipitation and outflows through the lake discharge spillway back to the Brazos River will diminish this ratio considerably on an annual basis. Sealy releases more domestic sewage than Wallis due to its larger population (estimated 3211 in 1975 compared to Wallis 1975 population estimate of 1108; FSFES, Table S.2.3). However, Sealy discharges into the upper end of Allens Creek which is ungaged and which goes dry during part of the year. Therefore, the amount of sewage exported to the cooling reservoir by Allens Creek cannot be calculated. It can be assumed that the combination of Sealy sewage discharges into the creek and runoff from agricultural activities in the Allens Creek drainage basin will provide considerable nutrients to the lake during stream flow periods. (Allens Creek average nutrients; 2.73 ppm nitrate-nitrogen, 2.4 ppm phosphate-phosphorus: FSFES, P.S.2-8). Brazos River water also will add considerable nutrients to the lake during make-up water pumping (Brazos River maximum nutrient concentrations; 0.97 ppm nitrate-nitrogen, 9.6 ppm phosphate-phosphorus: FSFES, Table S.3.2) as will the flooded agricultural soils during the early life of the reservoir. Thus,

the lake will be heavily loaded with nutrients, only some of which will come from sewage discharges.

- Q. Will the sewage discharges from Wallis, Sealy, and the ACNGS cause excessive algal growth in the cooling reservoir?
- A. The incremental nutrient loading contributed by these sources should not in themselves cause excessive algal growth except possibly in restricted areas immediately adjacent to the inflow locations. This is because the lake will be eutrophic even without these nutrient sources. Agricultural runoff combined with Brazos River nutrients and nutrients leached from flooded agricultural soils will be sufficient to maintain eutrophy in the lake. Furthermore, the lake phytoplankton will not be nutrient limited but will be light limited. High turbidity will be caused by the suspended silt load expected from Allens Creek runoff and from the Brazos River make-up water. Silt will be maintained in the water column by vertical mixing caused by power plant and wind driven circulation. Self-shading by the dense phytoplankton community also should occur. Thus, additional nutrients from the municipal sources listed above should do little to increase algal growth in the lake.
4. Heavy metals will concentrate in the lake and in the fish making them inedible.
- Q. What are the sources of heavy metals that could potentially enter the cooling reservoir?

A. Excessive heavy metal concentrations have been noted for both the Brazos River water and for Allens Creek water. High levels of mercury (up to 36 ppb on one occasion), cadmium (1-12 ppb reported) and zinc (2000 ppb on one occasion) have been found in Brazos River water. The elevated concentrations were found primarily during low flow periods in late summer and fall although some elevated concentrations (especially mercury) occurred during every part of the year (ER Suppl., Table 3.6). In addition, a review of water quality data collected by the U.S. Geological Survey for the years 1969-1976 at Richmond, TX, located upstream from Allens Creek, revealed no consistent heavy metal contamination of Brazos River water at this site. It also should be noted that two surveys by the applicant revealed no heavy metal contamination of Brazos River fish (initial survey of catfish conducted in March, 1974; and Brazos River Heavy Metal Survey, Dames and Moore, 1977). For Allens Creek, some elevated concentrations of mercury (3 ppb maximum) and cadmium (8 ppb maximum) also were reported during summer and fall low flow periods (ER Suppl., Table 3.6) although these concentrations were not highly significant (generally in low parts per billion range). In summary, some inflow of heavy metals to the cooling reservoir will occur.

Q. What are the water quality criteria for the protection of fish from mercury, cadmium, and zinc?

A. For mercury, the U.S. Environmental Protection Agency (U.S. EPA, 1976, has set 0.05 ppb as the water quality criteria to protect

against possible bioaccumulation of mercury in edible fish flesh. This assumes a bioaccumulation factor of 10^5 . Mercury chronic effect thresholds for fish appear to be in the neighborhood of 0.4-1.0 ppb. For cadmium, 12 ppb has been recommended for the protection of fish in hard waters, especially for sensitive catfish. For other warmwater fish, it appears that concentrations in the range of 30-40 ppb are safe (U.S. EPA, 1976). For zinc, the water quality criteria are set on the basis of laboratory bioassays using sensitive species and water from the location of interest. Such bioassays are not available for Brazos River water and fish species that should be present in the lake and thus an exact water quality criteria for zinc cannot be stated.

- Q. What will be the concentrations of these heavy metals in the cooling reservoir?
- A. The amount of heavy metals that will be introduced into the cooling reservoir cannot be calculated because it will depend upon the pumping mode (3 or 6 months) for Brazos River make-up water, the month-to-month variation in Brazos River water quality, the amount of heavy metals from Brazos River water that will be sequestered in the sedimentation basins, and the actual amounts of trace metals flowing into the reservoir from the Allens Creek drainage. The amount potentially introduced from the Brazos River is especially uncertain because heavy metal contamination appears to be a pulsed event probably reflecting upstream releases. Those amounts that are introduced will go through cycles of concentration (maximum

of 2X) and dilution in the cooling lake depending upon the season of the year and the fluctuations in inflow water quality and quantity. Furthermore, the metals will undergo complex and unpredictable chemical reactions with the lake water and sediment, which will affect both their ionic form and concentration. These reactions and the resultant equilibrium concentrations of various metal species (their chemical form) will govern both the biological availability and toxicity of the introduced heavy metals (Jenne and Luoma, 1977).

- Q. What can be concluded about the probable effect of heavy metal introductions on the cooling lake fishery?
- A. It appears reasonable to conclude that the eventual concentrations of cadmium and zinc will be below chronic effect thresholds in the main water body of the reservoir. Only in restricted areas where mixing and water quality is poor will there be any significant possibility of chronic effects occurring due to these metals. For mercury, which has a chronic effect threshold in the very low ppb range, there is a higher probability that some chronic effects on fish production will occur if elevated concentrations in the Brazos persist during make-up water pumping. However, because mercury has a high affinity for suspended and dissolved organic matter (Huckabee et al., 1979), direct chronic effects may be unlikely and it is much more likely that effects will be manifested through the processes of bioaccumulation and biomagnification.

- Q. What are these processes and how likely are they to affect the fishery?
- A. Heavy metal bioaccumulation (the direct uptake and accumulation in an organism from surrounding water and sediment) and biomagnification (increased body burdens resulting from ingestion of contaminated food) are complex phenomena. Our present ability to predict heavy metal accumulation in fish through either of these processes is poor and without detailed information on both the types of heavy metal compounds present in the lake water and their concentrations, we have almost no predictive ability. For instance, Jenne and Luoma (1977) have suggested that biotic accumulation of trace elements should vary inversely with the concentration of dissolved organics. Because Allens Creek will be high in dissolved organics, this would lead one to believe that heavy metal bioaccumulation will be low. In addition, cadmium and zinc may not biomagnify in fish (Phillips and Russo, 1978). However, there are no statistically adequate data on ecosystems from which to realistically extrapolate the quantitative potential for heavy metal accumulation in Texas reservoirs similar to Allens Creek (Vaughan, 1977). Therefore, all we can do is monitor fish flesh quality over time, observe the presence or absence of these phenomena, and act accordingly.
- Q. What is your conclusion regarding the potential for heavy metal effects in the cooling reservoir fishery?

- A. If elevated levels of mercury persist in the Brazos during make-up pumping there is some possibility that chronic effects will occur in areas adjacent to the sedimentation basins. However, if an adequate fish flesh quality monitoring program is maintained, then the public should be protected from the possible ingestion of contaminated fish if such contamination occurs.
5. Thermal (cold) shock will kill large numbers of fish when the plant shuts down during winter.
- Q. What is the nature and conditions under which cold shock occurs in thermally loaded reservoirs?
- A. Cold shock generally occurs when a thermal discharge is abruptly stopped during cold weather periods and the ambient water temperature goes through a rapid decline until it passes through a lower lethal temperature threshold (the lowest temperature that a species can survive when adapted to a considerably higher ambient temperature). When the lower lethal threshold is surpassed, large-scale fish mortality can result from temperature effects alone. However, before these lower temperatures are reached, loss of equilibrium can also occur in fish as a result of rapid temperature decline ($5-10^{\circ}\text{C}/\text{day}$), causing them to become much more susceptible to predation or to impingement mortality (indirectly caused mortality). Thus, in order to cause mortality from cold shock, there must be either a rapid drop in water temperature to levels causing loss of equilibrium or a drop in water temperatures below the lower lethal threshold.

Q. What are the temperatures for which these occurrences are most prevalent?

A. For southeastern reservoirs, the temperatures of concern are when ambient conditions drop to about 9-10°C for most shad or less than 4-6°C for other carnivorous species (bass, crappie, catfish) (National Academy of Science, 1972).

Q. What is the probability that these conditions will occur in Allens Creek cooling reservoir?

A. Allens Creek will be a sub-tropical reservoir that will function like a large partially re-circulating bathtub with a heat source at one end. Because of the constant circulation and heat emission by the power plant, the entire lake water volume is expected to be substantially above ambient air temperatures during the winter months. In the event of plant shutdown during the winter, a gradual reduction in thermal emissions will occur and the lake will gradually cool but it will not suffer rapid decline in water temperature (e.g., 5-10°C/day) except possibly in the immediate area of the discharge canal. The equilibrium temperature will be above the lower lethal threshold for most fish during average winter conditions. The lowest winter water temperature is expected to be approximately 10°C (50°F) as experienced in other reservoirs in the nearby area (R. L. Bounds, pers. comm.; see also ER Suppl., P. SH-140). Thus, there does not appear to be any substantial risk of cold shock either due to rapid temperature decline causing loss of equilibrium and subsequent predation or impingement or direct mortality associated with temperatures

falling below lower lethal thresholds. To reiterate the FSFES (P.S.5-14), only under the rare circumstances of extremely cold and prolonged winter temperatures and plant shutdown will cold shock occur. But if this happens in Allens Creek, it also should happen in other nearby public waterways as well and, therefore, would be a general phenomenon for this geographic region.

6. Even if the cooling lake is approved by the Board, the Board should require that it be redesigned to be more of an environmental benefit and less of an environmental burden. Specifically, the dam (levee) should be extended northward to a point just east of its present northeast corner so that the runoff can go into the lake and so that the north bluff area can be a viable fish spawning area.
- Q. What will be the potential ecological advantage of relocating the levee to the north bluff area on the aquatic ecology of the cooling reservoir?
- A. It will result in additional freshwater runoff as contended and will provide suitable shallow-water spawning habitat for reservoir fish.
- Q. Are any of these additions critical to maintenance of the reservoir fishery?
- A. The design of the proposed cooling reservoir will affect the maintenance of a self-sustaining recreational fishery, principally large-mouth and striped bass, but not the maintenance of any recreational fishery, especially crappie. The runoff from the north bluff area will not in itself add to the maintenance or enhancement of a fishery because it does not supply anything that is limiting to biological production of the system under the 5120-acre design (e.g. water inflows, silt or detritus, nutrients,

etc.). However, the use of this area by spawning fish is an important consideration. If the objective of Texas Department of Parks and Wildlife (who will be legally responsible for maintenance of the fishery) is to maintain a self-sustaining bass and catfish fishery, then the north bluff area is important to achieving this goal. However, if the objective is to sustain a viable recreational fishery, using the flexible management options already referenced in this testimony, then the function of this area for fish spawning can be supplanted by periodic stocking and/or the establishment of artificial nursery and rearing habitat for game fish juveniles. Under either cooling lake design, forage fish (primarily shad) will be abundant because they will probably successfully spawn in the reservoir and because their food supply (algae and zooplankton) will be abundant. Thus, the aspect of environmental burden depends upon the relationship between a self-sustaining or artificially propagated fishery and the public use of either of these potential reservoir fisheries in comparison to the poor Brazos River fishery presently existing at this site.

- Q. What is your conclusion regarding the environmental burden aspect of providing an artificially propagated fishery?
- A. This is essentially a socio-economic question. I can only add that the difference in the time and resource commitment by the Texas Department of Parks and Wildlife under either of the two lake designs may be small if the 5120-acre design does not require substantial nursery habitat development. Under either lake design, TDPW is committed to maintaining a fishery and therefore a certain minimum monitoring and stocking program will occur.

ATTACHMENT A
PROFESSIONAL QUALIFICATIONS

of

Frank S. Sanders

Oak Ridge National Laboratory

Environmental Sciences Division

Dr. Sanders is a limnologist trained in aquatic microbial ecology, especially the cycling of minerals and the measurement of primary production, and whose interest extends to both lake and stream systems. His past experience includes general limnological research involving measurement of primary and secondary production, flux rate experiments for mineral cycling, and measurement of physical and chemical parameters in aquatic habitats. He has worked in a broad spectrum of aquatic environments including oligotrophic Lake Tahoe, California-Nevada, mesotrophic Castle Lake, California, eutrophic Clear Lake, California, and Ward Creek in the Lake Tahoe drainage. He has recently developed an aquatic ecology section for ERDA's Fossil Energy Environmental Monitoring Handbook and has supplied technical assistance to ERDA's Division of Major Facility Project Management.

EDUCATION:

4 yrs, basic biology and ecology, University of California, Davis
B.S., Zoology, University of California, Davis, 1969
Ph.D., Limnology, University of California, Davis, 1976

PROFESSIONAL AFFILIATIONS:

Member of American Society of Limnology and Oceanography and Aquatic Division of the Ecological Society of America.

PUBLICATIONS:

Dr. Sanders has two manuscripts in progress dealing with benthic microbial ecology in an alpine lake and turbulent transfer of carbon at a sediment-water interface. In addition, he has co-authorship on a paper entitled, "A Preliminary Assessment of the Potential Impacts on Aquatic Ecosystems of Trace Elements in Coal Conversion Solid Waste," to be presented at the Savannah River Ecology Laboratory Symposium, November, 1977. Two other manuscripts are currently being developed on the ecological approach to environmental impact assessment.

PRIOR WORK HISTORY:

<u>YEARS</u>	<u>EMPLOYER</u>	<u>TITLE</u>	<u>REGIMEN</u>
1976-Present	ORNL	Research Associate	Aquatic impacts analyst
1969-1976	Institute of Ecology, Univ. of California, Davis	Research Assistant	Aquatic ecology research

ATTACHMENT 3

TRC Decay Calculation

Assuming worse-case discharge conditions, 2.2 mg/l of TRC will be discharged in a 15 minute slug, twice a day (FSFES, P.S.5-14). A conservative TRC decay or loss calculation for each of these slugs is based upon a first-order decay reaction of the TRC with the chlorine demand of the lake water. This assumes simple exponential decay without lateral mixing of the slug with the lake water during its migration away from the discharge canal. Thus:

$$C_t = C_0 e^{-kt}$$

where: C_t is the TRC concentration in the slug at any time t ,
 C_0 is the initial concentration in the slug at time t_0 , 2.2 mg/l,
 k is the exponential decay coefficient in units of time^{-1} , and
 t is time.

Because a value for k has not been experimentally determined for the Brazos River at Allens Creek, it is necessary to estimate this parameter from experiments conducted elsewhere and to use a range of possible k values in the calculation. Accordingly, k has been taken to be 14.894/days as an upper estimate (Comanche Peak 1977) and 1.64/day as a lower estimate (Baker and Cole 1974, ER Suppl., P.SH-48).

Using the above assumptions, the time required for the TRC in the slug to decay below the 0.0015 ppm chronic effect level for continuous exposure protection for fish is as follows:

Time Elapsed (Days)	C _t (ppm)	
	k = 1.64/day	k = 14.894/day
1	0.426	< 0.0001
2	0.083	
3	0.016	
4	0.003	
5	0.0006	

It is evident that in the most conservative case, the TRC concentrations in the slug will be above the chronic effect threshold for only slightly more than 4 days. Under more realistic conditions where lateral dispersion is happening simultaneously with TRC decay and a decay rate of greater than 1.64/day is assumed, the TRC concentration in the slug will be above the chronic effect threshold for a considerably shorter period of time.

References cited:

- Baker, R. and S. Cole (1974). Residual chlorine: Something new to worry about. Industrial Water Engineering, March/April, pp. 10-21.
- Comanche Peak Steam Electric Station, Units One and Two, Docket Nos. 50-445 and 50-446, C. P. Amendment Review of Chlorine Minimization Study, Oak Ridge National Laboratory, Oct. 6, 1977.

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MR. BLACK: The Staff has no further direct testimony.

As indicated earlier, I would like to have the questioning initially be directed to Dr. Gotchy's testimony since we are desirous of having Dr. Gotchy released as a witness today if it's at all possible.

JUDGE WOLFE: All right.

Cross-examination then will be initially directed to Dr. Gotchy.

Cross-examination, Mr. Newman?

MR. NEWMAN: The Applicant has no cross-examination of Dr. Gotchy.

JUDGE WOLFE: Mr. Doherty.

MR. DOHERTY: All right.

CROSS-EXAMINATION

BY MR. DOHERTY OF DR. GOTCHY:

Q I am an Intervenor, sir, opposed to this licensing. I think it's just good to say that, to make sure that you know where I'm coming from.

First of all, on the corrections that we went through, how do you -- what is the difference, sir, between a radiobiologist and a health physicist?

A The title -- My title is Senior Radiobiologist. I am a Certified Health Physicist also.

Health physicists are primarily involved in

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1 protecting people, essentially on the job, from unnecessary
2 radiation exposure.

3 A radiation biologist is a person who has ex-
4 pertise in the biological effects of radiation, where a
5 health physicist would be more involved in controlling
6 exposure, based on existing standards.

7 Q All right.

8 Have you as a health physicist ever been assigned
9 as that title in an operating nuclear powerplant?

10 A No, I have not.

11 Q I see.

12 Have you ever in any type of facility --
13 industrial facility where there was this type of exposure
14 to possible workers?

15 A Yes, sir.

16 Q Would you tell me what that was briefly.

17 A I worked for two years at the Watts Radiation
18 Laboratory in weapons testing at the Nevada Test Site.

19 And I worked for one year with the U. S. Public
20 Health Service as a health physicist in the Off-Site
21 Radiological Safety Program at the Nevada Test Site.

22 Q Did your work involve calculating the exposure
23 to employees in these laboratories in their duties? Was
24 that your work?

25 A That amongst other things, yes, sir.

1-14

1 Q All right. Thank you for that.

2 Now you made a correction on page four where
3 you changed "average adult" to "maximum individuals."
4 Would that calculation yield a more -- would it yield a
5 more conservative figure, in your opinion?

6 A Yes, sir, it would give a somewhat higher esti-
7 mate of dose.

8 Q It would give a somewhat higher estimate of
9 dose.

10 So that in determining if the plant is going to
11 be within 10 CFR restrictions, you would then be, in a
12 sense, sort of giving the people a break? Is that right?
13 Giving them a benefit or an extra margin of safety? Is
14 that what you feel?

15 A Well, that really wasn't what I think we did.
16 We would prefer, I guess, if we wanted to change our dose
17 estimates to revise them downwards rather than upwards.

18 And we've found over the years that in calculating
19 doses from liquid pathways, the doses tend to be much
20 lower than those from the gaseous pathways.

21 And so rather than spending a great deal of time
22 determining the detailed hydrologic dispersion, we
23 normally take a maximum individual -- an assumed hypo-
24 thetical maximum individual, because there is no drinking
25 water pathway -- and assume no dilution of the water as it

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1 comes out of the discharge canal.

2 We've found that that assumption, in every case
3 that I have seen, still meets the Appendix I requirements.

4 So these doses would tend to be higher than most
5 people would be likely to get as a result of the operation
6 of the plant.

7 Q All right.

8 JUDGE LINENPERGER: Mr. Doherty, may I break in
9 here just a moment? Excuse me.

10 But, Dr. Gotchy, would you define for the record
11 the term "maximum individual," so that the record is
12 clear as to what change has been made here and what
13 that term means.

14 DR. GOTCHY: The maximum individual is defined
15 in Regulatory Guide 1.19 as the person who would receive
16 the maximum possible exposure for any of the pathways that
17 are considered.

18 Normally, the maximum individual for liquid
19 pathways will not be the same maximum individual for
20 gaseous effluents.

21 That's because the liquid pathway dose is
22 generally driven by fish consumption; and the gaseous
23 pathway dose is normally a result of the nearest proximity
24 to the site.

25 JUDGE LINENBERGER: And this individual by

1 definition is a member of the public, not an employee of
2 the facility?

3 DR. GOTCHY: That's correct, sir.

4 JUDGE LINENBERGER: Thank you.

5 BY MR. DOHERTY OF DR. GOTCHY:

6 Q You spoke of pathways in the previous question.
7 There is obviously more than one pathway.

8 Do you sum the total of the pathways to arrive
9 at the figure that you then must compare to the 10 CFR
10 figure to determine if the plant is acceptable?

11 A That's correct.

12 It considers food pathways, fish, invertebrates,
13 ingestion of water, swimming exposure and use of shoreline.

14 Q And at this time can you say if the sum, just
15 taken in straight units of exposure -- dosage, rather --
16 can you say that that exceeds the limits in 10 CFR for
17 any one of the pathways?

18 A No, sir.

19 The limit that we would be aiming for is spelled
20 out in the Supplement to the SER. It's considerably higher
21 than a maximum that the individual would receive.

22 Q I see.

23 A And those doses would again be much lower than
24 say in Part 20 limits -- we're talking about under the
25 Part 50, Appendix I limits.

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Q Uh-huh.

I apologize for my own ignorance of 10 CFR.
But are there limits set by pathway in 10 CFR, sir?

A No, sir. We sum all pathways.

Q So in 10 CFR the rules don't set limits by pathway, but perhaps by total alone?

A I want to make clear that when talking about liquid pathways, it's all of the pathways involved in liquids.

Q So it may --

A Those are separate from the gaseous.

Q Yes, sir.

But 10 CFR does not go into pathways from drinking, as opposed to pathways from ingesting aquatic animals; is that right?

A No, sir.

They're all calculated and summed.

Q I see. Okay.

A somewhat obtuse question: How did this error -- or what necessitated this change on the page that we've been discussing?

A There was some confusion when the testimony was prepared; in the original FES, which came out in 1974, we were using a different environmental model than we use now.

1-18

1 At the time they were calculating dose to an
2 average individual, who was assumed to consume 1.2 liters
3 of water per day.

4 Under Regulatory Guide 1.109, the maximum
5 individual was defined as one who consumes 2.0 liters of
6 water per day.

7 That was the reason I had to make these
8 changes.

9 Q So the maximum individual is a good deal more
10 thirsty than the previous maximum individual. Is that
11 right?

12 A Well, the previous was an average individual
13 and the dose for this case without any dilution in the
14 lake is much higher than it was in the FES in 1974.

15 Q I see.

16 Now, this change then reflects change in
17 the Regulatory Guide apparently, which, of course, are not
18 rules.

19 A That's correct.

20 Q I note here that in changing the phrase "average
21 adult" to "maximum individual," that that would then pre-
22 clude, conceivably, any human being of any age. Is that
23 right?

24 A That's correct. That includes infants, children,
25 teenagers and adults.

1-919

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1 Q That covers it. Okay.

2 And also, if I'm correct, does not this Regula-
3 tory Guide somewhat alter your next sentence, too? Is
4 that the source of that change?

5 A I'm sorry. Would you repeat that?

6 Q Yes, I will.

7 The next sentence you changed -- on page four
8 you changed it to say "Specific persons could receive
9 somewhat higher or much lower doses," etcetera.

10 Now, you've changed "will" to "could". "Will"
11 implies to me more certainty than "could."

12 I'm concerned ... you know, this just came up
13 this morning. I haven't had a chance to get in much
14 thought about it.

15 But --

16 A Yes.

17 In the Regulatory Guide we show the differences
18 in consumption for an average individual compared to a
19 maximum individual.

20 And in the case of fish, for example --

21 Q Hold on just a minute.

22 You've changed -- I'm sorry -- you've changed
23 the what?

24 We jumped from people to fish real quick and I --

25 A When we went from the average individual case --

1-20

1 Q Yes.

2 A -- to the maximum individual case, the consumption
3 patterns for the maximum individual defined in the Regula-
4 tory Guide is for a very healthy eater and a large con-
5 sumer compared to the average in the population.

6 And the fish consumption for that person is
7 about three times what it would be for an average individual,
8 for example.

9 Q Okay.

10 All right. Then the Reg Guide that the Agency has
11 relied on came out after the Final Environmental Statement
12 and --

13 What was the year of that change again? Nineteen
14 seventy what?

15 A The Regulatory Guide?

16 Q Yes. That you said.

17 A Well, the one we have now is an October '77
18 revision, but I believe it came out in 1975.

19 Q Uh-huh. All right.

20 That would account for some of these changes
21 then.

22 Okay.

23 You've already covered on page five why 2.0
24 liters is being used instead of 1.2, I believe.

25 This would tend to make the intake greater --

1-21

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1 A Yes.

2 Q -- in the person so that you would then be more
3 confident in the amount of radioactive material that he
4 would be consuming -- or that he or she would be con-
5 suming.

6 Is that right?

7 A Well, I guess -- As I explained, the purpose
8 is not to provide assurance to the public, but to make
9 sure that we would not significantly underestimate the
10 dose -- potential dose to any possible person.

11 Our position is that actual doses would be
12 much lower than we calculate.

13 As long as the calculated doses fall within the
14 Appendix I guidelines, why, we feel that -- and the fact
15 that we have assumed a maximum hypothetical individual
16 probably should provide some assurance to the public that
17 no one has been overlooked.

18 Q Yes. Okay.

19 Now, turning on to page six, again you've gone
20 to maximum individual. That seems to fit.

21 So the real problem in this correction was those
22 Guide changes; is that right?

23 A That's correct.

24 Q Sir, you'll pardon me, but I feel suspicious --
25 When did you actually write -- create this material,

1-22

1 sir?

2 A These calculations --

3 Q Sir, not the calculations. The material here ...
4 right here.

5 A The material here was put together in December --

6 MR. NEWMAN: Excuse me, Mr. Chairman. I don't
7 believe the record will reflect the document that Mr.
8 Doherty is referring to; and I think that would be ad-
9 visable.

10 JUDGE WOLFE: What are you referring to?

11 MR. DOHERTY: I'm referring to NRC Supplemental
12 Testimony of Reginald L. Gotchy, which was introduced in
13 evidence moments ago.

14 BY MR. DOHERTY OF DR. GOTCHY:

15 Q I think you understand the source of my concern.
16 It seems that this could have been written long ago, and
17 it might well apply --18 JUDGE WOLFE: We don't need the preamble. When
19 did you write this, Dr. Gotchy?20 DR. GOTCHY: It was prepared, as I understand,
21 about the end -- in final form, about the end of December.

22 BY MR. DOHERTY OF DR. GOTCHY:

23 Q You were writing it --

24 A I was on vacation when the final draft was put
25 together, and it was read to me over the telephone.

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Q I see.

So you took that, and you wrote it down -- you actually created these words what month of this year? Can you recall?

A It was last year. December.

Q December of '79.

MR. BLACK: December of 1980.

BY MR. DOHERTY OF DR. GOTCHY:

Q All right. My mistake. The years go by. Thank you.

Now, have you filed testimony addressing the issue of radioactivity in cooling lakes in any other NRC proceeding, to your recollection?

A I don't recall. I have done calculations for other cooling lakes, but I don't think there was ever a contention, or the need to file testimony.

Q All right.

Now on page six, you speak of the cooling lake at equilibrium. I'm curious to know just what that is briefly.

A The calculations are done with a model that's described in the Regulatory Guide.

The model allows for some recirculation of water from the cooling lake back through the reactor, which allows in particular the short-lived radionuclides

1 opportunities to reach higher concentrations in the im-
2 mediate vicinity of the discharge and intake point than
3 would normally be the case, if it were assumed to be
4 just passing once through.

5 The long-lived radioactivity, like cesium-134
6 and 137, will continue to build up to some level at a
7 point where the radioactive decay and removal mechanisms,
8 for example -- the sediment, and the added radioactivity
9 coming from the reactor will reach a level which is
10 relatively constant over a period of time.

11 That's called an equilibrium level.

12 Q All right, sir.

13 Now, in your professional qualifications, you
14 develop -- indicate you developed AEC and NRC standards.
15 Was one of these -- I guess we could call it standards --
16 Regulatory Guide 1.109?

17 A I wrote Regulatory Guide 1.42, which was an
18 interim regulatory guide that we used prior to the final
19 rule on Appendix I.

20 That was prepared by the Staff and used as an
21 interim guide for licensing activities.

22 The final guide was prepared somewhat later.

23 I have written one guide, Regulatory Guide 4.1,
24 in the original version, which was the regulatory guide
25 for environmental monitoring programs for nuclear

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powerplants.

I have written a draft rule for siting mixed-oxide fuel fabrication plants, which was never completed because the Carter Administration made the decision not to recycle plutonium.

So at that point we stopped the development of those standards.

I have worked on developing -- revising Regulatory Guide -- I'm sorry -- 10 CFR Part 20 currently being considered for revision.

I have worked on proposed revision to 10 CFR Part 100, which is siting criteria for white water reactors.

I guess that's about it.

Q Yes.

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2-1

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1 BY MR. DOHERTY OF DR. GOTCHY:

2 Q Now, with regard to page four of your testimony,
3 sir, you state that specific persons -- in the middle or
4 two-thirds down -- could receive somewhat higher or much
5 lower doses, depending upon their age.

6 How would that work? Are the elderly likely to
7 take in less, or are the young?

8 A We made no allowances for the elderly. We
9 assumed that all adults consume the same amount of food
10 and water and inhalation as -- for all ages.

11 In the case of infants, children, teens, the
12 consumption is much lower than it is for an adult. That's
13 one of the reasons that the adult turns out to be
14 usually the maximum individual for liquid pathway doses,
15 because he's the higher consumer of fish and water
16 both.

17 Q All right.

18 So that goes to those particular pathways once
19 more.

20 Do you still maintain that the -- I'm sorry
21 that I can't give a page reference to this --

22 Was it your testimony, sir, that there will be
23 less than one cancer-related health risk for the entire
24 40 years of licensing?

25 A No. That would be per year of operation.

2-2

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1 Q Oh, I see.

2 So that we may multiply less than one by 40,
3 if we have a plant that goes 40 years. Is that right?

4 A We normally consider 30 years.

5 Q Thirty years.

6 All right.

7 Have you been able to arrive at a figure less
8 than one that you would stand by -- less than one being
9 indefinite. Is there any figure that you feel comfortable
10 in using here?

11 A Yes. The number is based on the Final Supplement
12 to the FES, which quotes a total population dose of 41
13 man-rem. That's per year of operation.

14 Now, per year that represents six chances in a
15 thousand, or about .006 deaths per year. For 30 years that
16 would be 180 in a thousand, or about .2 deaths.

17 Q All right.

18 And also it says "and to future populations from
19 genetic effects." Do you come out then with the same
20 figure, about .2?

21 A It would be about .4.

22 Q About .4.

23 So that -- if I follow these quickly through,
24 then the risk is double for genetic problems than for
25 cancer risk? Is that --

1 A Yes.

2 The number I'm quoting is the risk of cancer
3 mortality. In the case of genetic effects it will include
4 many effects which, of course, are not lethal.

5 Q That's in genetic effects.

6 Now, does this cancer risk that we're talking
7 about mean a fatal cancer? Or does it just mean a cancer?

8 A This would be fatal cancers. The total risk of
9 cancer incidence would be about 50 percent higher than
10 that.

11 Q So that actually then it's about -- following
12 your figures -- about .4. And you're figuring if it
13 happened to be -- if you took all of the nuclear plants
14 in the country -- and assume they were just like this
15 one which, of course, is not a true assumption -- that
16 you'd have one person who survived the cancer and one who
17 was not so fortunate.

18 Is that right?

19 MR. NEWMAN: Mr. Chairman, I'm going to object
20 to that question.

21 As I understood it -- and I may have misheard --
22 I think that Mr. Doherty was asking a question concerning
23 the cumulative health effects at all reactors in the
24 United States.

25 Am I correct in that?

2-4

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1 MR. DOHERTY: I was intending to do that, to
2 try to illustrate my figures a little bit.

3 It was not applied -- I said "all reactors in
4 the United States, assuming they were just like ACNGS,"
5 which in order to cut down some of the exceptions, I do
6 not maintain that all of the reactors are just like
7 ACNGS.

8 And that's what

9 MR. NEWMAN: Mr. Chairman, I then fail to see
10 the relevance of referring to any other reactor in the
11 United States.

12 The question is: What are the health effects
13 of the operation of the Allens Creek plant.

14 I think counsel has to identify the purpose of
15 this line of testimony before proceeding further, because
16 the discussion could digress, I think, into the operation
17 of powerplants -- nuclear powerplants anywhere in the
18 United States.

19 JUDGE WOLFE: All right.

20 The question has been put to you, Mr. Doherty,
21 what's the purpose behind that question?

22 MR. DOHERTY: Well, I'm trying to get some ac-
23 curate figures of cancer risk from the Allens Creek Nuclear
24 Plant.

25 By referring to a hypothetical of all powerplants

1 in the United States, I was attempting to -- I was not
2 attempting to arrive at some sort of figure about the
3 national nuclear usage.

4 Instead, I was trying to find out -- I was
5 trying to take what seemed like strange figures ... two
6 risks.

7 That type of figure doesn't go with me -- I mean,
8 I can't work with it very well.

9 I was trying to get it up to some numbers that
10 I could deal with, that were more substantial. That was
11 the purpose of going to a larger number of reactors.

12 JUDGE WOLFE: Have you exhausted your question-
13 ing on how the figure of 2.4 was arrived at by the
14 witness?

15 MR. DOHERTY: No, sir, I haven't.

16 JUDGE WOLFE: Well, then why don't you exhaust
17 that.

18 And if you have any problem with how he arrived
19 at it, well -- not any problem -- but I would hope that
20 you would find out how he arrived at it and take it from
21 there.

22 I don't know that anything is being served by
23 questioning releases or emissions from plants all over
24 the country.

25 At this point maybe he didn't take it into

2-6

1 consideration. But you'll have to find that out first.

2 Limit yourself to -- at this point anyway --
3 to that question.

4 MR. DOHERTY: All right.

5 JUDGE WOLFE: Or line of questioning.

6 BY MR. DOHERTY OF DR. GOTCHY:

7 Q Is it correct, Dr. Gotchy, then that for 30
8 years of operation, you calculate a result with cancer-
9 related difficulties which would include then .2 survived
10 cancers and .2 failed?

11 A It would be about .1.

12 Q Which would be about .1?

13 A Those who would survive.

14 The total would be about .3, of which .2 would
15 die and .1 would survive.

16 Q That's over 30 years of the plant?

17 A Yes, sir.

18 Q And then for genetic impact, it would be about
19 .2 for the life -- the 30 years of operation?

20 A Four.

21 Q .4 for genetic?

22 A Yes.

23 And that would be for the subsequent five genera-
24 tions of the people who were exposed by the plant's opera-
25 tion. That would be over a period of about 150 years

2-7

1 approximately.

2 Q I see.

3 That's right. You have to find ... yes, all
4 right.

5 You have to go down looking at the next
6 generations obviously with genetic problems.

7 A Yes.

8 Q Is there any regulation that sets how many of
9 these misfortunes are acceptable?

10 A How many --

11 MR. NEWMAN: Mr. Chairman, I'm not clear about
12 the term "misfortunes," and I don't believe the witness
13 can respond to that question intelligently.

14 JUDGE WOLFE: Can you define that?

15 MR. DOHERTY: Yes, I will.

16 BY MR. DOHERTY OF DR. GOTCHY:

17 Q Are there any -- I'll rephrase.

18 Are there any rules or regulations setting up
19 what is an acceptable number of fatal cancers and genetic
20 defects and non-fatal cancers?

21 A No, there are not.

22 Q Okay. Thank you.

23 All right. Now, is it the position here that
24 because the radioactive materials in the Allens Creek
25 cooling pond meets the guidelines of the Code of Federal

1 Regulations that there is no need at this point to con-
2 sider the fact that some of them -- well, I won't say
3 that it's a fact, I don't know that it has been
4 established -- there's no need to consider any seepage
5 into the groundwater with consequent drinking by people
6 from wells?

7 Is that --

8 A Yes, sir, that's our belief, that maximum con-
9 centration would occur in the discharge canal. And con-
10 centrations anywhere else in the environment would be much
11 lower.

12 Q So that in order to argue this, is it true there
13 would have to be some type of mechanism that concentrated
14 some of the radioactive material or -- pardon me --
15 some of the lake effluent?

16 A That's correct.

17 Q Some type of mechanism is required that somehow
18 would -- what? Take a sample out and evaporate some water
19 out, for example. Would that do it?

20 A That would increase the concentration and dose,
21 yes.

22 Q I see.

23 Because --

24 A Except for tritium.

25 Q All right.

1 And that's because you find tritium evaporating
2 with water, I presume, or

3 A Yes, sir.

4 Q All right.

5 MR. DOHERTY: I need a moment to look at my
6 questions. You might want to lean back a moment.

7 (Pause.)

8 BY MR. DOHERTY OF DR. GOTCHY:

9 Q The Applicant filed -- or has made available
10 to Intervenors an Environmental Report. In the Environ-
11 mental Report they describe the aquifer which is beneath
12 the cooling pond.

13 They have described what they describe as a
14 cone of depression. In fact, this also occurs in the
15 Final Environmental Statement.

16 MR. DOHERTY: Is the Final Environmental State-
17 ment a document of record in this proceeding now, sir?

18 JUDGE WOLFE: No, it is not.

19 The Final Supplement to the Final Environmental
20 Statement is not in evidence, no.

21 MR. DOHERTY: Well, the Final Environmental
22 Statement that I read from states that --

23 JUDGE WOLFE: What page is that, please?

24 MR. DOHERTY: Pardon me. At page 2-8.

25 Under a section entitled "Groundwater," it

2-10

1 says: "Heavy withdrawals in Houston and surrounding
2 counties have caused a regional cone of depression which
3 extends into the site vicinity."

4 JUDGE LINENBERGER: Sir, could you tell us a
5 little more specifically what you are reading from?

6 MR. DOHERTY: Sure.

7 Section 2.5.2 under "Groundwater," the last
8 sentence of the second paragraph.

9 DR. GOTCHY: Is there a question?

10 MR. DOHERTY: Yes.

11 BY MR. DOHERTY TO DR. GOTCHY:

12 Q It speaks of the fact that -- right above
13 that -- that groundwater in the aquifer moves at rates
14 varying from 20 to 50 feet per year and gives the
15 direction.

16 Then it speaks of heavy withdrawals in Houston
17 and surrounding counties. This would appear to be an
18 exception to that 20 to 50 foot per year rule, or
19 finding.

20 Do you have knowledge of this at this point?

21 A No, I don't.

22 Q Did you write this part of the --

23 A No, sir. This would have been written by a
24 hydrologist -- groundwater hydrologist.

25 Q I see.

2-11

1 So then you really cannot answer a question
2 derived from that at this point?

3 A I might be able to, but I'm not a groundwater
4 hydrologist.

5 Q Okay.

6 Well, my question is: Would a regional cone of
7 depression cause a large amount of water movement?

8 I suppose my underneath problem is what is a
9 cone of depression.

10 A Well, I --

11 MR. BLACK: I would raise an objection to that.
12 I think this is outside the scope of the witness' direc
13 testimony.

14 I'm not objecting to any questions that may be
15 related to groundwater and radioactive seepage. But I
16 would be objecting to any line of questioning that has to
17 do with a cone of depression of any hydrological con-
18 dition dealing with the groundwater.

19 So if you can perhaps rephrase the question that
20 would pertain to radioactive seepage into the groundwater,
21 I think we could proceed.

22 JUDGE WOLFE: What is -- Why are you asking
23 this question of the witness?

24 MR. DOHERTY: I --

25 JUDGE WOLFE: And also respond as to how it's

1 related to the witness' direct testimony, or to Bishop
2 Contentions 12 and 21.

3 MR. DOHERTY: The contention apparently requires
4 that some concentration mechanism occur. In order for
5 the contention to win -- or whatever the term is --
6 some type of concentration will have to be established
7 somewhere in the aquifer.

8 MR. BLACK: Well, it's not up to this witness
9 to win your contention for you.

10 That's fairly evident. So if you're going to
11 prove through this witness that there are concentrations
12 of radioactivity, and consequently lead to a higher
13 dosage than that assumed by the NRC model, you're
14 perfectly able to try that avenue of attack.

15 But like I say, I would object to any questions
16 that deal strictly with hydrological conditions.

17 MR. DOHERTY: All right, sir.

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1 JUDGE WOLFE: Are you amending your question
2 then?

3 MR. DOHERTY: I will amend the question.

4 BY MR. DOHERTY TO DR. GOTCHY:

5 Q If, in fact, there were a locale in an under-
6 the-lake aquifer whereby water moved much more rapidly,
7 is there any mechanism you can think of which might per-
8 mit radioactive materials to concentrate?

9 A No, sir.

10 It would be the opposite. No matter how rapidly
11 the groundwater moved, there would always be mechanisms
12 resulting in the adsorption or absorption of radioactive
13 nuclides, particularly in ionic form, on particles that
14 are in the ground itself.

15 The groundwater must move through some space in
16 the ground. And there will always be surfaces for
17 adsorption, like ion exchange resin, so the concentrations
18 in the water will always be reduced as they move through
19 the ground, except for the case of tritium where there is
20 no way of concentrating or reducing concentrations by that
21 mechanism.

22 Q So then again -- we've run into tritium pre-
23 viously.

24 Tritium would be one substance that does not
25 fit the other reasons that you've described for --

1 A Yes.

2 Q -- not believing this would occur?

3 A That's correct. It would move with the
4 water at essentially the same speed as the groundwater
5 itself.

6 Q I see.

7 And if the groundwater were moving more rapidly,
8 then it would move with it, of course.

9 All right. Now I have a question with regard
10 to the amount of seepage, particularly at 3.3-2 of the
11 Environmental Report. It reports 1000 acre feet per
12 year will be seeped from the lake.

13 The Supplement to the Environmental Impact
14 Statement reports on Figure S.3-2 six hundred feet per
15 year.

16 MR. NEWMAN: I'm sorry, Mr. Chairman. Could
17 the counsel help us by giving the page number in the
18 FES?

19 MR. DOHERTY: I'm sorry. I gave you a figure
20 number.

21 MR. NEWMAN: What page is that on, Mr. Doherty?

22 MR. DOHERTY: It's on page S.3-3.

23 MR. NEWMAN: Thank you.

24 MR. DOHERTY: Then Figure 3.3-2 of the ER
25 states that the diagram -- identical diagram virtually --

1 where the figure is a thousand acre foot per year.

2 BY MR. DOHERTY TO DR. GOTCHY:

3 Q Do you have any knowledge as to why that number
4 differs?

5 A No, I don't.

6 Q All right.

7 Would there be a greater concentration of radio-
8 nuclides at the bottom of the lake, in your opinion, than
9 at the upper surface or even the middle surface?

10 A Over a period of time there would be higher
11 concentrations in the sediments.

12 Q How many years would it take for that to begin
13 to be observed, sir?

14 A To begin to what?

15 Q To be observed. When would that first be
16 noticed?

17 You said it would take some time.

18 A Well, it would start immediately when the plant
19 started operating. But it probably would not start to
20 show up on the shorelines, which is where you're able to
21 see sediments accumulating, for perhaps months or
22 years.

23 Q Perhaps months or years.

24 You would expect that seepage would occur when
25 it occurs at the water -- that the bottom of the lake would

1 be the first water out; is that right?

2 A I have no way of knowing. But that would be a
3 reasonable assumption.

4 Q That would be a reasonable assumption. All
5 right.

6 We don't know why the difference in the seepage,
7 but we do at this point know there will be some; and we
8 decide that it would be a reasonable assumption that it
9 would come from the bottom part of the pond.

10 You've spoken of sediment, which I would like to
11 ask you: Would that sediment then be suspended or would it
12 have reached bottom?

13 A The sediment that I was referring to --

14 MR. BLACK: I'd like to object at this point.
15 I think there was an assumption in that question that
16 has not been demonstrated or attested to by the witness,
17 and that is the assumption that the water at the bottom
18 of the reservoir would be the first to have seepage.

19 I don't believe Dr. Gotchy ever verified that
20 assumption.

21 So, number one, I think that assumption has not
22 been established.

23 So I think that the question should be re-
24 stated without that assumption.

25 JUDGE WOLFE: Isn't that so, Mr. Doherty?

1 MR. DOHERTY: I'll rephrase.

2 BY MR. DOHERTY TO DR. GOTCHY:

3 Q When you speak of sediment, may that be divided
4 into suspended sediment and bottom sediment?

5 A Yes, there would be both.

6 Q There would be both in this lake?

7 A Yes. More suspended in some areas, for
8 example, on the outfall, than in other areas where there
9 would be very little mechanism for re-suspension.

10 Q Would suspension be caused by the fact of
11 circulation of the lake, to some extent?

12 A To some extent.

13 Q I see.

14 So when plant shutdown occurred for, say, re-
15 fueling, there would be a chance for that circulation
16 system to slow down?

17 In other words, the plant is operating on a
18 discharge of water -- it has to discharge a considerable
19 quantity of water; and when it's refueling, that system
20 is closed or turned off.

21 So, of course, that whole circulation system
22 stops.

23 Would that then increase the descent of
24 suspended sediment?

25 A I'm not sure that the circulation system is shut

3-6

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1 off. Some of the circulation certainly is shut down.
2 But they do that to maintain circulation of the cooling
3 water through the core, even during refueling.

4 Q Well, assuming then -- Let's ask it this
5 way.

6 If there is indeed a reduction in circulation,
7 would there then be a tendency for suspended material to
8 sort of fall down and cease being part of the circulation?

9 A Yes. Certainly within the area of the discharge
10 canal, that would probably be true.

11 Q All right.

12 Would you expect the amount -- Are there any
13 conditions when you would not expect the amount of radio-
14 activity reaching the aquifer to increase if the amount
15 of seepage increased?

16 A I can't imagine that the concentration would
17 increase. The total radioactivity-- No, I can't think
18 of any situation where that would be true.

19 Q Have you done any calculations on the amount of
20 material that would seep into the aquifer for this parti-
21 cular plant?

22 A No, we have not.

23 Q With the 600 foot per acre you have not.

24 And may I ask why?

25 A Because we -- as I said earlier -- defined

3-7

1 maximum individual ... a hypothetical person who was
2 drinking water from the aquifer ... at a maximum rate
3 and --

4 Q Pardon me. A maximum what? I'm sorry.

5 A At a maximum consumption rate.

6 So that the dose was, we calculated, on the
7 order of a tenth of a millirem per year, which is really
8 a relatively insignificant quantity.

9 There was no reason in our judgment to go through
10 the detailed technical calculations that would be in-
11 volved in estimating radioactivity in groundwater
12 transport, because those concentrations, with the ex-
13 ception of tritium, would all be lower than what it was --
14 assumed to be in the lake for that person drinking the
15 water.

16 MR. BLACK: Excuse me, Dr. Gotchy. With that
17 answer, you said that you assumed a maximum individual
18 consumed water from the aquifer.

19 Do you mean from the aquifer or from the
20 cooling reservoir?

21 DR. GOTCHY: I'm sorry. I meant the cooling
22 lake. I'm sorry.

23 BY MR. DOHERTY OF DR. GOTCHY:

24 Q All right.

25 Now, on page five -- we'll get out of the lake

3-8

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1 for a while and go to the shore.

2 Is this process of cesium-137 that you speak of
3 deposited on the shore -- How would that process
4 occur, sir? What is that process?

5 A That is a process which was discussed in testi-
6 mony yesterday, too. But it basically involved the ad-
7 sorption of cesium-137 on particles suspended in the
8 water.

9 It would include uptake, for example, also by
10 algae which might be there. And with the subsequent
11 death of the algae, the remains would fall to the bottom.

12 It would include cesium in droppings from fish,
13 for example, who had made -- perhaps some small fish had
14 been feeding on algae.

15 All of this debris would fall to the bottom and
16 become a mix of organic and inorganic materials. And
17 that's generally what we refer to as sediment.

18 Q All right.

19 Did you say "adsorb" or "absorb"?

20 A It would be a combination.

21 Q So it's both. I see.

22 All right.

23 What is the half-life of cesium in your calcula-
24 tions? What do you use?

25 A The radioactive half-life --

1 Q 137.

2 A I believe it's 28 years.

3 Q Is there any precipitation involved at the
4 shoreline -- I don't mean that scientifically. But is
5 there any significant precipitation? Does that process
6 occur at all?

7 A I couldn't swear to that for this lake. I
8 really don't know the details of the water chemistry,
9 and that would determine the rate of precipitation of
10 materials.

11 Certainly, there probably would be some pre-
12 cipitation, although I couldn't hazard a guess as to how
13 much that would be.

14 The model that we used describes transfer of
15 radioactivity from groundwater sediment based on actual
16 studies in other areas of the country over extended
17 periods of time.

18 And what we're looking at is an overall net
19 transfer constant of radioactivity from groundwater to
20 sediments.

21 And that represents the sum of all of the three
22 mechanisms.

23 We have no way of breaking out what fraction
24 would be due to sedimentation, what fraction would be
25 due to precipitation and how much would be due to other

1 mechanisms.

2 Q I see.

3 Now, which of the substances would you say are
4 most readily uptaken in the sediment, in any of these
5 processes right now?

6 Is cesium-137 more taken in or less taken in
7 than strontium-85 would you say?

8 A Just a second.

9 (Pause.)

10 It would be conjecture. They would agree prob-
11 ably within about a factor of five or ten of each other.
12 Both would tend to be taken up in sediment, particularly
13 by adsorption mechanisms.

14 Q Are you aware of any sponsored research of the
15 Nuclear Regulatory Commission on this uptake?

16 A I'm not personally aware of any. I'm sure
17 there's some.

18 Q I see.

19 All right. Now in your calculations, would you
20 have taken into consideration any differences in these
21 materials on this?

22 A Yes, we do.

23 The transfer constants that are used depend upon
24 the nuclides to a considerable extent. But ... yes,
25 we would.

3-11

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1 Q So then it's just a matter of recall, you'd look
2 them up in a table and it would be hard for you at this
3 moment to --

4 A They are built into the computer code as it's
5 now operating.

6 Q What's the name of the program, sir?

7 A It's called LADTAP, L-A-D-T-A-P.

8 Q LADAPT?

9 A LADTAP.

10 Q LADTAP.

11 A Yes.

12 Q All right.

13 JUDGE LINENBERGER: Mr. Doherty, may I just get
14 in a quick question here?

15 Dr. Gotchy, you referred to -- with respect to
16 that code, something built into the computer, which you
17 designated as, I believe, transfer functions or transfer
18 coefficients --

19 DR. GOTCHY: Transfer constants, yes, sir.

20 JUDGE LINENBERGER: Transfer constants.

21 Could you -- Would you qualitatively at least
22 define what those are?

23 DR. GOTCHY: They represent the transfer rate
24 per kilogram/per liter/per hour.

25 In other words, the transfer rate from water to

3-12

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1 surface.

2 Let me see if I can find this --

3 JUDGE LINENBERGER: Excuse me. I --

4 DR. GOTCHY: I'm sorry. Liters/per kilogram/
5 per hour --

6 JUDGE LINENBERGER: From water to what?

7 DR. GOTCHY: Sediment.

8 JUDGE LINENBERGER: Oh.

9 And do these constants take account of specific
10 physical or chemical makeup of sediments? In other words,
11 if the sediment is pure clay, is the constant one value?
12 If it's sand, another value?

13 DR. GOTCHY: No, sir.

14 The code, as it now exists, looked at transfer
15 constants for a number of situations. Most of the data
16 comes from studies in the Columbia River through an
17 awarded funded now by the Department of Energy, over a
18 period of several years.

19 It contains a mixture of organic and inorganic
20 components in the sediment.

21 And as I said earlier, it represents an upper
22 bound of the kind of ranges of values that they have
23 seen over the years in various areas along the river,
24 behind dams, for example, as well as in moving water.

25 JUDGE LINENBERGER: I see.

3-13

1 So, in effect, it's a conservative representa-
2 tive sediment that is calculated here?

3 DR. GOTCHY: That's what I've been told. I was
4 not involved in the selection of those numbers myself.

5 But I know how they were selected, and they
6 looked at a range of values and we would usually pick
7 the upper bound of the ranges.

8 JUDGE LINENBERGER: Thank you, sir.

9 Pardon the intrusion here, Mr. Doherty.

10 BY MR. DOHERTY OF DR. GOTCHY:

11 Q All right.

12 I'm curious to know -- you spoke of some research
13 on the Columbia River as being sponsored by DOE. Does
14 the NRC regularly inform employees of progress of its
15 own sponsored research?

16 A In some areas, yes. More so in recent years
17 than in the last few years because when the Agency was
18 formed, we had a very, very small research budget which
19 was restricted to gathering information needed to do our
20 case work.

21 And as the research budget of the Agency has
22 increased over the last few years, we have been able to
23 fund additional research; some of it not basic research,
24 but closer to basic research than applied research.

25 Q I see.

3-14

1 Do you-- When a contractor report is writ-
2 ten, do you receive word of it, its title and its topic
3 through some sort of internal system?

4 A I don't get necessarily all contract reports,
5 only those --

6 Q Not all of the reports, but some type of
7 newsletter or something ... a list, so that you would
8 know that there was something in the library that related
9 to your area and you -- you know, that interested you.

10 Is that done in the Commission?

11 A Well, quite often I get the reports. For
12 example, from Oak Ridge. A wide selection of reports
13 are just normally sent to me as a matter of course.

14 And I am a review member of panels which are
15 reviewing -- periodically reviewing certain research that
16 is being conducted.

17 But I would get even quarterly reports on
18 those long before the final report is written.

19 Q I see.

20 A Progress reports.

21 Q I see.

22 Well, my concern is that you fellows on the
23 battle line ... you know, it's easy to forget them and
24 so ... you know --

25 Are you aware of a recent report called NEUREG

3-15 1 CR 0803, "Distribution Coefficients for Radionuclides in
2 Aquatic Environments"?

3 Has that ever come to your attention during the
4 past year?

5 JUDGE WOLFE: Would you hand the document to the
6 witness?

7 MR. DOHERTY: Yes, certainly.

8 (Document is shown to Dr. Gotchy.)

9 BY MR. DOHERTY OF DR. GOTCHY:

10 Q Having examined the document, does its title --
11 Is it familiar to you from the past year -- 1980?

12 A No, sir, it's not.

13 Q I see.

14 I know you didn't have long to look at it, but
15 does it seem the type of document you should have perhaps
16 had a look at?

17 I mean, not because -- that someone should have
18 informed you existed?

19 A It's kind of a document that I probably should
20 have looked at.

21 I will say that those documents are made avail-
22 able to the contractors who are working on periodically
23 updating the codes that we use.

24 Batelle - Northwest Laboratories would get those
25 reports. And when they do update the various constants and

3-16

1 coefficients in the code, they would consider those kinds
2 of reports.

3 But I personally am not aware of that report.

4 Q I see.

5 Do you feel the need for this report yourself
6 in your own work? Would it apply to your work, do you
7 believe?

8 A It could, yes.

9 But, like I say, normally for the kinds of
10 assessments that we do, we would normally use the code
11 as it exists, since the detailed calculations involved
12 with handling dozens of radionuclides in the source
13 term would be very cumbersome to do with a hand cal-
14 culator.

15 Q So that you do recognize it as something --
16 somewhat tangential to your efforts? Is that correct?

17 A Yes, sir.

18 Q Something you would look at if you perhaps had a
19 spare moment, but the pressing moments perhaps might keep
20 you away from it? Would that be fair to say?

21 A Yes, I try to look at these things when they
22 come across my desk.

23 Q I see. Okay.

24 I'd like to turn -- In your testimony you
25 mentioned the use -- Pardon me. I have too many papers

3-17

1 here.

2 Yes. On page six, up at the top, your first
3 answer, you mention the SER.

4 I'd like, if possible, to turn to the SER.
5 It may be that that's not available to you. I don't know
6 if it is or not.

7 A I don't have it here with me, but we have
8 copies -- the Staff has copies here.

9 MR. BLACK: Are you talking about what is
10 referenced there? Supplement No. 2 to the SER?

11 MR. DOHERTY: Yes, sir, that's right, Mr.
12 Black.

13 BY MR. DOHERTY TO DR. GOTCHY:

14 Q Turning to Chapter 11, Table 11-1 of that,
15 the material tritium keeps cropping up.

16 I note on this table that it appears that it's
17 not classified as either a corrosion and activation
18 product or a fission product.

19 A It's classified under fission products. But
20 it's broken out separately.

21 Q Uh-huh.

22 A At the bottom of the table.

23 Q So it is a fission product?

24 A Yes. It is formed in other ways, too, but
25 primarily -- well, tertiary fission, I guess. And there

3-18

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1 is some activation of normal -- deturium in water,
2 for example.

3 Q Deturium can be activated to create tritium;
4 is that right?

5 A Yes, it can.

6 Q All right.

7 Now, I'd like to consider one substance there,
8 and that's under the fission products. Actually, I'd
9 like to consider one substance with two radionuclides:
10 strontium-80, strontium-90, strontium-91 in the first
11 column.

12 Is there a radionuclide strontium-80?

13 A No, I think that should be strontium-89.

14 Q All right.

15 What is the half-life, sir, of strontium-90?

16 A It's about 30 years also.

17 Q I see.

18 Both it and cesium-137 have about the same half-
19 life?

20 A That's correct.

21 Q All right.

22 Now, this may be complex, but I'm interested to
23 know ultimately, in terms of the calculations, how you
24 deal with what we might call -- and what I'd prefer to
25 call degradation of radioactive materials.

3-19

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1 My understanding is that you may have an isotope
2 of a substance, and when it emits one of its particles,
3 that that material then, for any length of time, is
4 another material, in the sense that it is a different
5 isotope of the same material.

6 A It can be. It can also become a different
7 element.

8 For example, strontium will normally decay to
9 yttrium.

10 Q To what, sir?

11 A Strontium would normally decay to yttrium. So it
12 becomes a different element.

13 Q I'm sorry. I didn't identify the name of
14 the material that you mentioned that it decayed to. I'm
15 sorry.

16 A I said strontium would normally decay to
17 yttrium.

18 Cesium would normally decay to --

19 Q Yttrium --

20 A -- barium.

21 So it would become different elements.

22 Q I see.

23 A As well as different radionuclides.

24 Q All right.

25 Now, when this degradation takes places with

3-20

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1 strontium (our example), would it then degrade to
2 possibly -- and let's take this example -- to a radioactive
3 isotope of yttrium?

4 A Yes.

5 Q I see.

6 But going back to strontium a minute, strontium-
7 90 slowly then breaks down to possibly strontium-89? Is
8 that --

9 A No.

10 Strontium-90 decays to yttrium-90.

11 Q When it decays to yttrium-90, it does not reach
12 strontium-89 as a decay product; is that right?

13 A No.

14 Q All right.

15 Well, I see no yttrium-90 here. When would --

16 MR. NEWMAN: Mr. Chairman -- excuse me -- when
17 he just said he found no -- the element that he
18 referred to "here," what document or table was he
19 looking at?

20 MR. DOHERTY: Pardon me, Mr. Newman.

21 It's Table 11.1 of the SER.

22 MR. NEWMAN: Thank you.

23 MR. DOHERTY: That's all right.

24 BY MR. DOHERTY OF DR. GOTCHY:

25 Q Now, this says at the top "Calculated Releases

3 21

1 of Radioactive Materials in Liquid Effluents." At what
2 moment in time is this?

3 In other words, strontium-90 cannot -- Maybe
4 you can answer that question. In what moment is this
5 considered to be correct?

6 A Well, these releases that are listed in the
7 table are calculated to be those which will appear in the
8 cooling water --

9 I'm sorry. Is this --

10 Yes, in the cooling water.

11 It would be essentially at the time of their
12 release.

13 I think your concern about yttrium-90, I can
14 answer that. Where you have very short-lived daughters --
15 and yttrium-90 is very short relative to strontium-90 --
16 they are normally considered to be in radioactive
17 equilibrium all of the time.

18 So that when you do the calculation for
19 strontium, the code also does the calculation for yttrium-
20 90, even though it's not listed here.

21 Q So actually this list is not complete. It's
22 theoretically complete, but not -- In reality, there is
23 yttrium-90 as part of the release; is that right?

24 A They are normally assumed to be in radioactive
25 equilibrium. This would be true also for technetium and

3-22

1 rodium-106. There's no rodium-106 listed because of the
2 short half-life.

3 When the computer gets that nuclide identified
4 in the code, it will automatically assume an equal amount
5 of the short-life daughter to be present and does a
6 calculation for that and adds it to the dose from the
7 parent.

8 Q All right.

9 This short-lived daughter ... that will then
10 undergo another degradation. Is that correct?

11 A That's correct.

12 Q So the short-lived -- And your code then will
13 take into account whatever happens to it? Is that right?
14 Or will it not?

15 A That's correct. It will.

16 Q It will.

17 Does it take into account -- the code -- Does
18 it take into account all of these materials and all their
19 daughters?

20 A That's correct.

21 It will follow each nuclide listed here until
22 it decays to a stable element and is no longer radio-
23 active.

24 Q I see.

25 And you have -- you then have some knowledge in

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1 the code as well imparted that -- of when and what
2 substance is the terminal substance in this chain of --

3 A I don't have that right here with me.

4 Q No, no, I wouldn't expect that.

5 But that, too, is a part of the code. I'm having
6 some difficulty with that because my knowledge runs to
7 the transuranics which run to lead, but obviously these
8 can't run to lead.

9 A No. None of these would.

10 Q Yes.

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1 BY MR. DOHERTY OF DR. GOTCHY:

2 Q Is there any way, sir, in your knowledge that
3 the conversion to -- from one material to another results
4 in any increase in the radioactivity of the material
5 itself?

6 A No, sir. It's all considered in the calculation
7 of the concentrations.

8 Q In other words, then at any point, like we'll
9 take the top one for a minute in the fission products
10 list, Bromium-83 -- and let us say, for example, that it
11 has two daughters, 50 percent each, for example -- then
12 you would know that it was one times $10(-4)$ of Daughter A,
13 one times $10(-4)$ of Daughter B.

14 And it could never be in excess of two. Is
15 that right?

16 A I don't know what the decay -- the daughters are
17 for the decay of Bromium-83.

18 Q Well, I just made up a hypothetical for us.
19 Fifty percent each of two.

20 A If there were -- I think I could give an
21 example of Strontium-90, which I know decays Ytrium-90.

22 Q All right.

23 A We list 2.4 times $10(-3)$ Curies per year of
24 Strontium-90.

25 That means that ultimately you would also have

4-2

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1 2.4 times 10^{-3} Curies of Yttrium-90, which is included
2 in the calculations.

3 Q Strontium-91 has but a single identifiable
4 daughter.

5 A That's correct.

6 Q And that quantity is the same.

7 Now, what about materials that have more than
8 one daughter?

9 A Well, some like, for example, Strontium-91,
10 they show there Yttrium-91/Medistable (that's M) and
11 Yttrium-91.

12 It would decay -- All of the Strontium-91
13 would decay to one or the other of these two nuclides.
14 I think they all go to Yttrium-91, but I'd have to have a
15 table to be sure that was true.

16 I think they go to the Medistable state and
17 then decay to Yttrium-91.

18 So for each atom of Strontium-91 that decays,
19 you would get another atom of Yttrium-91M and another
20 atom of Yttrium-91.

21 Those would be considered in the calculations.

22 Q So then your calculations and your code follows
23 the law of conservation of -- what would that be? Not
24 mass -- but what would it be?

25 Do you have a rule? A name for it?

1 A I can't think of one right now.

2 Q Okay.

3 We established that Tritium is a fission product.
4 What's the half-life of Tritium, please?

5 A I think it's 12 years.

6 Q Uh-huh.

7 In previous testimony from Dr. Armstrong, he
8 stated that seepage through the lake would not -- pardon
9 me -- that the seepage through the lake to the aquifer
10 would be close to 100 percent (if not 100 percent) for
11 this material only.

12 Does that agree with your --

13 A I don't recall him saying that. But I would
14 agree with that, yes.

15 Q You do agree with that statement?

16 A The Tritium, the concentration in the ground-
17 water initially as it exits the lake would be the same as
18 in the lake.

19 However, after exiting the lake, it would be
20 diluted by water pre-existing which didn't contain any
21 Tritium -- pre-existing in the pore space of the soil.

22 So it would tend to be diluted as it moved
23 away from the lake with more and more water.

24 Q So then dilution would then tend to reduce the
25 concentration of the Tritium which eventually got to the

4-4

1 groundwater?

2 A Yes, sir.

3 Q What is the Commission's -- Well, what is your
4 opinion?

5 What are the health effects of Tritium?

6 A Well, I guess if you calculate a dose --
7 Tritium is ubiquitous to all living things because we're
8 basically hydrocarbon creatures.

9 Tritium is a part of everything we are, and it's
10 pretty uniformly distributed everywhere in our body, both
11 as parts of the organic molecules and as water itself.

12 Most of the Tritium in our body remains part
13 of the total body water and turns over with an effective
14 half-life of about 12 days.

15 In other words, if you ingested a certain amount
16 of Tritium on a given day, 12 days later you'd have half
17 of what you ingested -- 10 or 12 days, something in
18 that range.

19 It turns over fairly rapidly.

20 Q You have used the term half-life in that case
21 in a sort of physiological sense, instead of the radio-
22 logical sense?

23 A The radiological half-life is considered, but
24 I have mentioned an effective half-life, which is some of
25 the removal contents from a reactor decay --

4-5

1 Q Well, let me stop you. You're really going
2 way past me, sir. I'm sorry.

3 What I meant was in the previous statement that
4 I had thought of a person ingesting a tablet with a
5 measurable amount of tritium and people checking that
6 person daily until they couldn't detect it.

7 You then said something about a half-life of 12
8 days --

9 A An effective half-life, yes.

10 Q An effective half-life in the body then. The
11 body would then eliminate another half in 12 more days?

12 A That's correct.

13 Q And so actually some of it might reside --
14 well, theoretically forever, but its residence is seen
15 that way? 12 days for a half?

16 A Yes.

17 Again, the elimination rate can be increased
18 by ingesting larger volumes of water than you normally
19 take.

20 Standard treatment in the health physics field
21 is to give somebody a case of beer.

22 It increases the elimination rate.

23 Q Yes.

24 Well, on page 2.7 of the Final Environmental
25 Statement, it talks about faulting at the site. And in

4-6

1 Section 2.4, geology, it says, "Although faults do occur
2 within the site area, there is little seismic activity
3 related to faulting."

4 Well, seismic activity isn't the significant
5 part; faulting is.

6 Do you know -- Has it been part of your review
7 to consider faulting at all, in terms of this seepage
8 problem?

9 A No, we didn't feel it was necessary in this
10 case, as I said, because we considered taking water
11 directly from the area of the discharge, and assuming that
12 it was consumed and that fish was caught there and also
13 consumed, which would tend to provide us a maximum upper
14 limit of the potential dose to anyone.

15 Going through the detailed groundwater hydrology
16 is a lot of work. And we normally don't do that, unless
17 we have to.

18 Q I'd like to indulge in a hypothetical for a
19 moment.

20 Let us suppose that -- This is helpful some-
21 times in radiological questions, I think.

22 Let us assume that the entire contents of the
23 lake, all 81,000 acre feet, entered the aquifer. Would
24 you say that after that event, that your calculations
25 from 1.109 and from the other -- would still give the

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maximum individual dose that might occur?

A Do you mean that if it went into the aquifer and someone had a well and drew from that aquifer and drank it, as opposed to taking water from the cooling lake?

Q Yes, that's right.

A Yes. It would be a lot lower than what we calculated.

Q It would still be lower?

A Yes, sir, primarily because all of the tritium dose would remain -- well, it would also be reduced by dilution.

The cat ions, like Cesium-137 and 134, would contribute a major fraction of the total dose. They would be sorbed on clay particles in the soil as they moved with the groundwater.

And so they would be reduced by two methods: dilution and sorption.

Q Yes. I had momentarily, in this hypothetical, turned the cooling lake into somewhat of a bathtub in which someone had pulled the plug in order to get some of those effects out of the way. That was the reason.

Now, in the review, to your knowledge are there any underwater -- underground streams?

A I don't know of any. I have not reviewed the

4-8

1 zoology of the site.

2 Q I see.

3 Now, Regulatory Guide 1.109, is there a section
4 in there that does instruct or direct the reviewer to
5 consider sediment concentration, in terms of the fish
6 ingestion pathway?

7 A That's considered as part of the fish ingestion
8 pathway, yes.

9 Q Part of the --

10 A It's a component of the bioaccumulation factor
11 for fish.

12 Q All right.

13 And you concluded, running through that, that
14 you would still stay within 10 CFR limits; is that right?

15 A Yes.

16 Q Okay.

17 I have approached the end here.

18 (Pause.)

19 I believe Dr. Armstrong in his written testi-
20 mony mentioned a process calling fingering in an aquifer.
21 Are you familiar with that?

22 A No, sir, I'm not.

23 Q All right.

24 I think it might be relevant to one discussion
25 of the possible concentration.

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1 Dr. Armstrong did testify -- He gave a kind
2 of list -- it was on page eight of his testimony, for
3 those who want to follow -- of --

4 Do you have that?

5 A I don't have Dr. Armstrong's testimony. I
6 think it's sitting down there in the chair.

7 (Pause.)

8 I have a copy now.

9 Q He testified in his written statement that
10 during transport of radionuclides from the cooling lake
11 to the aquifer, various processes would occur; and he
12 listed them on page eight, starting on line 11, roughly.

13 Are any of those processes influenced by the
14 temperature of the water, would you say, just going through
15 them?

16 A Probably not within a reasonable range of
17 temperatures. It would not significantly be affected.

18 Q It would take an extreme change in temperature.

19 I think the statement has been that the change
20 in temperature of the cooling lake is not -- I think it
21 was 10 degrees Fahrenheit -- throughout usage. Would that
22 be sufficient?

23 A I would not think that would make a significant
24 difference in the rates.

25 Q All right.

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What about the pH of the lake?

A. That could make a significant difference.

Q. That could.

All right. What would be that effect -- you know, positive or negative, in terms of that? What is the effect, say, of a more acidic pH on some of these processes? Can you tell me?

A. I couldn't quantify that.

Q. Qualitatively could you tell me.

A. I'm sorry.

Q. Qualitatively.

A. I couldn't even do that for this particular soil without knowing the properties of the soil itself, because with the sorption processes -- particularly for cat ions -- in general, the higher the pH, the more of the material is available is ionic form.

As the pH increases, you can actually get sybilazation of certain cat ions from sediment back into the water.

Q. All right.

MR. DOHERTY: Mr. Chairman, I request that we have a short break. I'd like to look over my notes and see if there is anything else. I've just about concluded with this witness.

I'd like to have a minute or two. That might

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1 be the best way to do it.

2 Would that be suitable?

3 JUDGE WOLFE: Yes.

4 Before we had our recess though, I had occasion
5 to review yesterday's transcript. And what I thought
6 had been off record was really a matter of record regarding
7 conversations between Mr. Scott and Mr. Newman and
8 Mr. Copeland. So it is a matter of record.

9 There was one brief statement that apparently
10 was not made on the record. There was some controversy
11 over the use of good cause. I don't even remember in
12 what context it was used.

13 But as I have indicated time and time again,
14 these arguments ... I listen to them. If they --
15 I just have to draw my own conclusions.

16 But in any event, these were a matter of record.
17 The other matter -- some argument about good cause, I
18 paid no attention to it. I don't even remember what it
19 was all about yesterday.

20 But I think your comment is well taken, Mr.
21 Doherty. There should be no off-the-record comments.

22 And as I've indicated before, the Board does
23 not like parties or representatives coming forward and
24 talking to the Board without it being a matter of
25 record.

4-12

1 Secondly, I suggested to you that you might
2 call Mr. Bishop. I don't insist on it.

3 I have looked at this record now, and yesterday
4 we advised, at page 3227 of the transcript, I stated
5 that "I would anticipate that you would be here tomorrow,
6 Mr. Bishop, to cross-examine the witness on both of your
7 contentions -- both of the Staff witnesses."

8 And I also stated that Dr. Gotchy would appear
9 first, Mr. Sanders second.

10 I've indicated previously that we expect -- we
11 would like for the parties and representatives to be here
12 at all times. If they're not, and they appear before
13 the conclusion of alphabetical sequence cross-examination,
14 fine.

15 If they appear here before we excuse the witness
16 or witnesses that are here, they will have the right to
17 cross-examine.

18 If you wish to call Mr. Bishop, you may; if
19 you don't, well, that's something else again. I'm not
20 going to concern myself about it. I have too many other
21 matters on my mind to be concerned with advising the
22 parties what they themselves should be making inquiry
23 about and being present at all times.

24 I would also indicate for the record that Mr.
25 Scott appeared at 9:30 and was here for approximately half

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1 an hour. He has stepped out, it now being about ten of
2 eleven.

3 We will recess now --

4 MR. NEWMAN: Mr. Chairman, before we recess, may
5 I just add one word for the record?

6 JUDGE WOLFE: Yes.

7 MR. NEWMAN: It's an announcement regarding the
8 availability of witnesses.

9 We have confirmed that Drs. Armstrong and
10 Tischler will be here tomorrow morning to stand cross-
11 examination.

12 JUDGE WOLFE: As to Dr. Schlicht, I'm not certain
13 about him. What about him?

14 MR. NEWMAN: I believe that Dr. Schlicht will
15 be available as well.

16 If there's any contrary indication, I'll inform
17 the Board as soon as we've completed the break.

18 JUDGE WOLFE: All right. We'll recess until
19 five after eleven.

20 (A recess was taken.)

21 JUDGE WOLFE: All right.

22 Mr. Doherty.

23 MR. DOHERTY: All right, to continue -- and I
24 only have a few more questions.

25 ///

4-14

1 BY MR. DOHERTY OF DR. GOTCHY:

2 Q The contention, either in its supporting basis
3 or its actual wording, spoke about the following kind
4 of problems: That there are wells in the vicinity at
5 which water from the aquifer, of course, will reach. At
6 some points in time evaporation may occur around this
7 well, such that radioactivity would concentrate there
8 due to evaporation -- underground evaporation.

9 A I don't believe there would be any underground
10 evaporation.

11 It has to be in contact with air, because
12 the evaporation process -- it's going from the liquid
13 state to the gaseous state.

14 And to do that, there has to be air present.

15 Q Well --

16 A There would be evaporation on the cooling
17 lake, but not underground in the aquifer.

18 Q So then what your testimony is is that such a
19 phenomenon on a well casing would not be possible because --
20 Would it be because of lack of air?

21 Would it be because of lack of air?

22 A Yes. The only place in a well where there
23 would be evaporation would be the top of the column -- the
24 water column in the well where it was in contact with
25 air.

4-15

1 Q That would be at the ground level then.

2 A Wherever the -- Yes, sir. Wherever the top
3 of the well column is.

4 Q All right.

5 So that some type of air would have to get down
6 there in order to permit this to occur, is that --

7 A That's correct.

8 Q All right.

9 Now, I'm interested in the fish ingestion path-
10 way a little more. In using Regulatory Guide 1.109, we
11 have heard a great deal of discussion earlier, which you
12 may not have been party to, with regard to the fish
13 species in the lake -- sport fishes --

14 One Centrarchidae particularly comes to mind,
15 which is called the white perch (although it's not a
16 perch).

17 Do you in figuring the bioaccumulation factors
18 for the fish ingestion pathway take into account particular
19 species?

20 A No, we do not.

21 The values that are in the Regulatory Guide
22 represent the -- usually the upper range of the bioac-
23 cumulation factors for all species combined, where there
24 is data for each element in question.

25 Q I see.

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1 Well, at the risk of perhaps having the testimony
2 somewhat inaccurate, the general gist is that this one
3 particular game fish, which will be predominantly either
4 stocked or supported in that aquatic environment and
5 intaken by fishermen --

6 In other words, even though, sir, you use an
7 average or some type of upper range (I guess you'd call
8 it), it looks as if it's going to be pretty specific as
9 to what animal is going to be taken out of that.

10 And it will be the main fish ingestion pathway.

11 Do you use -- in the fish ingestion pathway
12 calculation, do you include inedible animals?

13 A Inedible?

14 Q Yes.

15 A No.

16 Q You make an attempt then to eliminate some of
17 the ones that are just unlikely to be consumed by
18 people, such as what you know to be inedible even though
19 they may not?

20 A Well -- No. We don't discriminate against
21 species of fish because they're inedible. The bioac-
22 cumulation factors turn out to be not terribly species-
23 dependent for each particular type of water.

24 There can be large differences between saltwater
25 and freshwater fishes in bioaccumulation. But, say, for

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1 given freshwater, there are not normally great differences
2 in bioaccumulation between species, although those that
3 tend to -- those that would be involved in perhaps eating
4 some of the organic constituents in sediment would tend
5 to have higher concentrations than those who did not.

6 Q I see.

7 Now, in the Final Environmental Statement,
8 there is quite a long list of fish -- I'm not certain
9 you have attempted to analyze the fish contents of the
10 lake.

11 But you do list in the Final Environmental
12 Statement a considerable listing -- I'll try to locate
13 that, I didn't expect this to come up.

14 (Pause.)

15 There's a considerably long list. I'm certain
16 some of the animals would never be in there. But again,
17 what I'm getting down to is: Can you give me a range of
18 freshwater sportfish and what difference would you find
19 in the bioaccumulation factors between species of fresh-
20 water sportfish?

21 A I couldn't give you that right off the top of
22 my head.

23 I would -- trying to recall numbers that I've
24 seen in the past -- it would perhaps range over as much
25 as an order of magnitude difference between the low end of

4-18

1 the range and the high end of the range.

2 Q That is for sport --

3 A For sportfish.

4 Q Sportfish.

5 Now, an order of magnitude is a scientist's
6 term for ten; is that right?

7 A That's correct.

8 Q Okay.

9 Now, that would mean that there might be one
10 sportfish fairly common, whose bioaccumulation factor
11 was but a tenth of another's?

12 A Yes, sir.

13 Q Okay.

14 Now, as a reviewer -- I guess I should first
15 ask -- All right. Strike that.

16 As a reviewer, would you feel comfortable if
17 you received additional information that the expected
18 sportfish catch was to be 70 percent of one species? Would
19 you feel comfortable in relying on this sort of higher
20 rate number that you've spoken of?

21 A Yes, I would.

22 Q You would not -- pardon the probing, but I
23 think it's important. You would not feel that you might
24 like to take a look at what the bioaccumulation factor
25 for that particular species was, and just taking a look

4-19

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1 at what you had used previously?

2 A. No, I wouldn't.

3 In many cases, there simply is no data for
4 certain species of fish.

5 Q I presume that there --

6 A The common species which you would have bio-
7 accumulation data for --

8 Q Yes.

9 Let's assume you have it. Would you feel that
10 would be a good practice, just to assume the figures are
11 going to be conservative?

12 MR. NEWMAN: Mr. Chairman, I believe that the
13 witness has already stated that the assumptions used
14 by the Staff presume the highest bioaccumulation factors
15 in sportfish.

16 I think we've reached the point now where
17 counsel is arguing with the witness as to the testimony.

18 MR. DOHERTY: Mr. Newman has said the highest.
19 That is not the testimony of this gentleman, that it is
20 the highest.

21 He said higher -- I didn't get the exact
22 term -- higher rate, I think he said, not "highest."
23 And that's significant here.

24 DR. GOTCHY: That's correct. It's not
25 necessarily the highest in the range. It would tend to

4-20

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1 be representative of the upper bounds for all of the
2 species that were looked at.

3 MR. NEWMAN: I withdraw any objection to that
4 question.

5 JUDGE WOLFE: Do you recall the question,
6 Doctor?

7 DR. GOTCHY: No, I don't.

8 MR. DOHERTY: I'm sorry, but could you read it
9 back, please? I would rather do that.

10 (Question read.)

11 DR. GOTCHY: Unless there was an indication that
12 perhaps the calculated doses might exceed Appendix I
13 values, and then we would perhaps go back and look at the
14 specific species and whatever bioaccumulation data was
15 available for those species for the particular radio-
16 nuclides that are in the source term for the particular
17 plant.

18 We normally don't do that because that involves
19 a tremendous amount of work.

20 BY MR. DOHERTY OF DR. GOTCHY:

21 Q Well, I'm concerned that something may have
22 slipped through the net here. It has been shown that --
23 as I described earlier -- that one particular species
24 would be very commonly caught and there would be a defi-
25 nite -- far fewer number of other.

4-21

1 Would it be provisionally done at the operating
2 environmental -- operating license statement, for instance?
3 Or is that asking you to speculate?

4 A I'm sorry. What's the question again?

5 Q It wasn't very well phrased.

6 By what mechanism within the Agency would such
7 a calculation be made, even though out of order or out of
8 practice? Who would make that decision?

9 MR. BLACK: I'm going to object. I believe this
10 question and answer have been asked -- or the question has
11 been asked and answered. I think it's very clear on the
12 record that the calculation has not been done, and under
13 what circumstances it would be done.

14 I believe that this line of questioning is
15 getting argumentative.

16 JUDGE WOLFE: My understanding is that you
17 asked who within the Agency would make what you consider
18 to be a more desirable calculation. Is that your
19 question?

20 MR. DOHERTY: Yes.

21 JUDGE WOLFE: Objection sustained.

22 - - -

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1 BY MR. DOHERTY TO WITNESS GOTCHY:

2 Q. Is there any mechanism at this point, assuming
3 the licensing goes through this particular type of lake
4 and what we have heard so far, whereby the Agency will
5 review at least to determine if they are approximating
6 exceeding Appendix I because of the bioaccumulation
7 factor of one intensely popular fish.

8 Is the Agency capable of that? What -- who
9 will do it?

10 MR. NEWMAN: It was the same question, Mr.
11 Chairman and the same point, I believe. I object.

12 MR. LINENBERGER: Mr. Doherty, perhaps I can
13 ask a question here that would -- might shed light on
14 what I think is bothering you. Let me ask it in the
15 following way.

16 Dr. Gotchy, you indicated that routinely you
17 do not use species specific bioaccumulation factors in
18 these calculations. I think the possible concern that
19 might derive from that statement is what is your basis of
20 confidence that in any given lake and fauna makeup of
21 that lake, what is your basis of confidence that the
22 calculations would not be conservative because some
23 particular specie in that lake may have an unusually
24 high accumulation factor for some chemical or
25 radiological ingredient in that lake.

5-2

1 JUDGE WOLFE: I will sustain the objection to
2 Mr. Doherty's question and you will answer Judge
3 Linenberger's question.

4 THE WITNESS: As I said, we don't have detailed
5 bioaccumulation data for all the species that would be
6 involved in any given lake in most situations, so what
7 we do on the staff is normally look at a reasonable upper
8 bound of the range of all values that are reported in
9 literature for all the species of the -- for example,
10 all freshwater species for each element, where there is
11 data. And this data is not easy to come by as I'm sure
12 you know.

13 By using the upper bounds of the ranges that
14 we have observed in the literature we feel reasonably
15 confident that the doses that we estimate in most cases
16 will be overestimates of the probable dose, but, certainly
17 the doses could approach those levels on the assumption
18 that an individual did take fish and ingest them directly
19 from essentially the vicinity of the discharge.

20 Most cases we find doses from food pathways,
21 for example, from rivers and estuaries or oceans to be
22 much lower than would be the situation for a cooling lake
23 because of the recirculation of radioactivity in the
24 cooling water. But it would -- in my judgment, if I were
25 doing a review and I found the dose we had calculated was

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1 for example, five or 10 millirem per year, which is higher
2 than any number I have seen for a pond, but assuming it did
3 get that high, then we would probably go back and look at
4 the literature again for this specific species in that
5 lake to see if that's still reasonable.

6 If it were, there would be considerable pressure
7 I think for the Applicant to consider reducing the
8 particular nuclides that are contributing to that dose
9 which would be in excess of Appendix I design objectives.

10 But, again, that would represent also a cost
11 benefit analysis on the part of the Applicant and the
12 Staff to determine if adding additional equipment were
13 justified.

14 JUDGE LINENBFRGER: Thank you, Dr. Gotchy, that
15 answer satisfies me. I don't speak for Mr. Doherty,
16 however.

17 BY MR. DOHERTY TO WITNESS GOTCHY:

18 Q. Is there any sign, any symptom that freshwater
19 species show of excessive bioaccumulation of radioactive
20 substances other than sort of geiger counter type of thing.
21 Is there any symptoms in the health of the animal?

22 A. Not of the kinds of concentrations that you have
23 in the cooling lake. It would take concentrations
24 thousands of time greater than those before you could
25 induce any kind of a radiobiological change which would be

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1 manifested, say, in an increased susceptance to mold,
2 for example, in the water sample, or something
3 of that nature, or reduced fertility. It would take
4 doses, concentrations that would be thousands or more
5 times higher than anything you would have in the cooling
6 lake.

7 Q. So no individual that happened to float up to
8 the surface would exhibit anything that would make you
9 feel we've got a problem with, in this area. Is that
10 right?

11 A. No, sir. And it would be complicated, of course,
12 by the fact that there are chemicals also in the cooling
13 water from pollution inhibitors and that sort of thing
14 that would complicate the question.

15 Q. Then there is no clear symptom of excess
16 bioaccumulation to the eye.

17 A. Not that I am aware of.

18 Q. Now, I believe it's been testified that there
19 will be some types of wood material in the lake, I believe
20 to benefit spawning certain species. Now, I don't --
21 I'm not going to ask you about fish spawning -- but my
22 understanding from the testimony of Dr. Schlicht was that
23 when cooling lakes have old logs, for example, timber,
24 that that material can stay under water for a good many
25 years, perhaps even the life of the plant and that that

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1 is beneficial. Now what I'm asking is does that material
2 does wood tend in any way to accumulate radioactivity?

3 MR. NEWMAN: Mr. Chairman, I'm going to object
4 to the preface to that question. I believe Counsel was
5 testifying. The question itself however, is not
6 objectionable. I don't believe that Dr. Schlicht
7 testified that wood would be under water for hundreds of
8 years.

9 MR. DOHERTY: Again, of course, he did not. I
10 think I said 20 or the life of the plant. Perhaps that is
11 the source of confusion. I believe he said 30 years that
12 they had seen in cooling lakes in this particular
13 Applicant's system.

14 MR. NEWMAN: Do you have the transcript
15 citation on that, Mr. Doherty?

16 MR. DOHERTY: I'm looking for it now, sir.
17 No, sir, I do not. I feel highly confident
18 that he did state that wood would be in the bottom of
19 the pond.

20 MR. NEWMAN: Mr. Chairman, I think that we will
21 stipulate that there will be wood in the bottom of the
22 pond and let's proceed then with the question.

23 BY MR. DOHERTY TO WITNESS GOTCHY:

24 Q. All right, let's presume then that this wood
25 survives for five years and then whatever wood does -- goes

5-6

1 away -- for that five-year period would it accumulate
2 any of these radionuclides?

3 A. There's a possibility, certainly, that certain
4 radionuclides might adsorb on the surface.

5 Q. It would be an adsorption process on the
6 surface only? Would this be the fact or would it enter
7 in any way into the fibers of the material?

8 A. Well, there would be a tendency for it diffuse
9 into the wood -- certain nuclides, certainly. Some are
10 more mobile than other. Wood is essentially a cellulose
11 structure so it's -- if there were sediment there for
12 example, it might also infiltrate the wood as it would
13 a filter, but it would be less, for example, than I think
14 you would find in the bottom sediments of the lake.

15 MR. DOHERTY: I would like to thank you very
16 much and I believe this concludes my efforts, sir.

17 JUDGE LINENBERGER: Mr. Doherty, there is -- one
18 of your questions seems to me as kind of left hanging
19 here. In the very early part of your cross-examination
20 I seem to recall that you asked the witness how the -- his
21 quoted genetic and sematic effects from the Allen's
22 Creek Plant might translate into a nationwide figure if
23 you assumed Allen's Creek to be representative of all the
24 plants in the United States. And I think there was an
25 objection to that question. We have inquired about what

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1 you were getting at here in asking the question, but I
2 don't believe you ever got an answer. Now, where do we
3 stand here? Have you withdrawn that question or is that
4 a question for which you see a need for an answer or
5 that -- it's a loose end I would like to see cleaned up.

6 MR. DOHERTY: Well, at present I don't have
7 any true questions with regard to all nuclear plants
8 and any type of questioning train that would involve that.
9 I was able to determine getting a little more depth into
10 these calculations of cancer risks and genetic factors,
11 I got the numbers I wanted, which I feel adds something
12 to the testimony and that's -- I do not wish to pursue
13 that any further. I appreciate your offer though.

14 JUDGE WOLFE: Mr. Scott, cross-examination.
15 This is with respect to Dr. Gotchy.

16 MR. SCOTT: Your Honor, I had prepared to
17 cross-examine Mr. Sanders first and even more importantly,
18 I had planned that Mr. Doherty would finish up the
19 morning and I've been told that Mr. Schuessler and Mr.--
20 Dr. Marrack are both going to show up after the lunch
21 break. Now, I can proceed if that's what you wish, but
22 I think it would be a lot smoother if we let -- take an
23 early lunch break, reconvene earlier, you know, like
24 12:30 and let these other people who are much less
25 limited in the times that they can appear than I am, have

5-8

1 their testimony first, without having to interrupt mine
2 and having to start over again. So it's up to the Board.

3 JUDGE WOLFE: How long will your testimony -- or
4 cross-examination be? Approximately.

5 MR. SCOTT: I would guess approximately one day
6 per witness.

7 JUDGE WOLFE: Pardon me?

8 MR. SCOTT: Approximately one day per witness.

9 JUDGE WOLFE: How would you know if you
10 haven't, as you say, prepared for the cross-examination
11 of Dr. Gotchy?

12 MR. SCOTT: It's just past experience. I had
13 prepared some for Dr. Armstrong and it would be much the
14 same questions.

15 JUDGE WOLFE: Yesterday, as you know, at the
16 conclusion of the hearing yesterday we indicated that we
17 would take cross-examine -- we would take the testimony
18 and the cross-examination of Dr. Gotchy first. Do you
19 remember that?

20 MR. SCOTT: No, I don't. I think that was
21 announced this morning. I didn't know anything about
22 Dr. Gotchy being first today. I had heard the panel was
23 going to be one. My contention has to do with Mr. Sanders.

24 JUDGE WOLFE: But you intend to cross-examine
25 Dr. Gotchy.

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1 MR. SCOTT: Yes. I would suggest it would be
2 no delay in the proceedings. It would just be changing
3 our time for lunch break and we've already broken at
4 different times in the past for lunch. It's close to
5 lunch already.

6 JUDGE WOLFE: Any objections?

7 MR. NEWMAN: Yes, sir. I don't want to be
8 argumentative, but I am concerned that when the Board
9 indicates the order of presentation on a given day and
10 when everybody prepares in anticipation of that order
11 that simply to meet the convenience of one or more of
12 the Intervenors who may or may not be here, that that
13 order will be disrupted and I believe that Mr. Scott was
14 here yesterday when the Board indicated that Dr. Gotchy
15 would proceed first that day and I perceive no excuse in
16 his statement for not being prepared to cross-examine
17 Dr. Gotchy at this time.

18 MR. BLACK: Transcript page 3227, you indicated
19 Mr. Gotchy would come first and on page 3228, Mr. Scott
20 says he has no objections to any of this. He thinks it's
21 very reasonable.

22 JUDGE WOLFE: That's right.

23 MR. SCOTT: That is not right. It was not said
24 that Mr. Gotchy would go first; it would be the panel that
25 would go first.

5-10

1 JUDGE WOLFE: Well, Mr. Scott, it's in the
2 transcript.

3 MR. SCOTT: My discussion of reason which I
4 remember very clearly was that it was reasonable for us
5 to make -- allow this panel to come in out of order. In
6 other words, the schedule that Mr. Newman has so
7 eloquently talked about was not this one at all. It was
8 the one that had Mr. Armstrong, Tischler and Schlicht
9 here today. Now, I think it's infinitely reasonable to
10 allow these people to come in out of order, but it's just
11 as reasonable to allow these 2 or 3 Intervenor who will
12 be coming after the lunch break to start and not have me
13 interrupt.

14 JUDGE WOLFE: Yes, well, I'm making a distinction
15 now between you and the other Intervenor. What I'm
16 saying is that we indicated yesterday and I will go no
17 farther, that Mr. Gotchy would be the first to testify and
18 the first to be cross-examined. You were aware at that
19 time that you were to be prepared for cross-examination.
20 So in order that there be no further delay --

21 MR. SCOTT: Well, is it possible when the other
22 parties come in for me to stop and then let them proceed,
23 and then when they get finished, for me to proceed. That
24 is the big problem. It's the big problem I'm anticipating
25 is these other parties, you know, Dr. Marrack's got a very

5-11

1 strict schedule. It's the exact situation that put us in
2 this situation, namely, the witnesses, expert witnesses
3 have got a schedule. They've got classes to teach and
4 whatever. It's the identical problem.

5 JUDGE WOLFE: No. The parties have an
6 obligation that must be met. We've relaxed the
7 requirements that parties be present at all times. We've
8 relaxed that. The parties have an obligation to be here
9 at the specific times that cross-examination -- their turn
10 alphabetically begins. I've indicated we would relax
11 that. But I simply must have a rein on this and by that
12 I mean r-e-i-n, on these proceedings.

13 If each Intervenor and each -- and the other
14 parties proceed to make inroads on the Board's rulings,
15 we will have no procedure in this at all and I'm not going
16 to allow that sort of disillusion of these proceedings.

17 We have to have some orders, I will try to --
18 some order and I will try to bend over backwards to
19 accommodate all parties to the extent possible. If we
20 are going to have some procedure and this procedure is that
21 we are going to proceed with the cross-examination of
22 this witness right now through you, Mr. Scott.

23 MR. SCOTT: Mr. Wolfe, I would like to suggest
24 that Schuessler is before Texpirg and Mr. Schuessler is
25 here and that there is no loss of anything, in fact, it's

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1 the normal thing to have Mr. Schuessler proceed now.

2 JUDGE WOLFE: That's right. You are here,
3 Mr. Schuessler then, alphabetically.

4 You will proceed with cross-examination of
5 Dr. Gotchy.

6 MR. NEWMAN: Mr. Chairman, could the record just
7 reflect that Mr. Schuessler has just walked into the
8 auditorium. He hasn't been here.

9 JUDGE WOLFE: That is correct. And the record
10 will so reflect.

11 Mr. Schuessler, Dr. Gotchy is on the left.

12 MR. SCHUESSLER: And the other gentleman,
13 Mr. Sanders. Is that correct?

14 JUDGE WOLFE: Yes, sir.

15 BY MR. SCHUESSLER TO WITNESS GOTCHY:

16 Q. There is a very lengthy question in the --
17 or is that at the answer. Is that a misprint on page 2?
18 There's an answer "Yes" and then a question, "Has the
19 NRC staff estimated the problem nuclide releases to the
20 lake," and then it is captioned question. I assume that is
21 really an answer. Is that correct?

22 A. Yes, that would be correct.. That's a typo.

23 Q. I wasn't here -- I assume the preliminary
24 questions as to your qualifications have been asked and
25 I don't want to ask questions that are going to --

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1 JUDGE WOLFE: You can ask any questions you want,
2 there will be an objection, asked and answered, and we will
3 rule on it at that time. I don't intend to go over the
4 entire transcript of what's gone on before at this point.
5 BY MR. SCHUESSLER TO WITNESS GOTCHY:

6 Q. You are employed by the U.S. Nuclear Regulatory
7 Commission as a Senior Radiologist. What is the field
8 of a Radiologist? Can you explain briefly your -- I'm a
9 layman, I'm not a scientist.

10 A. Yes, sir. You weren't here. This morning we
11 corrected that. It should read Radiobiologist rather
12 than Radiologist.

13 MR. BLACK: And I believe the rest of that has
14 been asked and answered:

15 JUDGE WOLFE: Sustained.

16 BY MR. SCHUESSLER TO WITNESS GOTCHY:

17 Q. You are not part of the Nuclear Regulatory
18 Staff as such, are you, sir?

19 A. Yes, I am.

20 Q. You stated in your answer "nuclear power reactor is
21 required to include a preliminary discription of the
22 design of equipment to be installed for keeping levels
23 of radioactive materials in effluents to unrestricted
24 areas as low as reasonably achievable."

25 In Allen's Creek how would I understand

5-14

1 unrestricted areas?

2 A. That would be to an area that the population
3 would have access to which would be the cooling lake for
4 recreation, for example.

5 Q. Okay. That would have to do with the
6 recreational aspect of it then, people-wise.

7 A. Yes, sir.

8 Q. There are no unrestricted or restricted areas
9 for fishlife in the lake, are there, sir?

10 A Not that I'm aware of.

11 Q. Would all -- well. Am I correct in assuming
12 all radioactive materials would be from the plant? There
13 is some city sewage from the city of Wallis that would flow
14 into the lake also. Is that correct?

15 A. My testimony is limited only to the
16 radioactivity that would come from the plant.

17 Q. The term, as low as reasonably achievable, means
18 as low as reasonably achievable taking into account the
19 state of technology and economics and so on. I would like
20 to understand the bottom line, you might say. Are there
21 any precise limits beyond which this definition might
22 go.

23 MR. NEWMAN: Mr. Chairman, I think that question
24 is impermissibly vague and would appear to call for a
25 conclusion on the part of the witness interpreting

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1 the Commission's regulation. He's not an attorney who can
2 interpret those regulations, so I think the question is
3 both vague and really directed to a person who doesn't
4 have the competence to respond.

5 JUDGE WOLFE: Well, Mr. Schuessler, we will
6 take pains to assist you if we can in framing questions,
7 but the Board really thinks the question is too vague
8 for even the Board to assist you in your efforts in
9 cross-examination. Could you rephrase the question?

10 MR. SCHUESSLER: Well, I thought I was getting
11 to the meat. I'm troubled by this apparent, in my mind
12 at least, a very broad criteria here. I'm really trying
13 to determine if there is a final line where reasonable
14 becomes unreasonable. I may be -- I will try to be more
15 specific. I know that's a broad question, but I thought
16 it was getting to the heart of the question.

17 BY MR. SCHUESSLER TO WITNESS GOTCHY:

18 Q. Let me ask you this; what considerations go
19 into the reasoning in meeting that broad criteria?

20 A. I guess I can tell you -- I'm not exactly sure
21 what you are getting at -- but I can tell you how we would
22 determine whether or not we felt an applicant had met the
23 as-low-as-reasonably-achievable criterion in Part 50,
24 Appendix I to the Code of Federal Regulations. Normally
25 what we do -- and in this case there is no exception -- we

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1 looked at the maximum possible doses that any individual
2 might receive from all the various pathways. In the case
3 of liquid pathways, we looked at consumption of fish,
4 for example, and assumed people drank water from the lake,
5 even though there is no existing source for drinking water
6 from the lake at this time.

7 We then add these doses up and arrive at the
8 1.4 millirem which is mentioned in my testimony. We
9 would anticipate that doses to individuals -- to real
10 people -- would be lower than that. In many cases, by
11 even an order of magnitude of factor of 10 lower. The
12 original assessment, for example, in the final
13 environmental statement was almost a factor of a hundred
14 lower than what we came up with in this Appendix I because
15 we tended to maximize each of the values and the
16 calculation toward the upper end of the range for those
17 values.

18 But, at any rate, if we had arrived at a number
19 which was in excess of Appendix I guide for the liquid
20 pathway, we would normally, at that point, go back and
21 ask the people who calculate the source germs in the NRC,
22 the radioactive releases that are estimated, to go back
23 and make sure that the values for those particular
24 nuclides -- that's usually limited to a few out of all
25 those that are released -- to go back and check and make

5-17

1 sure their calculations are correct.

2 If the release estimates are correct, then we
3 would go back and determine if, for example, bioaccumulatio
4 factors for specific species that we had used in the
5 computer code were applicable to those particular species
6 in the lake. To see if the doses would be higher or
7 lower.

8 Assuming we had done all that and found that
9 the dose estimate represented still a reasonable estimate,
10 but was in excess of Appendix I, we would go back to the
11 effluent treatment system branch, who would contact the
12 Applicant and point out the problem we had with them
13 meeting Appendix I with the existing -- I should
14 say the existing design -- radiochemical treatment
15 systems that they had proposed for their plant.

16 And at that point there would be a review to
17 see what things might be done to the plant as designed
18 to reduce the releases of those particular radionuclides
19 which were resulting in an excess exceeding the Appendix I
20 design objectives.

21 And it could be something simple like just
22 changing the resin in an ion exchange column that would
23 have a higher efficiency for those particular
24 radionuclides. If that didn't work, then they could
25 look at other things which would cost -- would result in

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1 cost to them, both in capital cost and operating costs.
2 At that point then it would be -- there would be a cost
3 benefit analysis done of the costs of the capital
4 equipment and maintenance and operationg of that equipment
5 over the life of the plant to see if the reduction in dose,
6 radiation dose, could be justified by adding that
7 equipment.

8 And the criteria for doing that comes out of
9 the Appendix I decision by the Nuclear Regulatory
10 Commissioners, using a thousand dollars per man-rem or
11 to any organ of the body of the general public to see if
12 the cost of the equipment exceeds that value. If it does,
13 and it always has in all the cases that I've been
14 personally involved in, in other words, it usually costs
15 tens or hundreds of thousands of dollars to do these
16 kinds of things, and the doses are so very small. In an
17 example, this plant, the total liquid pathway dose is only
18 41 person-rem. We should be worth \$41,000 at that rate.

19 To reduce that dose further, say, for example,
20 from maybe 10 rem down to three rem, they would have to
21 look at -- I'm sorry. Ten millirem down to three
22 millirem for the population -- I'm sorry. Strike that.

23 To reduce the population dose say from
24 41 person-rem maybe down to some lower value, would be
25 a cost benefit balance between the cost of the equipment

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1 and maintenance and so on. And the reduction that you
2 would get -- in no plant that I'm aware of, have any of
3 these changes been justified and that is because the
4 Appendix I values were determined by the Commission based
5 on a state of the art at that time which was very good
6 and, in many cases, -- in most cases -- resulted in doses
7 that were below the final Appendix I guides.

8 It's just hard to find any equipment that you
9 can add normally to a plant which will result in large
10 enough reductions in population doses to be justified by
11 the cost.

12 Q. Then you're saying that the criteria or the
13 standards are weighed against costs. That's cost benefit
14 ratio you are saying.

15 A number of questions came to mind while you
16 were discussing it there, but the one remaining got away.

17 The one remaining is in arriving at an
18 acceptable risk as opposed to cost, are these ratios
19 expressed in terms that I've seen in other areas of deaths
20 or injury per given number of -- you know -- given
21 population or something. Is that what we are talking
22 about? Am I making myself clear?

23 A. No, sir. The thousand dollar man-rem number
24 from the regulations is the criteria. Now that number
25 is arrived at by looking at estimates from all of the

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literature that was available at that time, and this was about 1973, which allowed health effects experts to determine the value in dollars, if you like, of a man-rem in terms of the risk associated with exposure to one rem.

Now the risk exposure, say, for an individual to one rem is something in your one chance in ten thousand of cancer mortality. It's a very small risk, in other words, compared to say the average risk of mortality in giving your life is about one in a hundred for any average person. So, I guess that thousand dollar figure that the Commission picked represented a rounding off of the highest value that anyone had ever published in the literature from two significant figures to one. In most of the estimates, including my own, over the years would be somewhere on the order of a factor of ten lower or even some lower than that. A factor of 20, even 50, I've seen.

So we feel that the thousand dollar man-rem number represents a level at which protection would certainly be assured.

BY MR. SCHUESSLER OF DR. GOTCHY:

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1 Q If I understand you correctly, then you are
2 saying that in the examples you used in that case: One,
3 the risk of 1 out of 10,000 would mean one death out of
4 10,000 people. Is that what you are saying?

5 A If you exposed 10,000 people to 1000 millirem
6 each, then there would be -- statistically, a probability
7 of one person dying in that group of a thousand from
8 cancer during the remainder of their life expectancy.

9 Q Is that cancer caused from this exposure or
10 just cancer -- Does that increase the normal or
11 unrelated risk of cancer? Is that over and above that,
12 or how does that --

13 A This would represent, even though you couldn't
14 distinguish it from those which would normally be occurring,
15 in that 1000 people in the example that we postulated,
16 about 200 of them would die from cancer in their life
17 time.

18 All right?

19 I'm saying that if everyone of them got 1000
20 millirem each, that there would be statistically 201
21 people who would die.

22 So this one person would be an incremental
23 increase in what you would expect from all other causes
24 of cancer, but would be indistinguishable in both type
25 of cancer and site.

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1 Q Now, you mentioned the figure that is used,
2 of 1000 -- could you restate that again.

3 1000 per millirems or something --

4 A A person-rem is what we call a collected
5 dose. For example, if I gave one person one rem, that
6 would be one person-rem.

7 If I gave 1000 people one millirem each, that
8 would also be one person-rem.

9 We assume that there is no threshold below
10 which there is zero effect.

11 In other words, we assume that there is some
12 risk associated with going to any dose no matter how
13 low. This is probably a conservative assumption, but one
14 which in the absence of better data we feel is a prudent
15 assumption to make.

16 Q I think what I'm trying to understand there is
17 what value is balanced against the \$1000 investment to
18 deal with. You had a ratio, as I recall, that you stated
19 earlier.

20 Or did I misunderstand that?

21 A I'm not sure I understand the question.

22 We assumed \$1000 per man-rem or per person-rem.
23 Or to any individual organ of the public, if it were
24 something concentrated like Iodine-131 does in the
25 thyroid. That would also be worth \$1000, according to the

1 Commission rule.

2 Q Okay. That then answers that question.

3 When you refer to other societal and socio-
4 economic considerations, are they -- have they already
5 been covered in what you've discussed? Or could you
6 explain those for me?

7 MR. BLACK: Objection. The question, I believe,
8 is overly broad. It's certainly vague to me anyway.

9 I'm not so certain that we're getting within the
10 scope of the direct examination. I think we've wandered
11 far afield with respect to the background of Appendix I.

12 The direct testimony is fairly specific in
13 dealing with radioactivity in the cooling lake. I think
14 the questions ought to be directly related to that.

15 JUDGE WOLFE: Your question is what, Mr.
16 Schuessler?

17 MR. SCHUESSLER: My question is: In addition
18 to what he has already described and discussed, he refers
19 to "other societal and socioeconomic considerations."

20 I'm asking to be given an understanding of what
21 those terms mean.

22 JUDGE LINENBERGER: By way of further clarifica-
23 tion here, when you say "other," do you mean non-nuclear
24 powerplant related?

25 MR. SCHUESSLER: Well, let's see. I'm holding

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1 his testimony here.

2 JUDGE LINENBERGER: You're talking about the
3 context in which he used that expression?

4 MR. SCHUESSLER: Yes, sir.

5 JUDGE LINENBERGER: Thank you.

6 (Bench conference.)

7 JUDGE WOLFE: The objection is overruled.

8 DR. GOTCHY: I guess I'm not sure what you are
9 uncertain about.

10 That essentially comes out of the rule, as
11 written by the Commission. It was intended, I believe,
12 to take into consideration other things which they did
13 not provide specific monetary criteria for.

14 An example I could give would be in the case of
15 the start-up of Three Mile Island Unit 1 or 2, because of
16 psychological stress that the people have considered. My
17 understanding is that the Commission has directed the
18 Staff to consider those, in addition to those things that
19 we can quantify and monetize, in making a decision about
20 start-up and clean-up and those kinds of things.

21 Those are very hard things to define quanti-
22 tatively. Yet, we know the stress, for example, was
23 there and still is to some extent.

24 BY MR. SCHUESSLER OF DR. GOTCHY:

25 Q Did they weigh or did you consider that they

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1 were of any significant importance or have any significant
2 relationship to any judgments related to Allens Creek?

3 A Not to my knowledge.

4 Q I'll ask -- Well, the bottom line on page two,
5 "in relation to the utilization of atomic energy in the
6 public interest."

7 Maybe you're not the one to ask this of, but
8 I wonder what -- this is speaking from the standpoint,
9 I assume, of the Nuclear Regulatory Commission. Is that
10 correct?

11 MR. NEWMAN: Mr. Chairman, I'm going to object
12 to that question.

13 The language which Mr. Schuessler refers to
14 comes out of the Commission Regulations. "As low as
15 reasonably achievable" is a defined term.

16 And in the context of that definition are the
17 words, "and in relation to the utilization of atomic
18 energy in the public interest."

19 If he is asking for a definition of that term,
20 he's calling for a legal conclusion on the part of the
21 witness. The Regulations are as the Regulations are
22 set out in 50.34A.

23 MR. SCHUESSLER: Well, Mr. Chairman, if I may.
24 It would be my view that as an expert member of the NRC
25 Staff, I would expect anyone to have an understanding --

1 and they would very likely be able to explain to me how
2 that comes into play. That's what I was going to ask.

3 How does he understand that? What does it
4 mean?

5 JUDGE WOLFE: You made an ultimate determination,
6 did you not, within the framework of "as low as reason-
7 ably achievable," Dr. Gotchy?

8 DR. GOTCHY: Yes, that's correct.

9 JUDGE WOLFE: Objection overruled.
10 Answer the question.

11 DR. GOTCHY: The reason that's in the rule, by
12 the way, is because there's a Public Law that was put
13 forward by Congress which requires the Nuclear Regulatory
14 Commission to consider the utilization of atomic energy
15 in the public interest.

16 Some of the things that the Commission might
17 consider, for example, would be -- and I believe there
18 is testimony which has been put forward and not considered
19 today by Dr. Leonard Hamilton, for example, which con-
20 siders the alternatives to providing electricity by other
21 means, and evaluating those risks to the general public
22 as opposed to the risks that we could compute for the
23 nuclear fuel cycle of the plant that's proposed.

24 Well, again, like I say, the rule -- the
25 Public Law requires the Commission to consider those

1 kinds of things in making a decision on granting a
2 license to an applicant to operate a nuclear powerplant,
3 or construct one.

4 BY MR. SCHUESSLER OF DR. GOTCHY:

5 Q Well, it sounds like that's a term within the
6 law and the Commission that is open to broad interpreta-
7 tion, I presume. Would you agree with that? A rather
8 imprecise definition or understanding.

9 A That would be my interpretation. I couldn't
10 speak for the Commission.

11 (Bench conference)

12 JUDGE LINENBERGER: Dr. Gotchy -- then perhaps
13 an extension of Mr. Schuessler's question, and leaving
14 aside legal interpretations of the law for the moment --
15 what kinds of things did you do in relationship to the
16 Allens Creek proposed plant and application to satisfy
17 the requirement, stated in that last sentence at the
18 bottom of page two with respect to the utilization of
19 atomic energy in the public interest?

20 In other words, with respect to this application,
21 this proposed plant and site, how did the utilization of
22 atomic energy in the public interest come into the work
23 that you did for this testimony?

24 DR. GOTCHY: This particular testimony?

25 JUDGE LINENBERGER: Yes.

1 DR. GOTCHY: I can't think of anything right
2 offhand that would refer to utilization -- the benefits
3 of utilization of atomic energy that would be directly
4 related to my testimony here today.

5 MR. NEWMAN: May I just note for the record,
6 Judge Linenberger, that the guides which implement
7 Appendix I themselves take into account the utilization
8 of atomic energy in the public interest.

9 And so in making any analysis which compares
10 this facility to Appendix I guideline values, there is,
11 in fact, a taking into account of the extent to which
12 nuclear energy is in the public interest.

13 I offer that by way of explanation; it is
14 not testimony. It is simply for purposes of clarification
15 of the law.

16 JUDGE LINENBERGER: In your opinion, counselor,
17 is that an explicit or implicit taking into account of
18 the utilization of atomic energy in the public interest?

19 MR. NEWMAN: As I know the extraordinary lengths
20 to which the Commission went in formulating the Appendix I
21 guidelines, the months, if not years, of testimony that
22 was taken from the hundreds of witnesses who offered
23 testimony on virtually every aspect of the use of nuclear
24 energy, I would have to say that the guidelines do in
25 fact reflect some factor for the public interest in the

6-9

1 utilization of atomic energy.

2 I don't know that I can give you a quantitative
3 number for that factor. But I believe it's there.

4 JUDGE LINENBERGER: Okay.

5 Then, Dr. Gotchy, coming back to you for the
6 moment, is it through the mechanism of the utilization of
7 that Reg Guide that you -- Is that the only direct or
8 indirect way that you took account of the utilization of
9 atomic energy in the public interest?

10 DR. GOTCHY: I guess there might be some indirect
11 consideration involved, although -- I'm trying to remember
12 back to 19... when that rule -- proposed rule was written.

13 I was a reviewer on that rule. I don't recall
14 those particular items being taken into consideration in
15 developing the Appendix I design objectives.

16 Those were based primarily on what existed --
17 the state of the art at the time and what might be done
18 in addition to that, and there was a cost/benefit balance
19 which looked at adding other types of equipment, and
20 recognizing, of course, that Appendix I -- the Appendix I
21 values are about a factor of a hundred lower than per-
22 mitted by 10 CFR Part 20, for example, for exposure of
23 the general public, which is based on international
24 standards of radiation protection.

25 I just don't recall anything in that rule which

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1 dealt implicitly with the benefit involved to the public,
2 although the fact that they went ahead in developing the
3 rule which permitted the nuclear program to go forward,
4 there is obviously something in there that is related to
5 the public benefits involved through the use of nuclear
6 power.

7 I don't recall it specifically being dis-
8 cussed.

9 JUDGE LINENBERGER: Okay. That's all I have
10 now. Thank you.

11 Excuse me, Mr. Schuessler.

12 BY MR. SCHUESSLER OF DR. GOTCHY:

13 Q You've made reference on two occasions to the
14 fact that there are basic criteria, basic numbers; and
15 then you used them with a -- what I would call, I guess,
16 a safety factor or a buffer there, of ten times.

17 Are you saying then that your calculations and
18 appraisals are going ten percent or a thousand percent on
19 the safe side? Am I making my question clear?

20 A Yes. It would be, in my judgment, in the
21 range -- It could be up to a factor of ten, if you
22 would like to call that a safety factor -- in that our
23 estimates would be higher than what we actually expect
24 any individual to get as a result of the operation of the
25 plant.

1 So there is some kind of -- what I guess you
2 could term a safety factor involved in those.

3 But remember: What we're doing there is
4 calculating what we think is an upper bound -- a reasonable
5 upper bound estimate of the potential dose to anyone in
6 the public and comparing that with the standard in
7 Appendix I.

8 And as long as that dose is less -- is below
9 that standard (the design objective dose) then we have no
10 further work to do.

11 Q What we were just discussing then is what you
12 are referring to here on page three. This is the process
13 which was used -- elected in lieu of performing a cost/
14 benefit analysis as required in Section 2D of Appendix
15 I? Is that really what we're talking about?

16 A Yes.

17 Q You refer to the Staff's detailed evaluation.
18 How many people were involved in this particular work
19 for the Staff? Did you work alone on it or --

20 A Are you talking about the Appendix I assessment
21 or just my testimony here?

22 Q Well, I guess the whole assessment.

23 A I can't give you an exact number because there
24 has been a turnover in Staff through the years.

25 I would guess in this assessment that something

1 on the order of perhaps 10 or 20 people have been involved
2 in one way or another in making this assessment, consider-
3 ing meteorology, hydrology, the development of source
4 terms, the hydrology, dosemetry and the estimation of
5 dose.

6 Q This application was originally proposed in
7 1973. The work we're talking about now, was that done
8 during that initial stage when this matter came to the
9 Commission?

10 Or has it beer done over this period of time?
11 Or does this represent the most recent figures -- the
12 most recent information and so forth?

13 A This would represent the work in this particular
14 area -- looking at doses to population, over the time --
15 from the time the licensee made application for a con-
16 struction permit.

17 Q Let me ask it this way: How recent would be
18 the very latest input?

19 A I believe it's 1979 or '80.

20 Q That's close enough.

21 Would that have involved a review of the earlier
22 findings or opinions, and possibly any changes?

23 A The changes that were made resulted from
24 incorporation of the new models, which were developed after
25 the Appendix I rule, in order to determine compliance with

6-13

1 Appendix I.

2 Those models are implicit in a number of
3 Regulatory Guides. The radiation dose models that were
4 used are in Regulatory Guide 1.109, as mentioned in my
5 testimony.

6 Those came out -- I believe about 1975, although
7 there were interim operating guides that came out prior
8 to the final guides.

9 I think about 1973 or '74 -- late '73 or early
10 '74 -- somewhere during that time interval, but the
11 final guides didn't come out until about 1975.

12 Q Is that Appendix I?

13 A The Appendix I Guides, yes.

14 Q That's what you're referring to.

15 It states that it was September 4, 1975, I
16 believe.

17 A Now, these have been periodically updated since
18 then. The Regulatory Guide 1.109 we're looking at now
19 was revised in 1977.

20 Q Could you give me an idea of what areas
21 specifically might have been updated with population
22 estimates -- or were they related to population change --

23 In other words, after the 1973 or '74 -- the
24 earliest findings -- can you tell us what areas might
25 have been significantly updated or changed that no longer

6-14

1 stood, in other words?

2 A The only thing that I can think of offhand --
3 There have not been any great changes.

4 But there was a change made for Carbon 14 released
5 for gaseous pathways, for example, which took into
6 consideration -- or allowed the State to take into
7 consideration the limits of photosynthesis and incorpora-
8 tion of Carbon 14 into vegetation, limited by the growing
9 season for plants.

10 Prior to that, it was assumed that the plants
11 grow all year round and continue to incorporate the
12 Carbon 14.

13 That's about the only intermediate change that
14 I can think of.

15 Q Would this have occurred by an advance in the
16 so-called state of the art -- new-found information?

17 A Yes, we do that --

18 Q -- that wasn't available earlier.

19 A There have been some minor changes in the dose
20 factors for a number of the radionuclides that came out
21 in the original guide. But the changes are relatively
22 small, on the order of 10 or 20 percent.

23 Q Okay, thank you.

24 Are you aware of the rather substantial popula-
25 tion growth of the Houston, Harris County area? You're not

6-13

1 a native Houstonian by any chance, are you?

2 A No, sir.

3 I know there has been a lot of growth here.

4 Q I think it would be significant to ask -- or
5 at least worthwhile to ask what the most recent population
6 estimates were which were used?

7 MR. BLACK: I object at this point. I'm having
8 a hard time understanding the relevance of the population
9 dose to this direct testimony which dealt with the liquid
10 pathway and ingestion of cooling lake water and seepage
11 from that cooling lake.

12 I'm not certain that this isn't getting into
13 perhaps another pathway that is not the liquid pathway.

14 I'd like to have the Examiner point out the
15 relevance of this in relationship to the direct testi-
16 mony.

17 MR. SCHUESSLER: Well, on page three at the
18 very bottom, the witness has stated that the Safety
19 Evaluation Report, Section s.5.4 of the FS-FES, were
20 the calculated doses to individuals and the population that
21 will result from these effluent quantities.

22 My thinking is that any population changes,
23 considering, as I believe he has testified, the bulk of
24 the findings were based on available information back at
25 the time that this permit was originally applied for, back

1 in 1973.

16
2 Since substantial population changes have
3 actually occurred since then, I think it's very relevant
4 as to how appropriate those findings would be today.

5 MR. BLACK: I think it might be relevant insofar
6 as the liquid pathway is concerned. But I'm not so certain
7 that the population in the context that you're referring
8 to it here -- the calculations that were done in the
9 FES and the Safety Evaluation Report with respect to
10 population aren't dealing with the air pathway.

11 But I would have no objection to the question
12 if you would speak in terms of population and its
13 relationship to the liquid pathway.

14 (Bench conference.)

15 MR. SCHUESSLER: I think the population changes
16 would --

17 JUDGE WOLFE: No. Hold it.

18 MR. SCHUESSLER: I'm sorry.

19 (Bench conference continued.)

20 MR. NEWMAN: Mr. Chairman, may I just add
21 one comment to that objection?

22 JUDGE WOLFE: Well, had you finished, Mr.
23 Schuessler? You were going to add something?

24 MR. SCHUESSLER: I was merely going to say that
25 I'm not real certain really what the liquid pathway -- how

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1 it applies. I can't claim to understand the matter that
2 deeply.

3 But I think the population changes would very
4 likely affect, as I understand how it might apply --
5 would apply to the areas immediately adjacent to the
6 lake.

7 MR. BLACK: Well, I think the pathways that
8 we're discussing are fairly well set forth in Dr.
9 Gotchy's testimony, specifically at the top of page five.

10 And also these pathways were discussed as a
11 result of the interrogation by Mr. Doherty earlier this
12 morning.

13 So I think that was fairly clear on the record.
14 I just don't want this line of questioning to get in an
15 extraneous pathway that has not been considered by this
16 witness in this testimony.

17 MR. NEWMAN: Mr. Chairman, may I make a sug-
18 gestion in order to be sure that the time of the hearing
19 is used profitably.

20 It's not uncommon in NRC proceedings for the
21 Board to ask the party doing the questioning what point
22 he hopes to elicit during the course of his cross-
23 examination.

24 We have two specific contentions here: Bishop
25 12 and Bishop 21.

1 I think it might be useful if Mr. Schuessler
2 identified the points that he wishes to make through his
3 cross-examination with respect to Bishop 12 and Bishop
4 21.

5 And then I think we would all have a better
6 idea as to whether or not the questioning was relevant.

7 (Bench conference.)

8 JUDGE WOLFE: With respect to your question
9 that's pending before the Board, for what purpose is the
10 question posed? What do you want to establish by an
11 answer to that question that relates to the Bishop's
12 two contentions?

13 MR. SCHUESSLER: The question at issue right
14 here has to do with population.

15 My point -- or the direction -- what I'm trying
16 to determine here is how valid these estimates are today,
17 in light of what I believe have proven to be unexpected
18 population growth in this area.

19 I just have serious question about whether when
20 these appraisals and estimates and decisions were made
21 back in 1973, that they could possibly be valid today.

22 JUDGE LINENBERGER: Mr. Schuessler, I think
23 that is a valid concern. And indeed, it does come up in
24 a later part of the hearing.

25 But by and large, Dr. Gotchy's testimony is

6-19

1 relatively independent of what the last census showed,
2 versus what the actual population is today.

3 It is based on characteristics of the lake
4 water and the plant itself, and is not intended to even
5 address any inaccuracies in population or excessive
6 growth in population.

7 Those will have to come up later, and they are
8 indeed going to come up later.

9 However, the other point is that your line of
10 questioning, by our rules, must be in the context of the
11 two contentions that Dr. Gotchy's testimony addresses.

12 And unless you see something that the Board
13 does not see, the Board does not see either of those
14 Bishop contentions -- these two, 21 and 12 -- bringing
15 in excessive population growth either.

16 Again, that comes in as separate contentions.

17 MR. SCHUESSLER: I understand.

18 JUDGE WOLFE: So we sustain the objection,
19 Mr. Schuessler.

20 (Bench conference.)

21 JUDGE WOLFE: All right.

22 I think this might be a good time to recess.
23 We'll recess until a quarter of two --

24 MR. BLACK: Mr. Chairman --

25 JUDGE WOLFE: Yes.

1 MR. BLACK: Before we recess, I think we're
2 getting to a point where I perceive some other scheduling
3 problems. I think I'd like to discuss those before
4 recessing, so we can at least make some plans over the
5 noon hour.

6 But in any event, I hope that Dr. Gotchy would
7 be finished today and would be excused from the panel.
8 But --

9 JUDGE WOLFE: That was what you had indicated
10 yesterday afternoon. That's why the Board agreed that
11 Dr. Gotchy should go first.

12 Yes.

13 MR. BLACK: But it appears from at least Mr.
14 Scott's statements that that is not possible.

15 So, therefore, with the Applicant's panel resum-
16 ing tomorrow, with perhaps their panel taking up the rest
17 of this week, I'm wondering whether I can excuse Dr.
18 Gotchy in any event, subject to recall at -- who knows
19 when -- to complete his cross-examination.

20 We are having serious scheduling problems
21 here.

22 I'm just throwing that out, because I have no
23 solutions to them. We're running into a real hodge-podge
24 here.

25 JUDGE WOLFE: Yes.

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MR. BLACK: I'd like help from the Board.

JUDGE WOLFE: Well, we can't make that determination now. We will make it at the time we recess today.

It may well be that Mr. Scott will find he only has 20 minutes of cross-examination, and the other intervenors may find likewise, that they don't have that much cross.

So this may all be academic.

We recognize that attention must be given to witnesses. We would hope that -- as we've indicated many times before -- that the parties could informally agree on these sorts of things.

This differs from the Board's scheduling -- not the Board's scheduling, but the Board's insistence that the parties, being parties, should always be here for presentation of their direct testimony and the cross-examination in a timely manner.

We try to accommodate them as well. But why don't the parties get together during the recess and see if something can't be worked out.

Maybe it's all academic anyway.

But certainly we will give consideration to what you are now proposing, Mr. Black.

MR. NEWMAN: Mr. Chairman, I might just also note

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for the record, I believe you asked me at the close of the -- before the first recess whether Dr. Schlicht would be here. He will be here along with the other witnesses on the panel tomorrow morning.

JUDGE WOLFE: Fine.

We'll recess until a quarter of two.

(Whereupon, at 12:35 p.m. the hearing was recessed, to reconvene at 1:45 p.m. of the same day.)

- - -

AFTERNOON SESSION

1:45 p.m.

1
2
3 JUDGE WOLFE: All right.

4 Mr. Schuessler, you may proceed with your cross-
5 examination.

6 MR. SCHUESSLER: I've forgotten. Were we in
7 the middle of something at the time -- Was that
8 resolved?

9 There was a point of difference, and I'm not
10 sure now --

11 MR. NEWMAN: I think perhaps I can help.

12 I listened to the last few moments of the
13 transcript earlier.

14 Mr. Schuessler had asked a question regarding
15 the estimates of growth in the population in the vicinity
16 of the plant.

17 I believe that either I or Mr. Black -- perhaps
18 both of us -- objected to that question.

19 At that point I asked that the Chair ask Mr.
20 Schuessler for what purpose is your question asked, what
21 point do you want to establish with regard to the Bishop
22 contentions.

23 And then at the very close, Mr. Linenberger --
24 Judge Linenberger, excuse me -- Judge Linenberger noticed
25 that the Gotchy testimony is independent of population

1 questions, that this testimony by Mr. Gotchy is not in-
2 tended to address population matters, that this will come
3 up later.

4 And then Judge Linenberger said: "The line of
5 your questioning must be in the context of the Gotchy
6 testimony and the contentions which Gotchy discusses in
7 his testimony."

8 At that point, I believe the Chair sustained
9 the objection, and I believe that Mr. Schuessler was at
10 that point in the middle of some further thought.

11 JUDGE WOLFE: Go ahead, Mr. Schuessler.

12 MR. SCHUESSLER: Well, I'd like to understand
13 where we're at then. You know, the reason that came up
14 is because Mr. Gotchy had used that reference -- had
15 referred to population at the time.

16 Now, am I free to raise questions related to
17 anything he states in here, even though it may not,
18 strictly speaking, be --

19 JUDGE WOLFE: Well, you know --

20 MR. SCHUESSLER: -- a population thing. It's
21 not a population contention; I understand that.

22 JUDGE WOLFE: Yes.

23 MR. SCHUESSLER: But if -- Or shall I just go
24 ahead and you'll correct me if I'm wrong? Would that be
25 best?

7-3

1 JUDGE WOLFE: I think that's the best way to do
2 it.

3 MR. SCHUESSLER: Okay.

4 BY MR. SCHUESSLER OF DR. GOTCHY:

5 Q At the top of page four there's a paragraph
6 which states: "At the time of the operating license,
7 the applicant will be required to submit Technical
8 Specifications which will establish release rates" --
9 I won't read the whole thing.

10 We're at a construction permit stage right now.
11 I'd like to ask Mr. Gotchy, with that in mind and in light
12 of what he has already answered to earlier questions,
13 do these Technical Specifications that have to be met at
14 a future licensing stage, are they of the nature that
15 would have to be incorporated into the plant and built into
16 the plant, as it's constructed?

17 A To some extent, yes.

18 However, the Technical Specifications which
19 would result in the plant operating within the Appendix I
20 guidelines are implemented by sitting certain levels on
21 instruments which are built in the plant.

22 And those instruments monitor the effluent
23 releases, measure the quantities released, and they're set
24 so that the release rate won't exceed -- or the total
25 release rate will not result in the doses exceeding

1 Appendix I.

2 And those are determined at the time the plant
3 is built, before -- when it comes in for an operating
4 license.

5 Q Well, okay.

6 Does that mean then that part of your considera-
7 tion at this time is to see that the plant is built to
8 accommodate or to meet those future standards? Is that
9 actually part of your area of judgment at this time?

10 A Yes, as the plant is presently designed, the
11 Applicant has the prerogative to come in with certain
12 design changes between the time the CP is granted and the
13 operating license is granted, which may result in a re-
14 evaluation of the Appendix I.

15 But at any rate, when the plant is finally con-
16 structed, before it's given an operating license, there
17 will be levels set on these instruments which will control
18 the releases to assure that the doses will remain within
19 the Appendix I guidelines for the ... you know, for any
20 lightwater reactor.

21 Q Well, I'm puzzled why these requirements are not
22 met at this stage.

23 A They are. But just calculated. Again, the
24 plant is not built.

25 These are all calculated estimated releases and

7-5

1 calculated doses to really hypothetical individuals in
2 many cases.

3 Q Then it is your role at this time to reasonably
4 assure that that capability exists in the designed con-
5 struction, right?

6 A Yes, sir.

7 Q In answer to a question dealing with how did
8 the Staff calculate radiation doses that an individual
9 would receive from liquid effluents in the cooling lake,
10 you state that the radionuclides in the liquid discharge
11 and man's activities using the cooling lake would have
12 a bearing on the exposure rate.

13 "In general, radiation doses calculated by the
14 staff are intended to apply to an average adult."

15 And then you go on to suggest that specifically
16 there would be higher or lower doses depending upon
17 ages, living habits, food preferences and so forth.

18 I'd like to understand, since these figures are
19 based on averages -- I can visualize a retired gentleman,
20 let's say, who likes to fish day in and day out, as
21 opposed to someone who maybe fishes on weekends or
22 occasionally -- would there be --

23 How appreciable would be the distinction that
24 might be made between the exposure to -- and I gather
25 from that -- am I correct in assuming that just using the

1 lake, say in a fishing boat along the shoreline, that an
2 individual wouldn't be subject to radiation exposure;
3 is that correct -- in proximity to the lake?

4 JUDGE WOLFE: I think there are two questions
5 there, Mr. Schuessler.

6 Do you understand the two questions, Dr.
7 Gotchy; one, as to the regularity of exposure and the
8 other question directed to the extent of exposure if
9 boating as against fishing from the shoreline? Is that
10 correct?

11 MR. SCHUESSLER: Well, the second one was
12 really -- I realize that I should have asked that
13 first, whether my presumption was correct, that proximity
14 to the lake does expose a human being to radiation.

15 DR. GOTCHY: Yes. There would be some exposure
16 from gamma radioactivity in the water itself, and some
17 additional exposure from sediments on the bottom.

18 The closer he fished to the shoreline, there
19 would be somewhat higher doses from those sources, as the
20 depth of water decreased, because it tends to shield out
21 that radiation from the sediment.

22 BY MR. SCHUESSLER OF DR. GOTCHY:

23 Q Okay.

24 The lake would be used for swimming, too.

25 Would exposure be greater for those comparable to the person

7-7

1 fishing on the bank or from a boat? Would that exposure --
2 actually being immersed in the water increased that
3 dosage?

4 A A person who would fish from the shore and use
5 the shoreline would be likely to get the highest dose of
6 any of those three situations.

7 Certainly, the tritium dose is higher for the
8 swimmer.

9 But most of the dose would come from gamma mini-
10 nuclides, like Cesium-134 and 137.

11 And because the water is very shallow near the
12 shoreline, more of the radioactivity would be able to
13 escape the water and have the possibility of giving an
14 exposure to that person.

15 Q You're saying it would tend to concentrate along
16 the shoreline; is that what --

17 A It will concentrate in sediments. And, you know,
18 the sediments go right up to the shoreline. They're
19 washed up there by wave action.

20 Q And, hence, from the shoreline would be the
21 highest dosage.

22 You named two elements there. Can I jot those
23 down, please.

24 You mentioned two elements just as examples.

25 A Two radionuclides: Cesium-134 and cesium-137.

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Q Okay.

A Those tend to be some of the higher dose contributors.

Q Can you tell me what the half-life of those two are? Are they the same? Or give me an idea off the top of your head.

A I can't remember exactly. I think Cesium-134 is about four years, as I recall.

Q Four years?

A Four years.

And Cesium-137 is close to 30 years.

Q Would they tend to accumulate through the life of the plant?

A That's correct.

Q -- along the shoreline.

Would you foresee a point where that accumulation, that buildup along the shoreline, considering the half-life of these two radionuclides are very similar to the expected or anticipated life of the plant itself -- it seems to me a good question of whether the -- how seriously radioactive the shoreline would be at, say, the time of decommissioning this plant.

Would it be a -- I don't know how to ask the question.

Would the same relative

7-9

1 In other words, this suggests that all of the
2 things are within prescribed limits -- these radiation
3 doses.

4 Over that period of time, given those elements,
5 would the dosage at any time exceed, in your opinion --
6 could it possibly exceed these permissible doses?

7 A When you say permissible doses, that is normally
8 Part 20 limits, which are about 100 times higher than the
9 Appendix I limits.

10 Are you referring to the design objective
11 dose or the dose that would be written into the tech
12 specs for condition of operation, or the doses that would
13 be permitted under Part 20?

14 They would never exceed Part 20.

15 And it's unlikely, I would say, that they would
16 exceed the Appendix I dose.

17 Q I think that answered my question essentially.
18 I was just visualizing a point somewhere along the line
19 where it might really be exceeded.

20 A As long as the plant operates normally, that
21 would not be the situation.

22 Q Nuclear plants do normally put out a level of
23 radiation, is that correct, in operation?

24 A Put out what? I'm sorry.

25 Q Put out some level of radiation.

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1 A Yes, sir. There's no way to operate a plant
2 without having some release of radioactivity.

3 Q What form does that take? Is it one form or
4 two forms, or how would you --

5 A Relative to this contention of liquid path-
6 ways?

7 Q Well, just generally, I guess, if that's
8 permissible.

9 A In liquids you can have some dissolved noble
10 gases. And you can have tritium, which is usually a
11 form of tritiated water.

12 And the balance of the material will be what
13 we would call particulate, but in water it would be in an
14 ionic form; in other words, dissolved in the water as an
15 ion.

16 Q Let's see. I read somewhere that Allens Creek
17 is rated to produce 3400 -- no, 34,000 curies per year;
18 is that a fair way to state it?

19 There's a table somewhere that I made notes
20 from.

21 MR. NEWMAN: Can you identify the table that
22 you're referring to, Mr. Schuessler?

23 Or perhaps -- Is that sufficient --

24 MR. SCHUESSLER: It's in the Environmental
25 Statement, I believe, somewhere.

1 DR. GOTCHY: I think that probably would
2 include noble gases and that would account for all of
3 those numbers.

4 I'll see if I can find it --

5 MR. SCHUESSLER: As I recall, it made a compari-
6 son between -- well, some other -- Allens Creek with other
7 plants.

8 But there -- Let me approach it this way.
9 Allens Creek is ~~is~~ you know, you tell me. How would you
10 state the level of radioactive emissions that will be
11 produced by Allens Creek in operation?

12 DR. GOTCHY: In Table S.5.10 of the Final
13 Supplement to the FES --

14 MR. SCHUESSLER: Let me get that, please.

15 DR. GOTCHY: On page S.5-24.

16 (Pause.)

17 JUDGE WOLFE: While we're looking at this docu-
18 ment, I would note for the record that this afternoon
19 we're proceeding by the quorum rule, inasmuch as Judge
20 Cheatum has a bad cold.

21 MR. NEWMAN: Mr. Chairman, would the record
22 also reflect -- I'm not sure it was done at the outset --
23 that counsel present for this afternoon's session include
24 counsel for the Applicant, counsel for the Staff, Mr.
25 Schuessler and no other party.

7-12

1 JUDGE WOLFE: Yes, that is correct.

2 (Pause.)

3 MR. BLACK: Is there a question pending?

4 MR. SCHUESSLER: Well, it was in the process.
5 I'm trying to get on base here.

6 BY MR. SCHUESSLER OF DR. GOTCHY:

7 Q Somewhere I recall that there were some numbers,
8 either in the text or in this table -- that's referring
9 to the table that Mr. Gotchy has referred to here.

10 A I would say that that table that we're talking
11 about is just for gaseous effluents.

12 The one for liquids is on page S.5-28.

13 Q Maybe that's the one I had in mind.

14 A That would be one that would be relevant to dis-
15 cussion of liquid pathways.

16 The total there of all radionuclides, excluding
17 tritium, is a quarter of a curie; and then there would be
18 15 curies of tritium estimated.

19 Q What I'm trying to get at is that -- none of
20 these tables here -- Can you tell me what the total
21 estimated radiation for Allens Creek is calculated to
22 be?

23 MR. NEWMAN: Mr. Chairman, I'm going to object
24 to that question unless it is limited to discharges and
25 liquid effluents. That's the only subject --

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1 JUDGE WOLFE: That's the only matter currently
2 at issue via these two contentions, Mr. Schuessler.

3 With that amendment are you agreeable to --

4 MR. SCHUESSLER: Yes, I understand.

5 DR. GOTCHY: I'm not sure I understand the
6 question. I'd like to get a clarification before I
7 proceed.

8 You said radiation. Are you referring to radio-
9 activity released in curies, or radiation doses to
10 people?

11 MR. SCHUESSLER: I think I'm talking about
12 radioactive releases.

13 DR. GOTCHY: And you wanted to know the total
14 radioactive releases for Allens Creek?

15 BY MR. SCHUESSLER OF DR. GOTCHY:

16 Q Well, if I could go right to the heart of the
17 matter, I'm curious to know -- some of this is just
18 knowledge that I've gained, or notions that I've gained.

19 It seems to me that I've learned that Allens
20 Creek will release something on the order of 27 times as
21 much as South Texas does.

22 And here -- you know, the plants serve, as I
23 understand it, comparable generating capacity.

24 And I'm curious to know, given the criteria
25 we discussed earlier of the -- I'm trying to get the right

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1 phrase here -- the lowest practicable level (that's close
2 enough), I have difficulty understanding why this dif-
3 ferential -- if the South Texas plant is like ... you
4 know, able to withhold radioactive emissions to that
5 level below what Allens Creek has projected, I wonder
6 why Allens Creek cannot meet that same clean standard.

7 MR. NEWMAN: Mr. Chairman, I'm going to object
8 to that question.

9 It assumes a fact not in evidence; namely, the
10 difference between STP and Allens Creek. This witness
11 has not discussed at all the difference between the two
12 plants.

13 Moreover, it's not clear to me at all that the
14 question relates specifically to liquid effluents through
15 the cooling lake.

16 JUDGE WOLFE: Well, in any event, we've had two
17 or three questions merged into a single question. You
18 have to ask single questions of the witness.

19 It's very difficult being a witness, as you can
20 imagine.

21 And if they're loaded down with several questions,
22 then it makes it much harder.

23 Would you --

24 MR. SCHUESSLER: Well, I'm having difficulty
25 with it.

7-15

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1 I feel it's relevant because it does get into the
2 area, I think, of the lowest practicable standard, and it
3 would seem to me to be a reasonable question to ask.

4 Stated very simply: Why is not possible to
5 meet the same standard for Allens Creek that's met at
6 South Texas?

7 MR. NEWMAN: Mr. Chairman, I really have to
8 object.

9 Before we broke, I believe you put to Mr.
10 Schuessler the requirement that he identify the point of
11 his testimony, the point of his examination, some aspect
12 of Bishop Contention 12 or Bishop Contention 21, both of
13 which relate to the calculation of radioactive releases
14 through the cooling lake.

15 And I do not hear a question addressed to those
16 contentions.

17 MR. BLACK: Mr. Chairman, I would make one
18 comment here, too. I think I understand what Mr.
19 Schuessler is driving at. I think that there are dif-
20 ferent release rates for PWR versus BWR.

21 Those of us who have sat through these hearings
22 realize that -- and South Texas, my understanding is a
23 PWR.

24 I'm sure that Dr. Gotchy could supply some
25 general information for Mr. Schuessler. But the problem,

7 16

1 as I see it, is developing a record that responds to the
2 contentions, the issues and controversies here.

3 And allowing Dr. Gotchy to respond to this
4 concern -- although I think it would be a fairly succinct
5 and brief response -- I think would pollute the record
6 for the issues and controversies here.

7 So that's my concern.

8 Sometimes these objections take longer than a
9 response, and we're having a cost/benefit analysis
10 here.

11 But my concern is protecting the record. I
12 don't know how to get around this.

13 I appreciate Mr. Schuessler's concern. But the
14 concern is not a derivative of the contention.

15 MR. SCHUESSLER: May I say one other thing, sir,
16 before you rule?

17 JUDGE WOLFE: Yes.

18 MR. SCHUESSLER: I realize the contention deals
19 with specifically emissions into the cooling lake, which
20 may be different from air emissions, but they are part
21 of the total that I'm talking about.

22 (Bench conference.)

23 JUDGE WOLFE: I will have to then sustain the
24 objections.

25 The contentions do not relate to air emissions

7-17

1 and only deal with liquid and gaseous emissions to the
2 lake.

3 You must restrict your questioning to the con-
4 tentions.

5 MR. SCHUESSLER: I understand.

6 BY MR. SCHUESSLER OF DR. GOTCHY:

7 Q With regard to specific pathways, I think drink-
8 ing water comes through the --

9 Would the life time ingestion, the length of
10 time, in other words -- that a child started drinking
11 water that came from this reservoir -- would their dosage
12 or any assumed hazard be greater over, let's say, a 50-
13 year life span, as opposed to someone starting to drink
14 that water at the relatively higher age of 50?

15 What my question, I guess, really is: Would a
16 person be subjected to an additional hazard (whatever that
17 hazard is) by virtue of being born and raised and living --
18 drinking that water their entire life time, as opposed to
19 a shorter period?

20 MR. BLACK: First, I would hope that it's clear the
21 premise of that question is such that the dose calculated
22 by the Staff using the model is based on a dose of --
23 assumed daily consumption of two liters.

24 That is an assumption, and there's no facts on
25 record that people do drink that reservoir water.

7-18

1 So I just wanted to make certain that that as-
2 sumption was clear.

3 MR. SCHUESSLER: Is that two liters a day?

4 MR. BLACK: Two liters a day.

5 We corrected that this morning, Mr. Schuessler;
6 on page five the assumed daily consumption is 2.0 liters
7 a day, as opposed to 1.2 liters a day.

8 MR. SCHUESSLER: Is that page five of the --

9 MR. BLACK: Dr. Gotchy's testimony.

10 MR. SCHUESSLER: Okay.

11 There was some testimony yesterday, as I recall,
12 about 1.5 or 1.2 liters.

13 So this should be changed to 2.0 liters,
14 period.

15 MR. BLACK: That's correct.

16 MR. SCHUESSLER: Okay.

17 BY MR. SCHUESSLER OF DR. GOTCHY:

18 Q Assuming that rate of consumption or use, would
19 a person consuming that water all of his life time be
20 appreciably at a greater risk than someone not drinking
21 it that long?

22 A Let me try to answer it this way. Now, you
23 postulated the case of a child -- or someone as a child
24 beginning to consume the water and consuming it on until
25 they were 50 or 60 years of age.

7-19

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1 The child's doses per year are lower than those
2 of the adult, because they consume smaller amounts of
3 water.

4 Now, the child doesn't stay a child for very
5 long. Over a 50-year period, for example, or during the
6 operating period of the plant, this person would be con-
7 suming at the rate of an adult rather than as a child,
8 at which time they would be consuming two liters a
9 day.

10 Now, if that person were there -- Say, the
11 plant operated 30 years. Most of the radioactivity that
12 that person would ingest from drinking lake water would
13 occur during the time the plant was in operation, since
14 the radioactivity in the water would tend to decline when
15 the plant was shut down and decommissioned, and would de-
16 cline over a period of years to approach levels that
17 were there essentially prior to the time that the plant
18 began operation.

19 So really there's probably only maybe a 40-year
20 period that is reasonable in terms of ingestion of the
21 water that is really crucial, because after that the
22 levels would be too low to really add much.

23 Now, if this child, say, were to consume this
24 water for 40 years -- not as a child, but growing up to
25 be a teenager and then an adult and going through all of the

7-20

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1 age categories that we considered in these calculations,
2 his dose would be larger than, say, a person who is 60
3 years old at the time the plant started to operate and
4 whose life expectancy at that age may be 15 to 20 years.

5 And the risk is higher for that person -- for
6 the child growing up because there is what is called a
7 latent period.

8 Normally, there's a time between the exposure
9 to radiation and a time before an effect might be ob-
10 served.

11 These are called latent periods.

12 It's true for cigarette smoking and a lot of
13 other things that we're more familiar with.

14 If the latent period exceeds the person's life
15 expectancy, in essence, he will statistically die from
16 cardiovascular disease or some other cause before he can
17 develop cancer.

18 So his risk would tend to be lower than that of
19 a child who was there for the full 30-year period of the
20 plant operation and consumed water maybe ten years after
21 the plant shut down.

22 However, I can't -- just off the top of my
23 head -- tell you exactly what that risk would be.

24 My guess is that that would be less than a factor
25 of ten difference; probably about a factor of about two or

1 three difference between the risk to one person and the
2 risk to the other ... being higher for the one who started
3 consumption as a child.

4 Q It would be two to three times higher for the
5 person drinking it all of his life, in other words?

6 A Yes, sir.

7 Q During your answer there, it crossed my mind
8 to ask whether you suggest that the volume of intake
9 would be less for a child.

10 Is there a relationship that you see between
11 the total volume -- size of the child --

12 In other words, would the effects be com-
13 parable, you know, regardless of size of that individual,
14 because of the smaller size of the individual related to
15 his lower volume of intake? Would that be a factor?

16 A Yes, it would.

17 For example, the number we use for drinking
18 water per year for an adult would be 730 liters.

19 For an infant, it would be 330. For a child it
20 would be 510. For a teen it would be 510. Those are
21 liters per year.

22 You'd have to divide that by 365 to get the
23 daily rate.

24 That does reflect the size of the person and
25 also differences in metabolic rates.

7-22

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1 Q Okay.

2 You mentioned a latent period. I guess there's
3 no precise figure; that's an unknown. But could you give
4 me just a general approximation of, say, the length of
5 time from -- I'm trying to get a framework here, and
6 I'm having trouble with it.

7 Is there a point during this ingestion of
8 radioactive material -- this latent period -- from what
9 point to the final cancer shall we say would you --

10 How would you measure that time frame? Is it
11 one injury? One cell, in other words, I guess is what
12 I'm trying to get at.

13 If a child -- You know, what would be the
14 beginning? How would you judge or estimate the beginning
15 of that latent period toward the end of it?

16 A The data we have now is based primarily on people
17 who are exposed to very high levels of radiation. For
18 example, the survivors of the bombs in Hiroshima/Nagasaki
19 and certain people who were treated for various diseases
20 by medical practitioners in the past.

21 What we have seen is a fairly consistent story
22 which indicates that leukemia, for example, for children
23 and adults has a latent period of about two years. The
24 typical time from exposure to diagnosis of the disease is
25 about ten years.

7-23

1 And the typical latent period from the onset
2 of the period of risk to the end of the period of risk
3 is also about ten years.

4 In the case of most other cancers, latent periods
5 are on the order of 15 years.

6 And the plateaus or the risk periods that risks
7 may range from 25 years to a lifetime after that ...
8 whatever your life expectancy is at that time.

9 Q Okay.

10 We were just discussing the drinking water
11 from the wells. Would the same standards apply to other
12 exposure? There's no difference in ingesting that material
13 through eating fish as opposed to drinking water, except
14 that you probably consume less of it, I would assume --

15 MR. NEWMAN: Mr. Chairman, I think that question
16 has a faulty premise; namely, that the Allens Creek lake
17 is a source of drinking water.

18 The witness has assumed, for purposes of the
19 testimony -- if you'll look at the testimony at page
20 five. The question is ask: "Will the Allens Creek cooling
21 lake be used as a drinking water supply?"

22 Answer: "No. However, for conservatism" --
23 and so forth, we calculate an assumed daily consumption
24 of 2.0 liters.

25 So I would not want the premise to stand that

1 this lake is a source of drinking water in practical
2 use. It is not.

3 Subject to correcting that premise in the
4 question, I have no objection to the witness responding.

5 JUDGE WOLFE: Is that understood as being a
6 limitation on the assumption, Mr. Schuessler?

7 It being understood that the reservoir -- the
8 cooling lake is not used -- will not be used as a
9 source of drinking water?

10 MR. SCHUESSLER: Does that mean directly?

11 The reason I asked the question, it seems that
12 other witnesses have testified to some aquifer --
13 there has been previous testimony and discussion and
14 question about drinking from that.

15 I assume that maybe this is not going to be
16 taken directly from the lake, but that the lake will
17 affect drinking water sources in some way.

18 Perhaps I'm mistaken in that assumption. But
19 I've been led to believe that.

20 MR. BLACK: Mr. Chairman, that is the contention
21 and that's what we're addressing in this testimony,
22 is the seepage from the lake and if it gets into the
23 aquifer what will be the dose.

24 That's the thrust of this testimony.

25 I'm afraid that this line of questioning is

7-25

1 getting into a whole new area though, and that's the
2 health effects of low level radiation which, as the Board
3 well knows, has been the subject of summary disposition
4 and motions, and is an entirely different area.

5 I'd hate to see this cross-examination get
6 into that area, which is not the subject of the direct
7 testimony.

8 MR. SCHUESSLER: Well, again the witness refers
9 to drinking water from the lake and eating fish and so
10 forth.

11 I'm questioning him on that basis.

12 MR. BLACK: Well, I think that your previous
13 question dealt with eating fish or other pathways. Perhaps
14 if you would rephrase the question and get your premises
15 right, there will be no objection and maybe we could
16 proceed.

17 (Bench conference.)

18 JUDGE WOLFE: Rather than make an effort now,
19 after all this discussion -- I will sustain the objection;
20 and you may rephrase your question. We'll just see how
21 we go on the rephrased question.

22 BY MR. SCHUESSLER OF DR. GOTCHY:

23 Q Is it anticipated that fish will be eaten that
24 are caught in Allens Creek lake?

25 A Yes.

1 Q The question would be then -- if I may refer to
2 the previous discussion without ... you know, accepting
3 or taking -- setting any premise -- what differences
4 would there be in the results of exposure or dosages
5 taken from fish as compared to the drinking water
6 effects that we've just discussed, if that's permissible?

7 I'm not trying to be difficult. If that's in
8 order.

9 A They would be over a hundred times higher from
10 fish ingestion than they would be from getting the water
11 directly from the discharge area.

12 Q A hundred times higher?

13 A Yes, sir.

14 Q Could you explain how that would be? I really
15 don't understand.

16 A It's because of the phenomenon called bio-
17 accumulation, wherein the organisms living in the lake
18 will tend to accumulate the radionuclides that are
19 released by the plant.

20 This starts out with the very small organisms,
21 like algae, for example, that feed on these very small
22 organisms, that are fed on by small fish, that are fed on
23 by large fish, and then the man eats the large fish when
24 he catches it.

25 So you have an amplification of the concentration

7-27

1 over what it is in the water of the lake.

2 In this particular case here, with one way of
3 estimating it, about 1.3 milligram per year from fish
4 ingestion and probably less than a tenth of a milligram
5 per year from ingesting the water.

6 Q Well, we had a figure of -- an estimate of the
7 amount of the water ingested of two liters. Is there a
8 figure -- an average ingestion of fish that would be
9 used --

10 MR. NEWMAN: Objection. That question was asked
11 and answered this morning during the cross-examination by
12 Mr. Doherty.

13 The question was what would the consumption of
14 fish be. And I believe that the assumption related was
15 something on the order of three times the consumption of
16 an average adult.

17 (Bench conference.)

18 JUDGE WOLFE: The Board doesn't recollect, so we
19 will allow the question.

20 DR. GOTCHY: For calculating dose through
21 fish pounds employed, we assumed the annual consumption
22 of 21 kilograms a year.

23 That's something on the order of 45 pounds a
24 year.

25

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BY MR. SCHUESSLER TO WITNESS GOTCHY:

Q. Based on that assumption then, is it your calculation or estimate that even consuming that much fish from Allen's Creek that it would still constitute no real hazard?

A. That's correct.

Q. Do you recall, just for a number, do you recall what number was used to -- what would be the dosage on that basis? Could you give me a figure of some sort?

MR. NEWMAN: I believe that question has been asked and answered. I believe Dr. Gotchy has answered it twice.

MR. SCHUESSLER: Okay. That's in the record then.

JUDGE WOLFE: Did you say something, Mr. Schuessler:

MR. SCHUESSLER: I said that's in the record. It was just a comment. I'm sorry.

JUDGE WOLFE: Do you withdraw your question then?

MR. SCHUESSLER: Yes, sir.

BY MR. SCHUESSLER TO WITNESS GOTCHY:

Q. Does your field include any knowledge or expertise on the distinctions that are made in where radiation or the effects are settled? I mean, I've heard

8-2

1 of whole body doses or exposure, thyroid and I think some
2 others.

3 I would like to be more specific, but what I
4 want to ask is what is the significant differences
5 between these definitions and I hope I can rely on you to
6 know what those definitions are, the thyroid for one,
7 total body and perhaps the others that I don't come up
8 with.

9 MR. NEWMAN: Mr. Chairman, that question is
10 simply impermissibly vague. The record is getting off
11 into rabbit trails now. I am really concerned that
12 we are not going to move along, get this witness finished
13 today. Again, I would urge that the Chair ask Mr.
14 Schuessler what it is he intends to adduce by his line
15 of questioning.

16 If we have an idea of where he is going, I
17 believe we will be able to cut down on these objections.

18 JUDGE WOLFE: What are you trying to establish
19 now, Mr. Schuessler?

20 MR. SCHUESSLER: Well, in part, I'm trying to
21 gain an understanding so that I can deal with this on a
22 more intelligent and knowledgeable basis. Maybe this is
23 not the form or the place to do that, but basically my
24 concern is consistent with the contention which essentially
25 says that this will not be a viable, safe --

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1 JUDGE WOLFE: Yes, I understand. I can
2 appreciate your concern, but we have to proceed
3 expeditiously although fairly and you must recognize, as
4 I'm sure you do, that your questions have to be based upon
5 or derived from the witness' testimony or from the
6 contentions.

7 Now, your questions just can't be general and/or
8 vague. They must be asked with some purpose in mind
9 relating to something that was said on direct testimony or
10 something that you intend to establish in support of the
11 contention.

12 We are not here just to educate, although that
13 is one of the purposes, but the true purpose, the actual
14 purpose, the express purpose, is to explore the validity
15 of the contentions and get the facts so that the Board
16 can make a decision.

17 So with that in mind, I give you one more
18 chance to ask direct questions, relevant questions. If
19 not, why we will just have to excuse you and go to the
20 next party.

21 MR. NEWMAN: Mr. Chairman, I would like the
22 record to reflect we are having extensive pauses between
23 each of Mr. Schuessler's questions. And that as a result,
24 the hearing -- the time of the hearing is, in fact, being us
25 while Mr. Schuessler reads the testimony to ask his various

8-4

1 questions.

2 JUDGE WOLFE: If that is so, I don't know for
3 what purpose you would have us note that for the record.

4 MR. NEWMAN: I guess, Mr. Chairman, ultimately
5 it would go to the reasonableness of rulings by the
6 Board as to the proper time that should be allotted to
7 cross-examination by the parties.

8 I think if one can establish early out, as this
9 Board has done, by the way, that it is extremely patient
10 with intervenors, particularly pro se intervenors that --
11 particularly if it's established that track record, when
12 the time comes to limit cross-examination, I believe that
13 the measures taken by the Board will, from the standpoint
14 of an appellate body, be demonstrably reasonable.

15 JUDGE WOLFE: Yes.

16 MR. SCHUESSLER: I would just like to state
17 that I would like the record to show that Counsel's
18 remarks, I think, were more extensive and time-consuming
19 than my pauses.

20 JUDGE WOLFE: I'm sorry, I don't have a
21 timewatch or a timeclock. I can't judge that. However,
22 please, let's try to clip along here.

23 MR. SCHUESSLER: I'm merely reviewing the
24 testimony here to jog my memory, see if there are any
25 additional questions. If not, then I will -- I think

8-5

1 that's all from my standpoint, Mr. Chairman.

2 JUDGE WOLFE: All right. I would now have the
3 record reflect that we have Mr. Doggett in attendance,
4 Dr. Marrack in attendance and seated up in the gallery,
5 Mr. Scott for whatever reason, and all right, Doctor,
6 let's see. We will --

7 MR. NEWMAN: Mr. Chairman, the record should
8 also, I think, indicate the time of which your statement
9 was made -- approximately 2:40.

10 JUDGE WOLFE: Approximately 2:40. All right.
11 Mr. Doggett, alphabetically, to you.

12 And, Mr. Doggett, in an effort to excuse
13 Dr. Gotchy as soon as possible, we have directed that
14 the cross-examination be directed to him solely today
15 on Bishop's Contentions 12 and 21.

16 MR. DOGGETT: Yes, sir.

17 BY MR. DOGGETT TO WITNESS GOTCHY:

18 Q. Dr. Gotchy, on page 4 of your direct testimony,
19 in the middle of the page, you state that quantities of
20 radioactive material that will be released to the cooling
21 lake are calculated -- that after quantities of
22 radioactive material that will be released to the cooling
23 lake are calculated, estimates of radiation doses to man
24 will be in the most significant pathways from the
25 cooling lake activities are calculated based on

8-6

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1 conservative assumptions regarding the dilutions of effluent
2 gases and radionuclides in the liquid discharge
3 and man's activities using the cooling lake,

4 Did you do any calculations taking into account
5 the possibility that there might be slightly higher
6 releases of radionuclides than normal due to equivalent
7 malfunctions or operator error?

8 A. Yes.

9 Q. And where is that?

10 A. Those come in in the calculation of the source
11 germs that were used to calculate the doses. They include
12 the so-called abnormal occurrences, but not serious
13 accidents, the kind of things we would anticipate to
14 occur relatively frequently, maybe one a year or one in
15 ten years, but certainly during the life of the plant.

16 Q. And what specifically -- or can you be more
17 specific in describing these non-major releases?

18 A. I can't be more specific. However, these
19 releases have been measured in operating plants and they
20 are built into the code that the NRC Staff uses to
21 calculate the releases. I did not do those calculations
22 myself. Those were done by the members of the Staff.

23 Q. Who specifically performed those calculations?

24 A. I don't know.

25 Q. Further on in that same answer you state that

8-7

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1 in general, radiation doses calculated by the Staff are
2 intended to apply to an average adult, specific persons
3 will receive higher or lower doses, depending upon their
4 age, living habits, food preferences or recreational
5 activities.

6 MR. NEWMAN: Mr. Chairman, before Dr. Gotchy
7 responds to that, Mr. Doggett has quoted from the text
8 of the testimony which was changed this morning to
9 reflect -- I will, for Mr. Doggett's benefit, read the
10 sentence as corrected. "In general, radiation doses
11 calculated by the Staff are intended to apply to maximum
12 individuals. Specific persons could receive somewhat
13 higher or much lower doses..." et cetera.

14 MR. DOGGETT: I suspect that I will be getting
15 into something that's already been asked about, but what
16 is -- how is maximum individual defined?

17 MR. BLACK: Objection. Asked and answered
18 earlier this morning.

19 JUDGE WOLFE: Sustained.

20 BY MR. DOGGETT TO WITNESS GOTCHY:

21 Q. Well, even with the change in your -- in the
22 wording of the direct testimony -- you are admitting that
23 this hypothetical person is nothing more than that, just
24 a hypothetical person.

25 A. That's correct at this time, yes.

8-8

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1 Q. This would be some -- so you have calculated
2 the hypothetical person's exposure based on some type of
3 average. Is that correct?

4 A. No. It represents the result of above-average
5 intakes of both fish and drinking water, in this case.
6 The fish consumption, for example, is about three times
7 higher than the average person would consume and the
8 drinking water is about double.

9 Q. Do you take into account the potential effects
10 of this higher than average exposure on, say, a pregnant
11 female?

12 A. What we have here is a calculation of dose. A
13 fact that she's pregnant really does not affect the dose
14 that we would calculate to her. And I guess we have not
15 made specific calculations of the risk associated -- with
16 a pregnant female being exposed as opposed to a man being
17 exposed.

18 Q. Is it or is it not true that pregnant females
19 and certain other types of individuals are more susceptible
20 to harm from radiation exposure than, say, an average male
21 individual?

22 MR. NEWMAN: Objection, Mr. Chairman. That
23 question was asked and answered this morning. Specifically,
24 Dr. Gotchy was asked whether his calculations took into
25 account differences in susceptibility in different parts

8-9

1 of the population.

2 JUDGE WOLFE: Well, if what you are reading
3 and/or... paraphrasing is what his response is, I don't think
4 it is particularized enough to bar this instant
5 question. Objection overruled.

6 Doctor?

7 A. The risk to the mother as opposed to the risk
8 to a man would not be significantly different. However,
9 the risk to the fetus in a pregnant woman would be at
10 perhaps two or three times higher risk per unit of
11 exposure than the mother would.

12 BY MR. DOGGETT TO WITNESS GOTCHY:

13 Q. Did you do any calculations concerning that
14 type of individual, say, pregnant female?

15 A. The doses would still apply. No, we didn't do
16 any risk calculations either.

17 Q. What other individuals besides pregnant
18 females are more susceptible to harm from radiation
19 exposure?

20 A. I would like to make it clear that when we
21 are talking about risks to certain people, that the
22 estimates we are using are based on very large doses of
23 radiation, for example, such as occurred in Hiroshima,
24 Nagasaki. We assume that they can be scaled linerally
25 down to very low doses, but no one really knows whether

8-10

1 that is true or not. We make the assumption that it is
2 and so we calculate a potential risk associated with that
3 dose.

4 Would you restate your question? I want to make
5 sure I'm trying to answer the right question.

6 Q. Okay. What would be some other common
7 situations where people would be more susceptible to harm
8 from radiation, for instance, like the pregnant woman.

9 A. There are a few cases where this has been
10 known. For example, the risk of leukemia among Mongoloid
11 children is much higher than the general population.
12 These are statistical risks. The risk of leukemia among
13 siblings of children who have had leukemia is higher than
14 the average.

15 The risk of thyroid cancer in young Jewish
16 females is at least a factor of ten higher than it is for
17 the average in the population. So there are some groups
18 that have been identified that are somewhat higher risks
19 for exposure. In some cases, specific organs, in some
20 cases to whole-body radiation than the average for the
21 population.

22 Q. Are these groups that you mentioned considered
23 in your calculations?

24 A. Well, let me make clear. We don't have any
25 calculations directly in this testimony about risks. We

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1 just have said that there is, based on the estimate of the
2 total population, the total dose of the population within
3 50 miles of the plant from all pathways, that we would
4 calculate less than one cancer over the lifetimes of all
5 the people, and we are talking now about about 2.8
6 million within 50 miles of the plant. And you have to
7 appreciate that of those 2.8 million people, about
8 500,000 of them are going to die from cancer from other
9 causes.

10 So what we are talking about is an incredibly
11 small increase in the risk that everyone in that population
12 would face.

13 Q. Did I understand you correctly to say that you
14 estimate there will be one -- an increase of one death,
15 cancer death --

16 A. Less than one.

17 Q. Less than one. All right.

18 When you performed your calculations, is there
19 a factor for these higher risks groups, the Mongoloids,
20 the young Jewish females, et cetera. Is that factored
21 into your calculations?

22 A. Yes, in effect, it is, because the data is based
23 on the total observed cancer in populations which, in
24 particular, Hiroshima, Nagasaki, which were composed of
25 people of all age groups and of all genetic constituency

8-12

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1 and there would be in that population those that are more
2 susceptible to radiation effects than those who are less
3 susceptible. So what we are really doing is looking at
4 the total for population and recognizing that there may be
5 some individuals who may be a somewhat higher risk, and
6 some who are at somewhat lower risk.

7 Q. The -- you are basing most of your calculations
8 based on studies from Nagasaki.

9 A. And Hiroshima.

10 Q. And Hiroshima.-- Are there any significant
11 differences in radiation effects on races, such as the
12 difference between Orientals, Negroid and Caucasian?

13 A. There certainly are differences in the
14 spontaneous rates of various cancers. And there are
15 differences in the overall spontaneous cancer rates. We
16 don't, at this time, I say we -- the radiation biology
17 community -- don't have the kind of data which really
18 permit us to distinguish between say, for example, the
19 Japanese and the United States. Even though we know that
20 the spontaneous risks of various cancers -- some are much
21 higher. For example, stomach cancer in the Japanese is
22 seven times higher than it is in the U.S., but then again,
23 the rate of colon-rectal cancer is many times lower than
24 it is in the U.S. The overall cancer rates are similar
25 to what they are in the U.S.

8-13

1 But we can't, in our models, at this time,
2 distinguish between Japanese and Caucasian and Blacks.

3 Q. Do you have any idea how many young Jewish
4 females were in Nagasaki and Hiroshima during World War II?

5 MR. NEWMAN: Mr. Chairman, I'm going to object
6 to that question. In addition to being pretty patently
7 frivolous, again, I think we have -- Counsel has to be
8 advised that the questions must relate to Bishop 12 or
9 Bishop 21, concerning the effects, the amount of
10 radioactivity in the Allen's Creek cooling lake and the
11 effects of that radioactivity in the lake. We have to
12 stick to the Allen's Creek Lake.

13 JUDGE WOLFE: Objection is overruled. You
14 may press your cross-examination.

15 BY MR. DOGGETT TO WITNESS GOTCHY:

16 Q. I assume you don't know the answer to that.

17 A. I would assume that would be pretty small, but
18 on the other hand, there weren't too many Orientals
19 included in this study in New York where they identified
20 the susceptible Jewish population either.

21 Q. Let me go one step further. Do you feel that
22 the fact that this particular group was not present in
23 Nagasaki and Hiroshima, might have any significant effect
24 on your extrapolation from those studies to the Allen's
25 Creek site?

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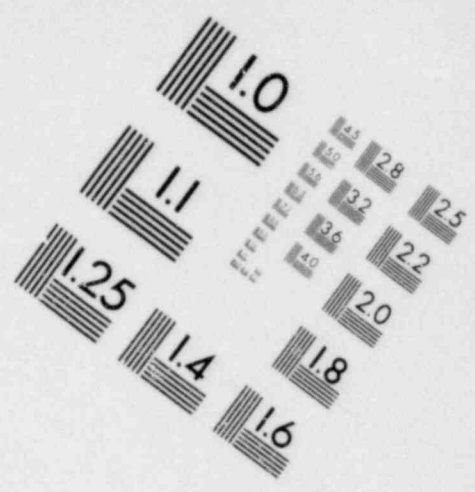
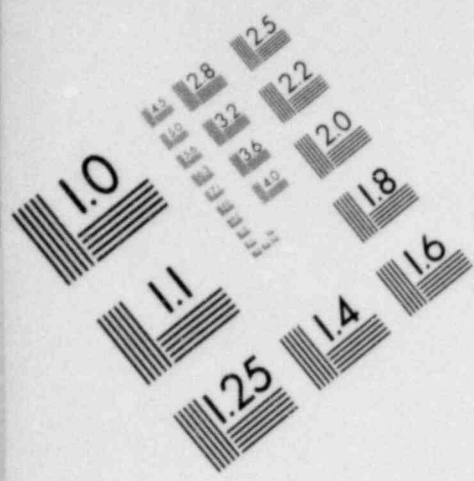
A. No, I don't.

Q. Let's go back to something you mentioned earlier which is apparently a basic assumption in all these analyses.

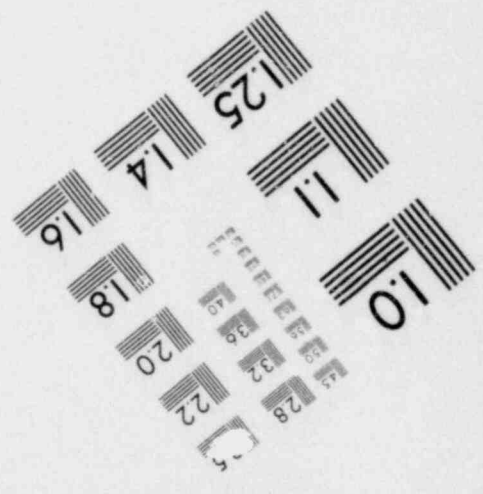
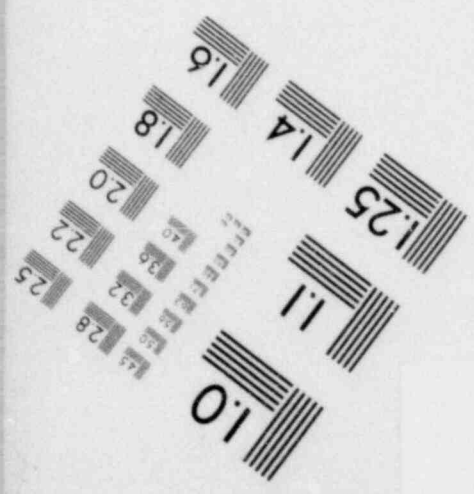
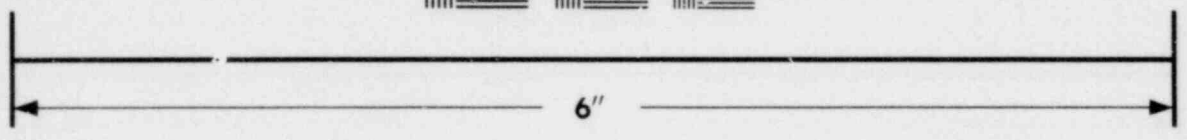
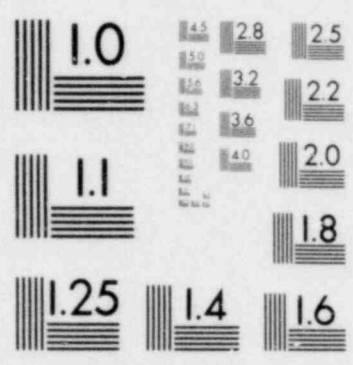
You stated that it is assumed that you can make a linear calculation based on the experience in Hiroshima and Nagasaki. Isn't there quite a bit of debate among the experts in this area about whether or not you can actually make such an assumption?

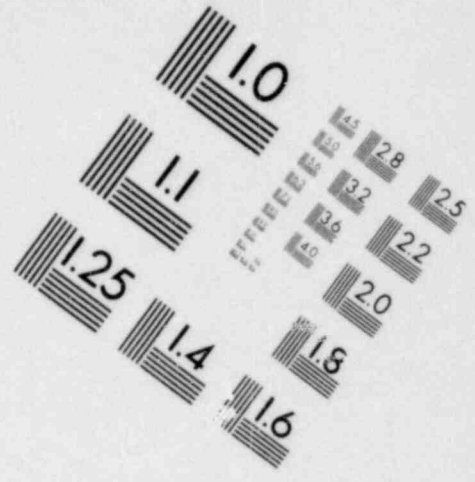
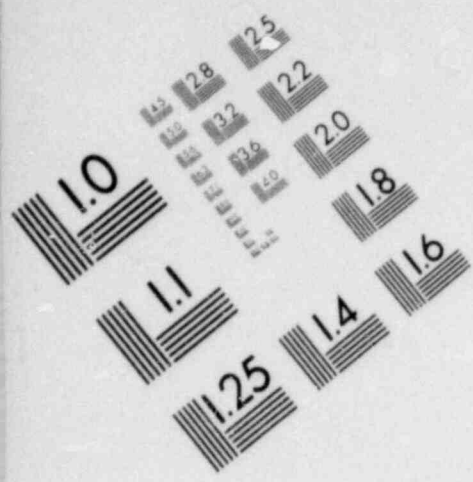
A. Yes.

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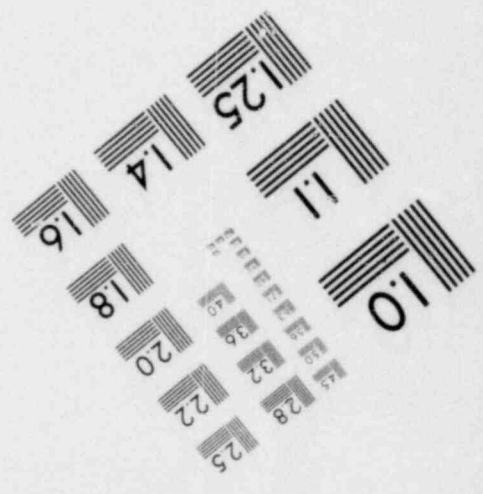
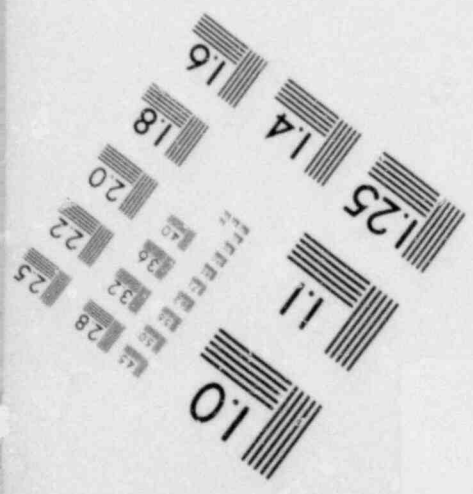
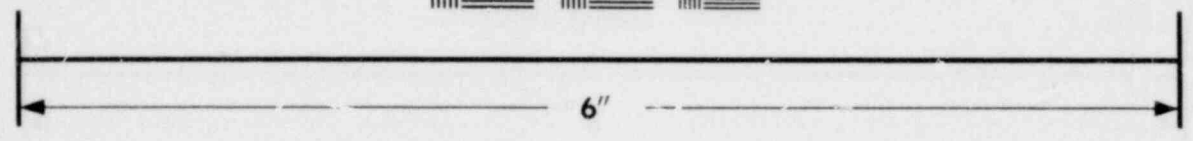
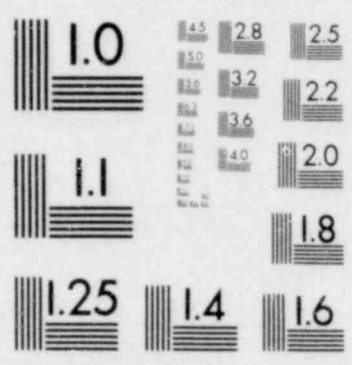


**IMAGE EVALUATION
TEST TARGET (MT-3)**





**IMAGE EVALUATION
TEST TARGET (MT-3)**



1 Q And some of the experts say that this assumption is
2 incorrect.

3 A Yes. Some say it underestimates the effects and
4 some say it overestimates the effects.

5 Q And this is something which is, as near as you can
6 tell, not something that is even close to being settled. This
7 is a raging debate in the field?

8 A I would characterize debate as amongst certainly
9 over 90 to 95 percent of the people who are expert in that area;
10 it really is over what amounts to, in most cases only differences
11 of about factor of two to three, although there are some people
12 who would argue that there is a threshold below which low-level,
13 or low doses don't cause any effect at all.

14 I think the majority of the radiation biology
15 community feels that it is prudent and reasonable to nevertheless
16 assume a linear area with no threshold, and we do that in the
17 Staff and always have since I have been on the Staff.

18 The latest report which just came out last year,
19 National Academy of Sciences postulates three radiation response
20 models. One called linear. One called linear quadratic, and
21 one called the pure quadratic.

22 I would say that most experts feel the linear
23 quadratic is probably the most realistic. The linear model is,
24 usually tend to overestimate the dose for the types of radiation
25 we are talking about at Allens Creek, and the quadratic estimates

1 would be at the kinds of doses we are talking about here more
2 than a factor of 100 lower than what we would estimate, using
3 the current models.

4 Q Do you all use the linear quadratic model?

5 A We are using the linear quadratic model at this
6 time, but that model is essentially a linear model from doses
7 below about 25 rems, 25,000 millirem, and if you look at the
8 models in the National Academy study you will see that there
9 is a constant ratio between the pure linear model for doses
10 that would be comparable to what we are talking about, and
11 the linear quadratic, and the difference between that ratio,
12 like I said, would be about a factor of two to three.

13 Q About a factor of two and a half.

14 A Yes.

15 Q Are you aware that there is a facility located in
16 Richmond, Texas, which houses mentally retarded persons?

17 A No. I am not aware of that.

18 Q Some of whom are Mongoloids.

19 Are you aware of whether or not these Mongoloid
20 children will be allowed to have recreational activities at
21 the proposed lake?

22 A No. I am not.

23 Q Would they be safe?

24 MR. BLACK: Mr. Chairman, I think this questioning
25 has wandered definitely from Bishop Contention 12 and Bishop

1 Contention 21, and I just would reiterate and restate the
2 objection that Mr. Newman posed just a little while ago, and
3 which I have stated before, in that we are now getting into an
4 area of health effects, low-level radiation health effects,
5 which is the subject of Motion For Summary Disposition, and
6 certainly one that Mr. Doggett spoke of, because he is a party
7 to that contention, but we should not seek to get into low-level
8 radiation health effects through this contention when, in fact,
9 it is the subject of the other Doggett contention.

10 JUDGE WOLFE: Was your question about the presence
11 of Mongoloid children in and about the cooling lake, you meant?

12 MR. DOGGETT: Yes.

13 JUDGE WOLFE: Objection overruled.

14 WITNESS GOTCHY: I'm sorry. What the question?

15 BY MR. DOGGETT TO DR. GOTCHY:

16 Q There is a Richmond State School located near this
17 facility. There are a number of Mongoloid children who live
18 at that facility.

19 JUDGE WOLFE: What would be the impact of having
20 these Mongoloid children in and about the lake; any adverse
21 effect, Dr. Gotchy?

22 A I guess they would not tend to be characterized as
23 a maximum individual. That would be a person who had ready,
24 essentially daily access to fishing in the lake, and that sort
25 of thing, and drinking the water, for example.

1 Children like that would be much more restricted in
2 their usage of the lake, so even though the risk might be five
3 or ten times higher than the maximum individual we assume their
4 doses would be much lower. For example, if they went swimming
5 there several times a year, the doses would be one to two orders
6 magnitude less than what you would get from ingesting the water
7 as a normal adult. And the risk, therefore, would still be
8 lower than for the case we have calculated.

9 I would say, yes, they would be fairly safe if they
10 went swimming there all summer, every year.

11 JUDGE LINENBERGER: Dr. Gotchy, when you talked
12 about restricted usage of such individuals, of the lake by
13 such individuals in what context did you mean that?

14 WITNESS GOTCHY: They would have to be supervised.
15 They would not be allowed to go down there every day and fish,
16 for example, or swim in the lake.

17 JUDGE LINENBERGER: Well, should I conclude from
18 that that you are assuming there will be somebody at the lake
19 site to insure that they do not come in and use the lake
20 every day, or --

21 WITNESS GOTCHY: No. I am just saying that these
22 children are institutionalized now, and they are under the
23 constant supervision of others, and their use and access to the
24 lake would be determined by the availability of competent adults
25 to take them there and look after their safety.

1 JUDGE LINENBERGER: It sounds as though that perhaps
2 you are making the assumption that such supervisory adults
3 cannot be made available to them; therefore, they won't come.
4 But in the situation that supervision could be made available
5 to them, and they use the lake regularly, to what extent would
6 that cause your results to be skewed from a representative
7 situation?

8 WITNESS GOTCHY: As I said, sir, if they were to
9 swim in the lake all summer, for example, or play in the water
10 and be along the shoreline where they might be exposed to
11 sediments, and even fish periodically, and someone fixed the
12 fish for them and feeds it to them, their risks would not be
13 significantly different than someone, for example, who is
14 retired, or a younger person living near the area who has
15 ready access to the lake anytime he wants to use it.

16 I issued the postulates of circumstances where
17 maybe they would have higher usage than some of these other
18 people, but I think the probability of that is relatively low.
19 I wouldn't say it is zero, but the most realistic case these
20 people would have access that would be restricted by the
21 availability of people to take them back and forth to look
22 after their safety.

23 JUDGE LINENBERGER: Thank you.

24 BY MR. DOGGETT TO DR. GOTCHY:

25 Q Do you think it would be wise to have some contact

1 with the Richmond State School to advise them as to the possible
2 increased risk, so that they might take appropriate precautions
3 to make sure that the children did not become overexposed?

4 A I don't even know where that school is, so -- Where
5 are they in relation to the proposed lake?

6 Q Thirty miles away. It would involve a supervised
7 trip to the lake.

8 A No. I wouldn't think -- certainly based on the
9 kinds of releases that we are talking about, and liquid pathways
10 that anyone ought to have any concern about using that lake,
11 even if they swim in the discharge canal.

12 Q Well, your model man, I think, according to your
13 calculations would be exposed to, is it 1.4 millirems?

14 A That's 1.3 millirems for fish ingestion. That's
15 eating about 40 to 50 pounds of fish a year taken from the
16 vicinity of the discharge, and taking water from the vicinity
17 of the discharge, two liters a day for a whole year; that's over
18 half a gallon a day.

19 Q Okay. And the lower level, the accepted level is
20 3 millirems per year, the whole body?

21 A That is the level at which the Commission has
22 directed Applicants to try to design their plants to operate
23 within. That's the Appendix I design objective for liquid
24 pathways, yes, 3 millirem per year.

25 I guess I should point out that that 1.4 millirem,

1 and the 1.3 millirem fish ingestion represents the upper bound
2 of the possible doses for fish taken over the entire lake,
3 concentrations of radioactivity in the parts of the lake that
4 about be upstream of the dam would be much lower than they are
5 in the immediate vicinity of the outfall. And an average dose
6 from fish ingestion from fish over that lake would be ten to a
7 hundred times lower than what we have calculated.

8 Q On Page 6 of your testimony you begin discussing
9 the possibility of radioactive contamination of drinking water,
10 and you discount the -- you say that you have not performed any
11 calculations on that because the effect of radioactive
12 contamination for local drinking water supplies will be
13 insignificant.

14 Do you have any engineering training?

15 A Not engineering courses per se. I have got basic
16 science courses in mathematics and physics, chemistry, and the
17 same general sciences that engineers study, but I have not had
18 any engineering training per se.

19 Q Do you know what an expert would be called who
20 determined whether or not underground water will migrate to
21 drinking wells or something like that.

22 A They would be a groundwater hydrologist.

23 Q Okay. Do you have any training in that field?

24 A Yes. I do.

25 Q What training is that?

1 A It was involved in work that I have done prior to
2 coming to Washington, D. C., work related to movement of
3 radioactivity from underground nuclear weapons tests in Nevada,
4 and Colorado, and Utah, and Wyoming -- proposed tests, I should
5 say, in some of those areas.

6 Q And what specifically did you do in relationship to
7 those tests?

8 A I have done calculations of potential groundwater
9 for migration of radioactivity in groundwater for the types of
10 soils and formations that were available, the types of aquifers
11 that were there.

12 Q And what type of training did you have to enable you
13 to do those calculations?

14 A It is principally physics and chemistry.

15 Q Who trained you to perform those calculations?

16 A My training was primarily in graduate school at
17 Colorado State University in radiation chemistry, and
18 subsequent to that from reading available literature in the
19 field, looking at various groundwater migration models that
20 were available for those types of calculations.

21 Q Do you feel that training qualifies you to express
22 an opinion as to groundwater migration in the Allens Creek area?

23 A I have not even looked at the question of ground-
24 water movement in the area. The reason we did not do that --
25 and I said this earlier this morning -- was by us making the

1 assumptions that we have made, and looking at the maximum possible
2 individual who might be exposed in that area by assuming that
3 he took water directly from the lake and took fish directly from
4 the lake, and in both cases in the vicinity outfall, that any
5 doses to anyone else after movement of radioactivity from
6 seepage of the lake, radioactivity into the Evangeline Aquifer,
7 with subsequent removal perhaps from a well, that those people
8 would be exposed to a much lower concentration, much lower
9 concentrations and much lower doses than the people we have
10 already discussed.

11 And since the people we had already discussed met
12 the Appendix I design objective requirements, we do not feel
13 that it was justified to spend the taxpayers time and money to
14 go in there and look in this other area.

15 Q Well, it seems to me that once you start talking
16 about how much water is going to get into the water wells you
17 are talking about groundwater hydrology, aren't you?

18 A Into the aquifer?

19 Q Yes.

20 A Sure.

21 Q So you did go into an area which involves that
22 area of expertise in your testimony?

23 A I have said is some very general principles; namely,
24 that when radioactivity seeps from the lake into groundwater
25 that is existing, you know, prior to the appearance of

1 radioactivity, say, in the lake water, that that radioactivity
2 with the exception of tritium is subject to ion exchange on the
3 particles of soil as they pass through the pore space in the
4 ground, and in the soil.

5 And they also are subject to dilution by water,
6 uncontaminated water that was pre-existing the time that the
7 seepage would begin.

8 And as a result of those two mechanisms alone, it
9 is clear that the dosage to anyone ingesting that water would
10 have to be orders of magnitude lower than would be the case
11 for someone drinking water directly from the vicinity of the
12 outfall.

13 Q So you are assuming, based on what experience you
14 have had with groundwater hydrology that the radionuclides will
15 be lower in the groundwater than they will be in the cooling
16 lake itself?

17 A That's a simple physical principle.

18 Q Well, it might be simple to you, but it might be so
19 simple to anybody that doesn't know anything about it.

20 A Well, it says that if you have ten apples, and you
21 take one out, you've got fewer than you started with. And even
22 if you don't quantify the amount, it is clear that if some of
23 the radioactivity in the groundwater exchange with stable
24 radionuclides on particles in the soil that there is going to
25 be a large concentration in the water with distance than you

1 started with.

2 I did not attempt to quantify how much it was
3 reduced, because I could see no point in it.

4 Q Now, I can understand that what you say when you
5 say that as the water moves through the soil and through other
6 water underground that the number of radionuclides would tend
7 to decrease as it gets further away from the lake, but what
8 about the long-term effect of this; wouldn't the radionuclides
9 that are being leached out by the soil tend to build up
10 underground?

11 A They would tend to build up in the soil, not in the
12 water. They would be absorbed on the soil, adsorbed, and
13 absorbed, both, in the particles of the soil.

14 It works just like ion exchangers in chemistry,
15 the same kind of ion exchangers they use in the plant to clean
16 up the liquid effluents before releasing into the lake.

17 Q Is there any danger of the radionuclides that are
18 built up in the soil getting washed or leached back into it,
19 the water?

20 A Some of them, perhaps, would be exchanged by other
21 ions, and would move along some distance, and then absorbed
22 another particle. That's the nature of transport of any kind
23 of ionic species in groundwater. It doesn't have to be
24 radioactive.

25 There is always an exchange going on for ionic

1 species in groundwaters. The groundwater moves, some are
2 absorbed, some of desorbed, and those that are desorbed will
3 go on and they absorb somewhere else, exchange with another ion,
4 and it goes on. The net result is that the movement of ionic
5 species other than tritium, things like cesium, for example,
6 is incredibly slow relative to the speed of the groundwater.

7 And I think in FES Supplement, it estimates something
8 like to 10 to 50 feet per year movement, which is relative fast.
9 That would be about the speed that the tritium would migrate,
10 but everything else would be sitting back there in the first
11 few inches of soil it was trying to get through, while tritium
12 was traveling 50 feet away in the first year.

13 The kind of migration we have seen related to
14 underground weapons test, and that sort of thing is incredibly
15 slow. It moves as a front to the soil, and some of that stuff
16 has not moved -- you can't measure any movement since the test,
17 and some of these tests are like 20 years old now. And they've
18 been sitting in groundwater, so...

19 I guess the longest test I can think of the
20 transuranics that were produced in the opal phenomena two billion
21 years ago in Africa where the first natural -- well, the first
22 nuclear reactor was created by chance, and they still find the
23 long-life transuranic elements sitting right there, and they
24 are still in the groundwater absorbed in the soil. They just
25 don't move very fast.

1 Q I would assume that different types of soils
2 absorb, or interact with these radionuclides in different ways.

3 A That's true.

4 Q Have any studies been done of the type of soil that
5 will be -- regarding the type of soil that will be in or around
6 the Allens Creek site?

7 A I imagine they have been. I have really not looked
8 at them.

9 In general, clays make the best ion exchangers,
10 clay particles.

11 Q I would assume that the stuff that you were dealing
12 with in Utah and Nevada was rock, as opposed to soil?

13 A No, it was soil. Well, both, actually. There was
14 some in granite we looked at, granitic use, and some of it in --
15 most of it was in alluvial soil, sedimentary soil in the desert,
16 several hundred feet underground.

17 Q Okay. You keep excepting tritium from your state-
18 ments. What is tritium, and why do you make an exception for
19 it?

20 A Tritium is a radioactive species of hydrogen, and
21 it forms radioactive water, in which it exchanges with an atom
22 of hydrogen, so you have an atom of hydrogen, and a tritium atom
23 connected to an oxygen molecule to form your H₂O. And that
24 tritium, while it is physically larger than normal hydrogen,
25 does not behave significantly different than the normal water.

1 It all moves with the same speed, essentially, as
2 groundwater moves. It is not subject to any ionic exchange
3 mechanisms I am aware of.

4 Q Can tritium be harmful to human health?

5 A Sure, if you get a high enough dose from anything
6 it is harmful to your health.

7 Q Does it or does it not tend to -- Is there a
8 maximum level that it can reach in the water, or can it build
9 up in the water?

10 A It will build up to a level which -- and I don't
11 know the exact period of time we have done on that
12 calculation, but in the calculation we assume that all of the
13 concentrations of radionuclides build up to approximately eq a.
14 in value in the lake.

15 This means that losses of tritium from the lake
16 from, for example, evaporation of water, and spill over the
17 dam and mixing, that water coming in in the spring with the
18 rain, that the tritium concentrations will reach a fairly
19 constant level after a period of time. And the calculations
20 that we have done would account for essentially all radionuclides
21 of importance, and that is really just a few, being approximately
22 near equilibrium values.

23 Q Could it build up in the underground water?

24 A Not tritium.

25 Q Why?

1 A Because it doesn't adsorb to anything. It just
2 moves through the groundwater, and as it moves out, it's
3 mixed with more and more water that was there before
4 it, and it's diluted out.

5 It's similar to the concept of releasing a puff
6 of smoke in the air. And as it passes through the air,
7 it's just dispersed to wider and wider, larger and larger
8 volumes with other air molecules.

9 And pretty soon the concentrations are orders
10 of magnitude lower than they were at the point of their
11 release.

12 Q How long does it take for this particular material
13 to decay down to a safe level?

14 A I'm saying, I guess, that the concentrations
15 estimated to be present at the time the tritium reaches
16 its maximum value in the level is a safe level.

17 And no additional decay would be needed. It
18 would represent a very small dose, a tenth of a millirem
19 per year or less.

20 It's less than a tenth of a percent of natural
21 background radiation in this area.

22 Q You say that there is no chance over a long
23 period of time, or over the operating life of this plant,
24 for the tritium to build up in the underground water?

25 A No.

1 Q Because you're assuming it will continue to
2 disperse in the underground water?

3 A Sure. The water just keeps moving. There's a
4 flow of water going under the lake and coming from the
5 lake, and they're continually mixing. As long as seepage
6 from the lake occurs, they will continue to mix.

7 And they continue to mix right on down to the
8 aquifer.

9 Q So based on that assumption, the worst that you
10 think could happen would be the same as the people drinking
11 water from the lake?

12 A That's correct.

13 MR. DOGGETT: That concludes my questions for
14 Dr. Gotchy.

15 JUDGE WOLFE: We'll have a recess until a
16 quarter of four.

17 (A recess was taken.)

18 JUDGE WOLFE: On the record.

19 I have got a limited appearance statement
20 from Laurence G. Cowles dated January 16, 1981.

21 I hand it to the reporter for incorporation
22 into the record.

23 (See attached page.)

24 ///

25 ///

9-17

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1 WRITTEN STATEMENT

2 OF

3 LAURENCE G. COWLES

4 "Laurence G. Cowles, Solid State Circuits,
5 5420 Brae Burn Drive, Bellair, Texas 77401.

6 "January 16, 1981.

7 "Mr. Sheldon J. Wolfe, Chairman, NRC Atomic
8 Safety & Licensing Board, U of H Bates College of
9 Law, 4800 Calhoun, Houston, TX 77004

10 "Dear Mr. Wolfe,

11 "Houston is too close to the Wallis site proposed
12 for a nuclear power plant because the city is so
13 rapidly moving westward. We live 35 miles from the
14 site, and a son and granddaughters live five miles
15 closer. My son, working for the Shell Oil Company,
16 may be transferred to their laboratory near the
17 Addicks Dam. In that event we have planned to move to
18 Alief or the Addicks area. It's too close!19 "We settled forty years ago on the western edge
20 of Houston to be away from the pollution of the
21 refineries, the congestion of the inner city, and the
22 noise of aircraft on the northern side. Now we
23 are threatened with a nuclear power plant just out
24 of sight.

25 "Nuclear plants cannot be as safe as claimed as

9-18

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1 long as they depend on the skill, integrity, and
2 fearlessness of human operators. The high cost of
3 shutting down a plant in a mistaken emergency forces
4 the employees to err in favor of their employer. Past
5 records and recent events show little concern for
6 the public by utilities, operators and even our
7 elected and employed government officials. It is so
8 much easier to need nuclear power than to find
9 alternatives.

10 "I am an electrical engineer, and I am firmly
11 opposed to the use of nuclear power. The utilities
12 have pushed a large part of the energy cost on the
13 taxpayer so that the costs they claim are below the
14 true costs. The utilities do not have to bear the
15 costs of insurance, and the government coverage is
16 totally inadequate. The long-term expense of
17 caring for the nuclear waste is merely left for the
18 next generations. A nuclear plant is a monument
19 to irresponsibility and the concealment of problems.

20 "We are already finding gas and new energy
21 sources, and we are reducing our wasteful uses of
22 energy. I urge the Board to rule against con-
23 struction of a nuclear power plant near Wallis,
24 Texas.

25 "Respectfully submitted, Laurence G. Cowles,

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Retired Project Engineer, The Superior Oil Company,
 Houston resident since 1934."

- - -

9010

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1 JUDGE WOLFE: After the recess, I would note
2 that Applicant's counsel, Staff counsel, Dr. Marrack
3 and Mr. Schuessler are in attendance.

4 Dr. Marrack, cross-examine, please, but only
5 as to Dr. Gotchy.

6 DR. MARRACK: Could I ask one question of you,
7 sir?

8 When does the Court expect to have Dr. Sanders
9 as a witness?

10 JUDGE WOLFE: We can't tell, Doctor. We're
11 going very, very slowly.

12 I just have no feel for that at all.

13 DR. MARRACK: Is he not available or is he
14 out of town and not going to be available for weeks or
15 what? Can you give me any guidance at all?

16 Might he be available later this week?

17 MR. BLACK: Well, Dr. Marrack, I think the
18 easiest way to respond to that is that we are running
19 behind scheduled.

20 Tomorrow the Applicant's panel on the cooling
21 lake will be coming back.

22 I suspect from what we have heard from Mr.
23 Scot that Applicant panel will be on the witness stand
24 at least all day tomorrow, and perhaps into Friday.

25 Whether that will complete all the -- or whether

9-21

1 the Applicant's panel will go all the way through Friday
2 is a question that remains.

3 But in any event, it is highly probable that
4 Dr. Sanders won't be back until the next evidentiary
5 session.

6 But we will let you know when that date will
7 be ... give you a very general schedule on that.

8 DR. MARRACK: Thank you.

9 MR. BLACK: But in any event, I just want to
10 assure you that he will be back. He will be recalled
11 as a witness.

12 DR. MARRACK: Could I ask another question.
13 Is this a rewording of a sentence beginning "in general"?
14 Has that been typed somewhere that I could have a copy
15 of that?

16 I listened to it this afternoon; I would like
17 to see it in writing. I'm not quite sure what it said.

18 JUDGE WOLFE: I don't know what you're speaking
19 to, Doctor.

20 DR. MARRACK: I understood that a correction
21 was made to the wording of the witness' testimony on
22 page four, beginning some two-thirds of the way down,
23 "In general."

24 I was not quick enough to get all of the wording
25 changes in when I listened to it. I wondered whether that

9-22

1 was typed somewhere where I could see it in the written
2 form.

3 (Pause.)

4 BY DR. MARRACK OF DR. GOTCHY:

5 Q Dr. Gotchy, in this calculation you do of the
6 radiation, you answered just earlier this afternoon and
7 said that you made allowances for abnormal occurrences
8 and both mechanical and human error.

9 I wondered how you quantitated those two
10 pieces -- two separate items of the elements in the
11 equation.

12 A I think what I testified -- I said I personally
13 did not do that. Those calculations were done by other
14 Staff members who were expert in that area.

15 My understanding of the code which they used --
16 the computer code -- is that in defining the quantities
17 of radioactivity of specific radionuclides that would be
18 released from the plant, they have looked at actual
19 operating data from real operating plants, both boiling
20 water reactors and pressurized water reactors over the
21 years, with equipment that was in place and have deter-
22 mined the kinds of releases that you would anticipate
23 and given the design of plants today.

24 But I can't quantify that for you, sir.

25 Q I see.

9-23

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1 So there's an area of doubt and possible
2 impreciseness of that piece of the calculation; is that
3 correct?

4 MR. NEWMAN: I object to that, Mr. Chairman.
5 That's a comment on the evidence. I don't hear a
6 question.

7 DR. MARRACK: I'm sorry.

8 BY DR. MARRACK OF DR. GOTCHY:

9 Q Am I correct in understanding that there is a
10 measure -- or a component of imprecision in those cal-
11 culations?

12 A There are components of imprecision in all of
13 my calculations -- in all of the calculations that are
14 made because they reflect, in many cases, ranges of
15 values; in some cases, the best judgments of experts in
16 certain areas.

17 So, yes, there is some imprecision in all such
18 calculations.

19 Q If you recognize that there are ranges of
20 values for the various elements in the calculations, did
21 you do the calculations both for the worst case and the
22 best case, and the average, for each of these components
23 in the element?

24 A No, sir.

25 My understanding -- in developing the source

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1 terms, what they have done is looked at the average for
2 plants of certain types and design.

3 And there is variation about that mean and
4 experience for similar plants in years past.

5 I couldn't even quantify the kinds of variations
6 that have been observed. They are considerable for some
7 radionuclides.

8 Q Are there examples of the equivalent to the pro-
9 posed hypothetical plant that you're considering?

10 A Are there examples?

11 Q Yes.

12 That were used in this modeling process.

13 A Yes. As far as my understanding -- again, I'm
14 not an expert in that area -- my understanding is that
15 they looked at both lightwater reactors and pressurized
16 water reactors made by different architects and vendors
17 and manufacturers, and then gone back and looked at each
18 component of that plant which would reduce the radio-
19 active releases from the point -- from the fuel to some
20 level that was observed in the effluent leaving the
21 plant.

22 And they have attempted to assign -- if you
23 will -- decontamination factors for each of these types
24 of treatment, based on experience in operating the plant.

25 Q Is my understanding not correct that this plant

1 is rather bigger than anything previous, except possibly
2 one that isn't operating yet?

3 A Not to my knowledge, sir.

4 Q But am I correct in understanding that there are
5 varieties of plants. Were these calculations made
6 specifically for the kind of plant that's going to be
7 manufactured -- proposed to be manufactured for this
8 plant or just take an average of all the plants in
9 operation?

10 A It would take -- Now you're getting into more
11 detail than I can really swear to.

12 As I said, they have looked at the capability
13 of various types of treatment systems, holding systems and
14 that sort of things, to reduce the radioactive releases
15 from the fuel.

16 They have also looked at different types of
17 fuel colliding too, which can have a tremendous impact on
18 the releases of noble gases, for example.

19 And what they have done is scaled those units
20 to the size of the plant.

21 For example, if the data were developed on a
22 600 megawatt plant, they would scale the releases up to
23 a 1000 megawatt plant or 1200 megawatt plant.

24 Q I see.

25 You, in answering earlier this afternoon, and in

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1 your testimony referred to the average adult. And it
2 became apparent that there were some groups within the
3 population which differ from some hypothetical average
4 adult.

5 I understand from your answer that you recognize
6 that children might be more sensitive to biological
7 effects of radiation.

8 How does this radiation affect human cells?

9 MR. NEWMAN: I object to that question, Mr.
10 Chairman. That relates to the effects of low-level
11 radiation, which is not the contention before the Board
12 at this time.

13 JUDGE WOLFE: Yes.

14 We're not dealing with low-level radiation here,
15 Doctor.

16 Your questioning is limited to the scope of the
17 direct testimony by Dr. Gotchy and within the framework
18 directly connected to Bishop's Contentions 12 and 21,
19 which do not relate to low-level radioactivity.

20 DR. MARRACK: I wasn't aware that the biological
21 effects of radiation and the chemical effects of radiation
22 were necessarily limited to low levels.

23 My question is a general one, and it's a basis
24 for some further questions.

25 I wonder if the witness could tell us how he

9-72

1 thinks radiation affects the cells -- what's the
2 mechanism of this.

3 (Bench conference.)

4 JUDGE WOLFE: All right.

5 With that understanding, you may proceed.

6 DR. MARRACK: Could I have an answer to the
7 question, please?

8 DR. GOTCHY: The question --

9 DR. MARRACK: I asked a question which you
10 objected to --

11 JUDGE WOLFE: I didn't object to it.

12 DR. MARRACK: I'm sorry.

13 Counsel objected to it, and the question
14 stands.

15 JUDGE WOLFE: Would you answer the question,
16 Doctor.

17 DR. GOTCHY: The question -- if I can phrase it
18 to make sure I've got it correct is that you would like
19 me to generally discuss what are the mechanisms by which
20 radiation interacts with matter -- with living matter --
21 biological effects, how they might be caused?

22 DR. MARRACK: Yes. That sounds reasonable.

23 DR. GOTCHY: Okay.

24 In the case of a nuclear powerplant, all of the
25 radioactive effluents that we deal with are classified as

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1 radiations -- gamma and beta radiations which are classi-
2 fied as low-energy transfer types of radiations.

3 That means that as these rays pass through a
4 tissue, for example, they leave a fairly sparse path of
5 ionization. That means they remove electrons from mole-
6 cules and from atoms and leave -- usually an electron is
7 knocked out and you have what's called an ion tear.

8 These ion tears can result in the formation of
9 free radicals, which are chemically very reactive agents
10 that can react with other living molecules; for example,
11 DNA (deoxyribonucleic acid) in the nucleus of this cell.

12 There are a number of theories regarding how
13 such effects might cause, for example, a cancer.

14 I can't give you all of those theories. I can
15 summarize, I think, the major ones.

16 One is that the damage is caused by the free
17 radicals for the DNA, which then somehow loses its
18 ability to control cellular division, resulting sometime
19 later in life in an uncontrolled growth which we refer to
20 as a cancer.

21 There is also evidence that breaks in the DNA
22 can be caused by the direct action of radiation. In
23 other words, if the electrons are knocked out from atoms
24 in the DNA itself, that can directly cause breakage.

25 If the DNA is lined up correctly, it can result

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1 in what are called double-stranded breaks which are the
2 worst types of damage to the DNA.

3 Sometimes these breaks can be repaired, parti-
4 cularly single-strand breaks.

5 If they are repaired, then there may be no
6 long-term effect at all from that.

7 If the damage is replaced by an improper repair,
8 namely, the replacement of certain bases or sugars in the
9 DNA chain in a manner different than that which was
10 originally present, you have essentially caused
11 mutation in a gene.

12 And whatever mechanism the gene regulated in the
13 body, that will be affected in some way, whether it's
14 the production of enzymes or the production of protein
15 for cellular -- for cell walls, for example.

16 The presumption now is that it probably takes,
17 in general, more than one break in a DNA molecule --
18 well, in the pair, to cause a long-term effect.

19 No one really knows why it is that there is a
20 latent period between the time when this damage occurs
21 and presumably there has been some repair made, and some
22 other event which apparently occurs sometime after the
23 initial event, which then induces the uncontrolled
24 growth of the cells to form a cancer.

25 Is that adequate, sir?

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DR. MARRACK: Thank you.

BY DR. MARRACK OF DR. GOTCHY:

Q Would you accept that most of these effects that you've discussed on the DNA might be classed as mutagenic? Or is that not reasonable?

A Might be what, sir?

Q Considered as a class mutagenic.

A They could be considered mutagenic in the genetic material, certainly.

You can have a gene mutation, as you know, in cells which are not part of the genetic pool of a person. In other words, they can't be passed on to their children.

But the ones that are generally involved in the production of cancer are those non-genetic cells which make up the normal tissues of our body.

Q But the cell whose DNA has been damaged, and some of the damage, of course, it retains it. Would it also be transferred to any derivative cells -- daughter cells from that cell?

A Yes.

Q When you referred earlier this afternoon in your answer to Mr. Schuessler that the fetal risk was two to three times higher, what did you mean by "risk"?

A I was talking in particular about the lifetime

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risk of mortality to a fetus as compared to an adult.

It's probably more important in the first trimester than the latter trimester -- or the latter trimesters.

But looking -- the number I gave was an average over the nine months pregnancy for a fetus.

- - -

10-1

1 Q. Was this for external radiation or for isotopes
2 ingested? Radioactive isotopes ingested.

3 A. It wouldn't make any difference. The cell can't
4 tell whether it came from an adjacent cell or even from
5 its own cell. Tritium, for example, would be ubiquitous
6 on all cells in the body. The gamma rays, for example,
7 which might be deposited in a particular organ in the
8 body can nevertheless irradiate other cells in the body,
9 so they really have no way of knowing where they come
10 from.

11 The radiations would produce the same kinds of
12 effects.

13 Q. But if -- does the radiation have the same
14 penetration in tissue or are there differences?

15 A. They are quite different. Beta rays have a
16 much shorter range because they react more rapidly with
17 tissue as they go through it. Beta particles are
18 essentially high-speed electrons. They have a negative
19 charge and as a charged particle, they will interact
20 more strongly with the electromagnetic field of an atom
21 and induce a higher density of ion pairs, then, say,
22 a gamma ray.

23 Q. What about alpha rays?

24 MR. BLACK: Mr. Chairman, this line of
25 questioning is all interesting, but it was supposed to be

10-2

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1 a basis for a question that was germane to the contention
2 and I have not heard such a question yet.

3 DR. MARRACK: That's coming. All right.

4 BY DR. MARRACK TO WITNESS GOTCHY:

5 Q. Now, if you say that the sort of test just
6 now that it didn't matter whether the isotopes were --
7 the radiation was outside or inside, i.e., ingested, is
8 that consistent with the admission that the kind of
9 radiation emitted by the material ingested could differ
10 depending on whether it was an alphabeta or a gamma
11 emitter?

12 A. Yes, sir. The -- what I meant -- what I was
13 talking about was that the type of effect that's caused,
14 namely the production of ion peers along a track are the
15 same, regardless of the origin of the particle.

16 However, in terms of radiation dose, because
17 of the much shorter range of beta rays in tissue, the
18 dose for beta particles will tend to be given -- if they
19 are localized in the organ -- tend to be given to that
20 organ much, to a much higher degree than any surrounding
21 tissues.

22 Q. One of the -- is one of the effects of
23 absorption of radiation the transfer of energy?

24 A. Yes, sir.

25 Q. And does it make any difference as to what

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1 happens in the degree of mutagenic effects on the
2 density of that energy released?

3 A. Yes. The probability of double-stranded breaks
4 would increase as the linear energy transfer increased.
5 And that would increase as a function of the charge in
6 the energy of the particle. Alpha particles having
7 about the maximum amount of energy deposition per unit
8 path length and gamma rays having the least.

9 Q. In that case, do all isotopes and radioactive
10 isotopes emit alpha and gamma radiation?

11 A. No, sir. The nuclides that we would estimate
12 to be released from Allen's Creek would be all alpha --
13 I'm sorry. All beta and gamma emitters. No alpha
14 radiation.

15 Q. But if there is a difference in this, does it
16 not matter which radioactive isotopes are absorbed by
17 the child or any other person for that matter, as to
18 whether it's an alpha or gamma or beta emitter?

19 A. Quite often they are both. However, for some
20 of the more important nuclides, like Tritium and carbon-14,
21 that are pure beta emitters, and in the case of cesium,
22 for example, emitting both beta and gamma rays.

23 Q. And iodine isotopes?

24 A. Iodine emits both beta and gamma radiation.
25 The dose, for example, on thyroid from iodine is -- the

10-4

1 reason that is higher than it is for the average tissue
2 in the body is because the -- well, as you know, the
3 iodine is concentrated in the thyroideal thyroxine
4 in the thyroid and the dose that's delivered to the
5 thyroid by the beta rays are absorbed almost entirely
6 by the thyroid.

7 Q. I see. Are there differences in the ability
8 of thyroid cells as commonly seen to take up I-131
9 depending upon the age of the person?

10 A. Yes.

11 Q. In what way?

12 A. Well, typically, the smaller the thyroid and
13 the higher the basal metabolic rate, the more rapidly it's
14 accumulated so that, for example, in a child with a 2-gram
15 thyroid, and a higher metabolic rate than an adult, they
16 would tend to have higher concentrations of iodine in
17 the thyroid than an adult.

18 Q. Does this have any implications in the
19 expectation of thyroid tumors in a child or a fetus
20 absorbing I-131 compared with an adult absorbing I-131?

21 MR. BLACK: Mr. Chairman, I'm waiting to hear
22 with tremendous anticipation this logical hook-up that
23 we have seen involved in this tremendous series of
24 questions on health effects of radiation. As stated
25 before and stated again, health effects of radiation is

10-5

1 not part of this testimony. It is totally in response
2 to Bishop 12 and Bishop Contention 21. Bishop Contention
3 12 deals with the ingestion of contaminated water that
4 may seep out of the cooling lake. Bishop Contention 21
5 deals with the accumulation, the bioaccumulation of
6 radioactive materials in the cooling lake and this series
7 of question has wondered far afield of that, and it's
8 more appropriate for rule making for Appendix I.

9 DR. MARRACK: Your Honor, the witness has made
10 the statement that there is a fetal risk difference. I'm
11 trying to pin down where these differences lie, and I'm
12 pursuing one of them, the thyroid, at the moment.

13 MR. NEWMAN: Mr. Chairman, could the Chair
14 ask Dr. Marrack what point he is trying to make with --
15 the point or points he is trying to make that bear on
16 Bishop Contention 12 or Bishop Contention 21.

17 JUDGE WOLFE: All right. Doctor?

18 DR. MARRACK: I'm calling up the answer of the
19 witness which -- he addressed the fetal risk problem and
20 I'm trying to find out why there are differences and what
21 these differences are. And this -- I think it's germane
22 to the drinking water and whether it matters or doesn't
23 matter whether these isotopes are in them.

24 JUDGE WOLFE: Yes. But the contention only
25 relates to the hazards from the ingestion of radioactivity

10-6

1 as it is -- into the pool itself, or into the aquifer.
2 Your questions, while interesting, certainly have to be
3 directed to that contention or contentions.

4 Now, we have given you leeway, and now I think
5 it's time to direct your attention and your questions to
6 the thrust of the contentions themselves.

7 DR. MARRACK: Your Honor, the last bit of
8 contention Bishop 21 presenting an unacceptable hazard
9 to humans -- and we had estimates of hazards and I'm
10 trying to pin down some of the aspects of that hazard.

11 JUDGE WOLFE: Which contention are you reading?

12 DR. MARRACK: Bishop 21, presenting an
13 unacceptable hazard to humans.

14 MR. BLACK: Mr. Chairman, that's reading
15 Bishop Contention 21 out of context. The thrust of
16 Bishop Contention 21 is the build-up of radioactive
17 material in the cooling lake over time.

18 JUDGE WOLFE: Yes. I think that, Doctor, you
19 have read the summarized version of Bishop 21 rather than
20 the full -- rather than the original.

21 What appears at the Staff's -- page 2 of the
22 Staff's testimony is a summarization of the contention.

23 DR. MARRACK: Sir, the full one even makes it
24 more obvious. I submit, "Radioactive material is known
25 to be hazardous to humans, particularly to children-expectan

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1 mothe-s." I'm trying to find out exactly why there is
2 his difference and to then determine whether the, in fact
3 the calculations made are reasonable in respect of this.

4 JUDGE WOLFE: But the contention itself, if read
5 fairly does not extend to all radioactive materials
6 through --

7 JUDGE LINENBERGER: Dr. Marrack, I'm afraid the
8 problem we are having -- all of us are having here has to
9 do with the consideration of doses of materials in the
10 lake on people near the lake or using the lake.

11 Now, you have a concern because it has been
12 stated that children and fetuses are more susceptible to
13 radiation. The logic of that concern in the context of
14 this contention lies solely in the consideration of whether
15 the kinds of calculations that Dr. Gotchy's testimony
16 reports on adequately took account of effects on
17 children and fetuses.

18 But to ask what is the nature of the mechanisms
19 that makes those affects different goes outside of the
20 contention and that is the problem that we are all having
21 when you get into cellular effects of betas and gammas on
22 human tissue.

23 So, it is fair game to inquire how the
24 calculations took account of the facts that the
25 representative population included infants and fetuses,

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1 but it is not fair game for you to go into the mechanisms
2 of radiation on these -- of radiation effects. Only the
3 dosages and were they accounted for in the calculation
4 presented by Dr. Gotchy's testimony.

5 Is that distinction understandable to you?

6 DR. MARRACK: Only in part, sir, because I don't
7 see how you can separate out the pieces of the calculation
8 from their effects. If you don't understand the process
9 of concentration and sensitivity of tissues and the
10 differences therein, I don't see how you can make the
11 calculation.

12 JUDGE LINENBERGER: Well, then in that
13 situation, rather than a long involved question and
14 answer marathon with the witness here on how much he
15 knows, why don't you ask him explicitly were these things
16 accounted for and try to find out whether the calculations
17 he reports on adequately reflects the presence of young
18 people or fetuses in the -- in discussing the dosage
19 results.

20 BY DR. MARRACK TO WITNESS GOTCHY:

21 Q. Did your calculations treat the -- each nuclide
22 that may be present from this hypothetical plot as a
23 separate entity and calculate the doses for each of these
24 separately, including their -- or did you calculate them
25 separately? Just start with that part.

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1 A. The calculations that I made are calculations of
2 radiation doses. Now we calculated doses to infants,
3 children -- infants being defined as from new-borns to
4 one-year old, less than one year old -- and to children,
5 teen-agers and adults. We did not calculate doses to
6 fetuses.

7 Q. Did you calculate these doses as whole-body
8 or as specific tissue doses?

9 A. Whole.

10 Q. I see.

11 A. The models that we use take into consideration
12 concentration, bioaccumulation, if you will, of certain
13 radionuclides within specific organs like the thyroid
14 for Iodine 131 and, for example, Carbon-14 in bone
15 because of all the carbonate present there. Those are
16 all considered in the dose models and determining the
17 distribution of dose in each of the age groups, with
18 the exception of the fetuses which are not one of the
19 groups that were considered.

20 Q. Why were they not considered?

21 A. I guess probably because the dose tends to be
22 lower to a fetus from -- when you look at the dose from
23 all radionuclides released, they tend to be lower in the
24 fetus than they would be in one of the other groups.
25 This is because one, the fetus doesn't directly inhale

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1 radioactivity, it doesn't directly ingest radioactivity
2 itself and the transfer of several nuclides from the
3 mother to the fetus are restricted, as you know, by
4 placental barriers in some cases, and so I guess that's
5 probably the reason they did it. I didn't develop the
6 model.

7 Q. Do you know of any materials which might be
8 radioactive which are in fact concentrated by the placenta
9 and transferred and selectively partitioned into the
10 fetus?

11 A. I'm sorry, I can't hear you, sir.

12 Q. Do you know of any radionuclides or compounds
13 of those which might be present in these hypothetical
14 waters and which are specifically concentrated by the
15 placenta and partitioned selectively into the fetus?

16 A. No, I'm not. Iodine is one that has been
17 found, at least in animal systems to accumulate -- well,
18 primarily in the third trimester of pregnancy when the
19 organogenesis of the thyroid is really taking -- the
20 thyroid is really becoming an organ that is active. I
21 can't think of any others that might be concentrated to
22 a greater extent in a fetus than it would be in the
23 parent.

24 The Iodine 131 is one which -- well, the studies
25 I've seen indicate that the doses to a fetal thyroid

10-11

1 could be in the range of, perhaps, two to ten times that
2 of the mother, depending on what stage in the pregnancy
3 the fetus was at.

4 Q. Was it your opinion that fostering tissues
5 might be more sensitive to radiation than non-growing
6 tissues?

7 MR. BLACK: Mr. Chairman, here we go again.
8 We are not looking at calculated doses, we are looking
9 at health effects from those calculated doses. It's still
10 certainly beyond the extent of direct and I object.

11 JUDGE LINENBERGER: Dr. Marrack, I think we are
12 back again on a similar line of questioning of health
13 effects versus radiation doses to be expected, and it is
14 certainly a privilege to attempt to find where radiation
15 doses might have been improperly reckoned with, but to
16 concentrate on health effects of those doses, as this
17 line of questioning seems to be doing, is outside of the
18 Bishop Contention, the health effects. Dosage is not,
19 health effects are.

20 DR. MARRACK: Have the witnesses admitted that
21 the calculations did not consider fetuses and I'm hoping
22 to show that, in fact, fetuses do accumulate certain
23 isotopes and that in preference, if you wish, and that
24 these calculations ought to have been part of their
25 consideration in the contentions, and their calculations

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1 thereto.

2 JUDGE LINENBERGER: In that vein then, I suggest
3 that your questioning to the witness be in the direction
4 of pressing him for why it is his results are perhaps
5 inadequate because they may have ignored these things
6 and, therefore, when they should have taken account of
7 them, but the health effects per se, and the interaction
8 of radiation with tissue is outside of our -- outside of
9 this contention so if you think what he has done is
10 inadequate, rifle in on that, but try to stay away from
11 the radiation effects and interaction with tissue.

12 DR. MARRACK: Well, sir, I thought I was asking
13 about whether there was concentration, not whether the
14 radiation made any difference, where the fetuses, in
15 fact, concentrated certain radioactive isotopes and all
16 their derivatives, the compounds with them.

17 JUDGE LINENBERGER: I can only repeat myself,
18 Dr. Marrack. If you think his results are lacking in
19 some way, focus on that and try to bring it out.

20 BY DR. MARRACK TO WITNESS GOTCHY:

21 Q. If you were going to redo these calculations
22 would you not include the potential effects on fetuses
23 as part of your risk calculation?

24 A. Probably not. I guess the reason I say that is
25 because even though, in general, more rapidly

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1 proliferating tissues, such as would be present in a
2 fetus, tend to be more sensitive to the effects of
3 radiation. The available evidence shows that exposures
4 of fetuses, fetal thyroids for example, apparently have
5 no demonstrable increase in risk of thyroid cancer after
6 the fetus is born. The major cause of the increase risk
7 from fetal radiation is primarily from the radiation of
8 the whole body to the fetus by organs that tend to give
9 whole-body doses, like Iodine, cesium 134 and 137, which
10 tend to be distributed fairly uniformly in the mother
11 and the child. And the dose to the fetus would be such
12 the same in that case as it would be to the mother.

13 Q. In answering that question, did you consider
14 the unfortunate experiment, human experiment of the
15 Marshall Island extent?

16 A. The -- well, are you talking about the thyroid
17 doses?

18 Q. Well, what happened?

19 A. (No response.)

20 Q. You stated that the effects were whole-body
21 radiation, the major effects on fetuses.

22 A. From the nuclides released by this plant --
23 it's not a nuclear weapon, it's a nuclear power plant.

24 Q. I understand that, but one of the most
25 specific -- would you consider the Marshall Island

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1 accident one of the most specific human experiments and
2 defined human experiments unfortunately occurred, in
3 radiation biology that ever occurred?

4 MR. BLACK: Mr. Chairman, I would like to
5 inquire as to the relevancy of the Marshall Island
6 experience as to the calculated doses that are at issue
7 here.

8 DR. MARRACK: Can I answer that?

9 JUDGE WOLFE: Yes.

10 DR. MARRACK: Do you know how many of the
11 children under 10 who were --

12 JUDGE WOLFE: Hold on. You have to respond
13 to Mr. Black.

14 DR. MARRACK: I was. I was going to ask him
15 the rest of that question, basically.

16 The relevance of this is because a very
17 specific set of circumstances occurred here and we now
18 have some 27 years or thereabouts of polarized data
19 on these unfortunate individuals and some very
20 unfortunate things happened to the children under 10
21 who were exposed and I think the assessment, the major
22 consideration I'm trying to get from the witness, the
23 assessment that the -- just considering whole-body
24 radiation is an adequate assessment of the consequences
25 and risks therefore of exposure to mixed nuclides.

10-15

1 MR. BLACK: Mr. Chairman, that goes directly
2 to my point. I think Dr. Marrack is -- his whole line
3 of questioning is dealing with health effects and not the
4 calculated doses. Perhaps if I could just offer a
5 general summary of what -- which may help Dr. Marrack or
6 anybody else that would care to risk, but -- and perhaps
7 put Dr. Gotchy's testimony in context, but given the
8 fact that we have the nuclear power plant here, that
9 nuclear power plant will emit certain radionuclides.
10 Those radionuclides are termed, or what we consider to
11 be source terms.

12 Dr. Gotchy indicated previously to you, Dr.
13 Marrack, that he is not the one that calculates source
14 terms. Those are a separate group of individuals, they
15 calculate source terms in accordance with a computer
16 model, taking into account the different nuclear power
17 plants, the different equipment in that nuclear power
18 plant.

19 Dr. Gotchy's testimony is related to taking
20 those source terms and calculating the dose which is
21 intended to apply to maximum individuals. The thrust of
22 these contentions is that those calculated doses are
23 mis-calculated because, number one, the calculated does
24 not take into account radioactive seepage which will --
25 which may tend to contaminate ground water; number two,

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1 that calculated dose is mis-calculated because it does
2 not account for the radioactive build-up around the
3 cooling lake over time.

4 You are trying to take it one step further and
5 taking those calculated doses and applying it to get
6 certain health affects. And the health affects and source
7 terms are outside the scope of this direct testimony.

8 And I think that we should make that perfectly
9 clear. If we thought that we were admitting a
10 contention on health affects, I can assure you that we
11 would remove it with all great haste. I can assure you
12 of that.

13 JUDGE WOLFE: Dr. Marrack, does Mr. Black's
14 statement, which obviously is not testimony, but
15 nevertheless, is intended to clarify the thrust of the
16 contention, does that serve to clarify what is and should
17 be the sort of questions you address to Dr. Gotchy?

18 DR. MARRACK: Only in part, sir, because the
19 game we are back at this situation, the witness says that
20 the main effect of the anticipated radiations is the
21 whole-body effect, and I'm trying to see how these
22 calculations that are presented and their consequences
23 presented here are I consider of a rather peculiar
24 situation, and in this case, I wish to consider the
25 thyroid and for which we have some rather interesting

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1 knowledge.

2 And I don't see how you can make a calculation of
3 risks if you don't know what's happened about not using
4 the data that's available, about what happens in thyroids
5 in infants and children.

6 MR. BLACK: Mr. Chairman, the short answer to
7 that as far as the Staff is concerned is that the
8 calculation of doses is entirely different from the
9 consequences of those doses and what is at issue here, I
10 repeat, is just the calculation of those doses.

11 MR. SCOTT: Can the Court Reporter hear me?

12 Assuming she can, I will point out that the
13 bottom line of contention, Bishop Contention 21 is that
14 this accumulation of radioactive material will increase over
15 time, presenting an unacceptable hazard to humans.

16 Surely the consequences are important in
17 determining the hazard.

18 MR. NEWMAN: Mr. Chairman, I can't let that
19 pass. The substance of this contention is not radiation
20 hazards in general. It's that degree of hazard brought
21 about by the accumulation of radioactive material over
22 a time in the cooling lake. And the question is whether
23 or not the NRC Staff has appropriately accounted for the
24 radioactivity seeping through the cooling lake and for the
25 radioactivity that may concentrate in the cooling lake.

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That is the sole question or those are the sole questions presented by Bishop 12 and Bishop 21 and he has wasted now, the better part of 50 minutes, exploring this entirely fruitless area of the effects of radiation on fetuses, on pregnant mothers and Lord knows what else.

DR. MARRACK: I think I was quite specific to which I was considering.

JUDGE WOLFE: All right. We've heard enough before ruling.

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(Bench conference.)

JUDGE WOLFE: Mr. Black, in conference the Board has been discussing -- it would seem that -- at least your position would seem to be a very restrictive one as contrasted perhaps to the Applicant's.

Your position seems to be that Bishop Contention 21 is only directed toward the subject matter in issue of miscalculation of doses.

Applicant's on the other hand -- by contrast, I should say -- would seem to be a little bit wider than your position; namely, that the contention relates to adverse health effects of radiation, but only to the extent that the radiation is directed and results ... to inadverse effects on humans, if ... as a result of the -- anybody being at or near the cooling lake.

And, obviously, Dr. Marrack's interpretation of Contention 21 opens up the entire vista of the adverse effects of radiation, whether it be through the food chain, whether it be through water, whatever -- or gaseous adverse effects.

I'm just wondering whether there is no consensus here at all as to the parties' interpretation of Bishop 21.

MR. NEWMAN: If I may, I think that the substance of Bishop Contention 21 is as admitted and discussed

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1 by the Board in its Order of March 10, 1981 at page 63.

2 If the Chair would wish me to wait before
3 going on --

4 JUDGE WOLFE: No.

5 MR. NEWMAN: In any event, in discussing the
6 contention, the Board stated that the petitioners --
7 I'm paraphrasing -- alleged that radioactive material will
8 build up in the sediment of the lake, that bottom-feeding
9 fish will accumulate rapidly -- excuse me -- more radio-
10 activity than the Applicant calculated; and that human
11 consumption of fish will lead to larger doses of radiation
12 than are allowed by 10 CFR 50.

13 While Section 5.4.2.2 of the FE-ES reported
14 the maximum individual dose to be 1.4 millirems per
15 year (well within the criteria in 10 CFR 50, Appendix I),
16 the alleged concentration phenomenon has not been
17 definitively discussed.

18 This portion of the contention is admitted.

19 I submit to you --

20 JUDGE WOLFE: What page is that?

21 MR. NEWMAN: I'm now reading at the bottom of
22 62 and just at the top of 63, Mr. Chairman.

23 (Bench conference.)

24 JUDGE WOLFE: What do you derive from that?

25 MR. NEWMAN: I derive from that, Mr. Chairman,

1 that the nature of the contention, as admitted by the
2 Board, is limited to the concentration phenomenon in the
3 cooling lake and not to the effects of whatever radioacti-
4 vity may be released on human beings.

5 JUDGE WOLFE: Your interpretation does go beyond
6 just questioning the miscalculation of dosage.

7 MR. NEWMAN: I don't believe it has really any-
8 thing to do with the miscalculation of doses, except inso-
9 far as the contention puts into question the degree of
10 concentration of radioactive material that may occur in
11 the cooling lake or seep through the cooling lake.

12 I think the question that's being put here is
13 whether or not the seepage in Bishop 12 -- whether the
14 seepage has been adequately accounted for.

15 And the question put in Bishop 21 is whether the
16 concentration phenomenon has been adequately accounted
17 for.

18 And so it's the physical phenomenon of the
19 release of these radioactive materials that's at issue,
20 and not the health effects of those releases, assuming
21 that they occur.

22 JUDGE WOLFE: I --

23 MR. BLACK: Mr. Chairman, I believe that's
24 consistent with what I thought I told you.

25 (Laughter)

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1 MR. BLACK: Whether it's the seepage phenomenon
2 or the concentration or the buildup phenomenon, to me it
3 applies to whether the Staff has calculated the doses
4 correctly and given adequate consideration to seepage,
5 as well as to concentrations.

6 In Bishop 21 it says "Presenting an unacceptable
7 hazard to humans." To me that's a mere conclusion based
8 upon the basis of the contention. It has nothing to do
9 with the contention itself.

10 DR. MARRACK: Your Honor, I have page 27 of
11 the document, which I think was July 18th, which is
12 "Cooling Lake/Radioactivity, Bishop 21"--

13 JUDGE LINENBERGER: Yes, we have that.

14 DR. MARRACK: And the second paragraph there
15 below the line, "I contend the Applicant," etcetera --

16 JUDGE LINENBERGER: Yes.

17 DR. MARRACK: -- seems to go a good deal wider
18 than anything either counsel has said.

19 The, 've said quite clearly that the lake is an
20 attractive hazard. In fact, it goes on to recognize
21 that there's a problem of expectant mothers ... and we
22 learn that these weren't even considered in the cal-
23 culations made here on the radiation exposure.

24 JUDGE LINENBERGER: Well, the whole thing comes
25 down -- still -- to the question of whether or not the

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1 individual dosages from various pathways have been ac-
2 curately calculated, and goes not to the question of
3 whether the health effects of those calculated doses for
4 some reason might be worse than was otherwise assumed.

5 That is clearly, decisively, plainly outside
6 the scope of this contention -- this testimony and this
7 cross-examination and must remain outside of it.

8 If the radiation levels and dose levels had
9 been properly calculated, that is the question we have to
10 address. It does include expectant mothers.

11 It does include the effects of concentration by
12 fish of radioactive species or sediment of radioactive
13 species.

14 But if those calculated doses are done cor-
15 rectly and somebody wishes to claim that the nature of the
16 fetus is such that that dose impact -- the health impact
17 is worse than has been previously realized, we absolutely
18 must not get into that.

19 That is a completely separate consideration that's
20 not before us.

21 We have to stick with whether the doses have
22 been properly calculated, and nothing beyond that.

23 That's --

24 DR. MARRACK: Your Honor, would you -- in
25 considering the quality of the calculations, that part of

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1 that should include whether the calculations included the
2 ability of certain tissues -- or waters, for that
3 matter -- to concentrate one or more of the radioactive
4 radionuclides?

5 Is that not part of this consideration and those
6 calculations?

7 JUDGE LINENBERGER: If, first, you can establish
8 a basis, Dr. Marrack, for that mechanism resulting in a
9 higher dose than had been calculated.

10 Now, let me explain myself. You were talking
11 about the ability of certain tissues to concentrate certain
12 radionuclides.

13 If they do that, the tissues will receive a
14 higher dose than had they not concentrated those radio-
15 nuclides.

16 But in order to get into that topic, you have to
17 establish a basis for that by showing that from the lake --
18 from this powerplant those radionuclides are available to
19 those tissues to be concentrated.

20 And so when you ask about Marshall Island kinds
21 of things, in a back-door manner and in a peripheral
22 way try to find out what the witness knows about these
23 kinds of things, that's very indirect. It leaves the
24 record in a shambles.

25 I repeat myself: If you can establish a basis

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1 that says a certain radionuclide can get to these tissues
2 which can concentrate it.

3 And, therefore, a question to the witness:
4 Does that not result in a higher dose than has been
5 calculated?

6 Then that is fair examination.

7 But we have not seen you quite doing that so
8 far.

9 So please come directly to the point. Find out
10 what the nuclides are that you -- State what the nuclides
11 are that you're concerned about.

12 Find out whether you and the witness agree
13 that these are available to a fetus or to some kind of
14 tissue. Then rifle in on whether the witness agrees with
15 you that these can result in higher doses than he has
16 calculated.

17 If you can put him on that spot, you have made
18 a very valid point. But when you talk to him about how
19 radiation impacts the health of tissues, that is out of
20 bounds.

21 DR. MARRACK: Having already made the point that
22 the fetus was not considered in these calculations,
23 sir?

24 (Bench conference.)

25 DR. MARRACK: Is that in the record already?

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(Bench conference.)

JUDGE WOLFE: All right, Doctor. With that limitation in mind, proceed with your cross-examination.

BY DR. MARRACK OF DR. GOTCHY:

Q Do you have some reason to believe that pregnant women will not be in the vicinity of this lake and will not use it as a recreational area?

A I have no reason to believe they would not.

Q Might they take part in contact sports in this proposed lake?

A I'm sorry?

Q Might these pregnant ladies take part in contact sports in this proposed lake?

A Would you care to define "contact sport"?

(Laughter)

Q Well, water skiing. That is in fact an EPA definition or concept.

Water skiing, swimming, any mechanism which brings the water in contact with the body or inside the body.

A Yes. I would anticipate that during certain parts of their pregnancy that they could water ski and swim and fish.

Q Why the limit of some part of the pregnancy, please?

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1 A Well, toward the end of the third trimester, it
2 gets a little tricky to have pregnant women -- a couple of
3 weeks before delivery running around water skiing.

4 Q What about swimming?

5 A I don't know. At least when my children were
6 developing, the doctor advised against my wife swimming
7 and that sort of thing for the last few weeks, in the
8 event that there was some damage to the placenta or to the
9 membranes which might permit some water to enter into --
10 to reach the fetus from outside the body.

11 Q Is that a current medical opinion?

12 A I'm sorry?

13 Q Is that a current medical opinion? Or are you
14 qualified to give a medical opinion?

15 A That's what the doctor told me at the time my
16 children were --

17 Q So it's hearsay, sir.

18 Would you recognize then that the fetus does
19 represent a special risk which is not considered in the
20 calculations presented?

21 MR. NEWMAN: I'm going to object to that
22 question again, Mr. Chairman. It goes to the effects
23 of radiation on a given organism, not to the question of
24 what the concentration of materials will be at the
25 lake.

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1 BY DR. MARRACK OF DR. GOTCHY:

2 Q Would you agree that the calculations did not
3 contain that component of risk which would arise for
4 pregnant women --

5 MR. NEWMAN: What calculation are you referring
6 to, Dr. Marrack?

7 DR. MARRACK: The calculation the witness is
8 referring to.

9 MR. NEWMAN: Which is that?

10 DR. MARRACK: The calculation of risk which he
11 refers to.

12 MR. NEWMAN: Identify that for me --

13 DR. MARRACK: Earlier the witness referred to
14 the fetal risk being two or three times higher. And now
15 we have the evidence that this fetal risk was never
16 considered in fact in the calculations.

17 MR. NEWMAN: That was at a time when you took
18 him on an excursion beyond the scope of this cross-
19 examination, beyond the scope of the direct, beyond the
20 scope of the contention.

21 DR. MARRACK: Mr. Counsel --

22 Your Honor, sir, may I point out to the counsel
23 that that fetal risk answer was an answer to Mr. Schuessler,
24 not to me.

25 I just picked it up and was following it.

1 MR. NEWMAN: That was likewise an excursion
2 beyond the scope of the direct.

3 DR. MARRACK: If he wants to object to it,
4 fine --

5 MR. SCOTT: These are opinions by attorneys
6 about what is competent evidence well after it is in
7 the record.

8 JUDGE WOLFE: Well, at any time obviously the
9 Board itself may call a halt even to a line of question-
10 ing, despite what has come into the record, even though
11 unobjected to.

12 (Bench conference.)

13 JUDGE WOLFE: The objection is sustained. It
14 goes beyond our ruling as bounded by Judge Linenberger.

15 However, Doctor, if you wish, you may ask the
16 witness if it's his opinion that no significant oversight
17 has occurred because dosages to fetuses were not included
18 in the calculation.

19 If you wish, the witness may answer that
20 question.

21 DR. MARRACK: All right, sir.

22 Before that, would you state the basis for this
23 objection, please, clearly? I don't think I follow that
24 yet.

25 JUDGE WOLFE: I'm sorry --

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1 DR. MARRACK: Would you repeat the basis on
2 which this objection is made? I'm not sure it's precise
3 in my mind exactly what the objection is

4 JUDGE WOLFE: Applicant's counsel's objection?

5 DR. MARRACK: The basis of the Board's ruling --

6 JUDGE WOLFE: It was based on Applicant
7 counsel's objection.

8 DR. MARRACK: I see.

9 In spite of the fact that the contention says
10 here --

11 JUDGE WOLFE: We've made our ruling now,
12 Doctor.

13 DR. MARRACK: Would you note my objection,
14 please.

15 JUDGE WOLFE: Objections are not necessary.
16 Any appeal of the transcript will take into account the
17 differing opinions of counsel and the ultimate Board
18 ruling.

19 DR. MARRACK: Thank you, sir.

20 JUDGE WOLFE: Would you like that question to
21 be addressed?

22 DR. MARRACK: Yes, sir, please.

23 JUDGE WOLFE: Did you hear my question?

24 DR. GOTCHY: No, sir.

25 JUDGE WOLFE: Is it your opinion that there has

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1 been no significant oversight in assessing population
2 doses because fetuses were not included in the cal-
3 culation?

4 DR. GOTCHY: No, sir.

5 I can amplify that, if you like.

6 JUDGE WOLFE: All right.

7 DR. GOTCHY: The reason it's not a significant
8 omission is because for -- although there are over five
9 dozen radionuclides identified in the source term, there
10 are only a few nuclides which significantly contribute
11 to dose of people using water.

12 And those are primarily from tritium, cesium-
13 134 and cesium-137.

14 Certainly, for some of these radionuclides that
15 were identified, some will be concentrated to higher
16 levels in the fetus than they would be in an adult. But
17 they don't contribute anything significant to the dose
18 at any rate.

19 The major risk associated with fetal radiation
20 is, in my judgment, not specific organ doses (although
21 they are calculated for all of the other age groups), but
22 the whole body doses, because the risks are 10 to 50
23 times higher per unit of dose than they would be for
24 any given organ.

25 Now, in the case of cesium-134, 137 and tritium,

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1 those nuclides are distributed fairly uniformly in both
2 the mother and child.

3 The mother's dose would be accounted for as an
4 adult, so there's no reason to assume that the dose to the
5 fetus would be significantly higher.

6 DR. MARRACK: Would the witness give us the
7 percentage of the contribution from each -- the tritium,
8 cesium-134 and 137.

9 DR. GOTCHY: I'm sorry, sir.

10 BY DR. MARRACK OF DR. GOTCHY:

11 Q Could you give us the percentage of the dose
12 from the tritium, the cesium-134 and 135?

13 A I don't have the calculations here with me
14 today.

15 The calculations -- I have seen calculations.
16 I have done my own calculations.

17 Typically, the tritium accounts for a few percent
18 of the dose, and the cesium-134 and 137 collectively
19 account for 80 or 90 percent of the dose.

20 And the other nuclides individually account
21 for less than one percent of the dose each, much less than
22 one percent of the dose each.

23 In other words, these three nuclides would
24 generally account for somewhere in the neighborhood of
25 90 percent of the total dose to the total body.

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1 Q That statement is whole body dose; is that
2 right?

3 A Yes, sir.

4 Q I see.

5 You used the word in your answer -- the second
6 one prior to that, "significant." I wondered what you
7 meant "significant" in this sense.

8 A Within the kinds of bounds that we have in
9 calculating doses -- the doses, you know, are probably
10 within a factor of two or three, that these kinds of
11 uncertainties would lead to differences in dose which
12 would, in my judgment, be less than a factor of two
13 in themselves.

14 So it would not significantly change the un-
15 certainty that is inherent in all of these calculations.

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1 Q Would you give us some idea of the range of
2 uncertainty in these calculations?

3 A Well, as I said, given a particular radionuclide
4 concentration which we would calculate, and exposure for those
5 pathways, the kinds of uncertainties involved are on the order
6 of factors of two or three, in my judgment.

7 Q Two or three times, you mean?

8 A They could be, perhaps, two or three times higher
9 or two or three times lower.

10 However, I will point out that because we looked
11 at the maximum kind of individual dose for the pathways that
12 would exist at the lake, in most cases the dose to average
13 people would be considerably lower than that, because their
14 consumption of fish and, for example, water would be much lower
15 than for this maximum hypothetical person.

16 Q In doing these calculations was site specific data
17 used, or is it some other source of generalized data?

18 A I am sorry. I did not understand the question.

19 Q In making this calculation did you make site
20 specific calculations, or are they as a general consideration
21 of this size --

22 A They are site specific in terms of the hydrology
23 recirculation of water in the cooling pond through the reactor
24 and the specific source germs, the health effects, or the dose
25 models that we used are the same for all sites.

1 In other words, the consumption consumed is the
2 same. It is site independent.

3 Q You consider an average population in these
4 claculations. You have also told us that there are genetic
5 difference, or the effects are through genetic courses.

6 Are there genetic differences between people, or are
7 people all the same in responsiveness?

8 MR. NEWMAN: Mr. Chairman, I think we are again now
9 in the area of the health effects of radiation. This time we
10 have moved from the sematic effects to genetic effects, and the
11 net result is the same. We are not addressing Mr. Bishop's
12 Contentions 12 or 21.

13 DR. MARRACK: The witness is citing one genetic
14 effects as having a difference sensitivity on the instance of
15 cancers, Mongoloids, that genetic disease, and I am asking if
16 he knows whether there are other genetic diseases, i.e., in the
17 population generally.

18 JUDGE WOLFE: Whether there are other what, doctor?

19 DR. MARRACK: Other genetic diseases which make a
20 person particularly sensitive to radiation, sensitive in a
21 sense of developing cancers.

22 MR. NEWMAN: Mr. Chairman, this is exactly the type
23 of question that is outside the bound of proper cross-
24 examiantion per the Board's Order.

25 (Bench conference.)

1 JUDGE LINENBERGER: There has been earlier mention
2 of special segments of society in the area that may be atypical
3 with respect to the average individual, and there has been
4 mention that certain types of afflicted people seem to be known
5 to be more susceptible to radiation, and that has come into the
6 record. And it came into the record because the Board was not
7 holding a tight enough rein on the testimony. It goes, again,
8 to the subject of health effects, and ultimately to the question,
9 really.

10 I think, Dr. Marrack -- think about this a moment --
11 doesn't this line of questioning ultimately go to the
12 consideration is the Commission's radiation and permissible
13 dosage levels sufficient when one considers that there may not
14 be such a thing as an average individual? Isn't that what this
15 really getting at, that there are certain types of tissues or
16 certain types of people that don't react in an average way to
17 radiation, and, therefore, the Commission's radiation tolerances,
18 radionuclide levels, --

19 Mr. Scott, I am talking directly to Dr. Marrack. I
20 should very much appreciate it if you would allow him to listen
21 to me. Thank you, sir.

22 So when we get into the consideration of these
23 special affects of radiation on tissue, if the dose has been
24 calculated correctly we are going into an area that we are not
25 statutorily or procedurally permitted to go into absent a special

1 showing, and before another forum; namely, are the release
2 limits, the dose limits, and the Commission's Regulations
3 adequate. We can't get into that, and that is exactly where
4 it takes us when we insist on talking about the effects of
5 radiation on Mongoloids, the effect of radiation on certain
6 tissues or certain organs, even though the doses may have been
7 calculated correctly.

8 We can only go to the question are the doses
9 calculated correctly; not might there be special effects on
10 special samples.

11 I'm sorry. We have to hold the line here.

12 DR. MARRACK: Sir, we have already in the record
13 recognized one of these, and there was some -- another one was
14 the Jewish female --

15 JUDGE LINENBERGER: Yes. I said we did not hold
16 the line tightly enough there when that was coming in. That
17 was our transgression.

18 DR. MARRACK: Did I understand you to agree that
19 fetal risks should have been considered and it was not, or --
20 I dropped part of what you said.

21 JUDGE LINENBERGER: What I said was that if we go
22 beyond the question of whether or not doses have been properly
23 calculated, then we are into the arena of whether the
24 Commission's Resulations on permissible doses is adequate, and
25 that is an arena that this Board does -- that's a topic, that's

1 a whole area that this Board is not empowered to consider.

2 I am not saying that it cannot be considered
3 legally, but not in front of this Board; before a different
4 forum.

5 DR. MARRACK: May I inquire further, then, sir,
6 may the question of whether the group already recognized, the
7 Mongoloids, and the potential possibilities of getting exposed
8 by going to this State Park, is that outside consideration now?

9 JUDGE LINENBERGER: I'm sorry. I just plain
10 didn't understand your words.

11 DR. MARRACK: The witness thought, expressed the
12 opinion that he -- that Mongoloids probably would not be using
13 this park very much because they would need adult supervision,
14 and I am asking is this a matter which the Board is able to
15 consider or is not able to consider?

16 (Bench conference.)

17 MR. NEWMAN: Mr. Chairman, I will submit that until
18 it is established that the basic dose calculations are wrong,
19 there is no issue with respect to health effects put by Bishop
20 12 or Bishop 21, and it is that point which Dr. Marrack refuses
21 to explore.

22 DR. MARRACK: Your Honor, --

23 JUDGE LINENBERGER: In answer to your question,
24 Dr. Marrack, you put a question to me which I left unanswered.
25

1 It somewhat parallels what Applicant's counsel just
2 said. Absent some basis for believing that the dose
3 calculations, some basis for believing that the dose
4 calculations are incorrect, the answer is no, this tribunal
5 may not look specifically at the Mongoloid element of the
6 population, or any other special element of the population.

7 And, indeed, if there is a showing that the dose
8 calculations are incorrect, fine, we will recognize that and
9 require that they either be done, or the plant not be built, but
10 we will, again, not go into special sections of the population.
11 That is a health impact area of litigation that we are not
12 empowered to enter into.

13 DR. MARRACK: Could I refer you to Table S.5.14.
14 The footnote at the bottom of that table, "...Appendix 1,
15 10 CFR Part 50," it talks about considering maximum doses to
16 individuals.

17 JUDGE WOLFE: What page was that, again?

18 DR. MARRACK: It is Page S.5-27, and it is
19 Table S.5.14.

20 JUDGE WOLFE: What was your --

21 DR. MARRACK: It says that he was considering --
22 the footrote -- maximum doses to individuals.

23 JUDGE WOLFE: Right.

24 DR. MARRACK: We are having to consider doses to
25 an average, hypothetical average.

1 MR. NEWMAN: Mr. Chairman, that footnote relates to
2 the substantive basis upon which Appendix I is based. I think
3 Dr. Marrack is, once again, confused. I think if he wants to
4 take issue with that table, then in fact he is mounting the
5 very challenge to the regulations that you referred to, Judge
6 Linenberger.

7 (Bench conference.)

8 JUDGE WOLFE: All right. We must abide by our
9 ruling, Dr. Marrack.

10 We will now recess until 9:00 a.m. in the morning.
11 I understand now that we will go back to cross-examination of
12 Dr. Schlicht Dr. Tischler, and Dr. Armstrong.

13 I have no -- I cannot advise the Intervenors on
14 Dr. Marrack, for example, when resumption will begin the
15 cross-examination of Dr. Gotchy. I take it that he will not
16 return now -- won't be able to return now until Monday; is that
17 correct? Not Monday, but until February 2; is that correct?

18 MR. BLACK: I am not even certain of that. I think
19 I would have to discuss this with Dr. Gotchy, but we haven't
20 gone beyond looking at today, really.

21 JUDGE WOLFE: Yes.

22 MR. BLACK: I would just have to advise the parties
23 one week in advance when we would resume with this panel.

24 JUDGE WOLFE: When does Dr. Gotchy have to leave?

25 MR. BLACK: He is leaving tomorrow morning.

12-8

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1 JUDGE WOLFE: Tomorrow morning.

2 MR. BLACK: Maybe we could explore the possibi-
3 lity of putting him on the stand tomorrow morning, with
4 the hope that he could finish at that time. I don't know
5 whether Dr. Gotchy could do that.

6 But there again, we run into the time allocated
7 to Applicant's panel.

8 So

9 MR. NEWMAN: I think that's probably not the
10 problem, Mr. Black.

11 The concern I have is that Mr. Scott indicated
12 earlier that he had some extensive cross-examination of
13 Dr. Gotchy --

14 JUDGE WOLFE: Oh, undoubtedly, in light of the
15 previous cross-examination. Now, he has honed down his
16 cross-examination to less than the day he originally
17 thought.

18 Isn't that true, Mr. Scott?

19 MR. SCOTT: I'm afraid quite to the contrary.
20 I have since been able to learn considerably more. So
21 I will have considerably more pertinent questions.

22 I have a question about Mr. Sanders. Is he
23 going to continue to be here?

24 I understood only Mr. Gotchy had a scheduling
25 problem.

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MR. BLACK: Well, it's becoming perfectly clear to me that Applicant's witnesses may take up the rest of the week.

I was going to seek permission from the Board to excuse Dr. Sanders until we can recall him at another date.

I do not like to hold witnesses around when, in fact, there is a very remote chance that we will be able to get to them.

It appears to me that Applicant's panel will take Thursday and part of Friday. And perhaps if we do have any time left over Friday, we can get to Dr. Marrack, or do some other line of business.

But I was going to ask permission of the Board to have Dr. Sanders excused until a somewhat later time.

JUDGE WOLFE: Is there any objection to that?

DR. MARRACK: As long as we can continue at sometime, yes.

MR. SCOTT: Your Honor, I would also like to ask that we have some reasonable notice as to when the panel will come back -- a week's notice or so.

JUDGE WOLFE: I don't know whether you need more than a week's notice. Certainly a week's notice, I think, is fair.

17-10

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1 But in any event, there being no objection,
2 the two witnesses are excused temporarily.

3 I would hope that after the hearing today, the
4 parties will get together and sort of toss it around,
5 informally, as to how much -- as to what the timing can
6 be for further cross-examination of the Applicant's three
7 expert witnesses, and how best to expedite cross-
8 examination.

9 Arrive at your own arrangements as best as you
10 can.

11 All right.

12 We'll recess --

13 MR. DOHERTY: Chairman Wolfe.

14 JUDGE WOLFE: Yes.

15 MR. DOHERTY: There are two things.

16 As of yet we have still not established a place
17 for the records of the days' proceedings in the library;
18 but we're still working on it. It's not complete.

19 JUDGE WOLFE: Have you checked with Mr. Black,
20 Mr. Doherty?

21 The Board has so much that it has under con-
22 sideration that it would seem to me -- that Mr. Black has
23 offered --

24 MR. DOHERTY: Yes, sir, that's right.

25 JUDGE WOLFE: It would seem to me that the two

11-11

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1 of you could work that out without coming to the Board
2 with it.

3 MR. DOHERTY: I simply wanted to inform the
4 Board of the progress. That's all.

5 The second thing was: As requested -- after
6 two tries, I reached Mr. Bishop today. He is under the
7 impression that the Applicant's panel will be here
8 tomorrow.

9 He was told that he has to be here tomorrow.
10 He was informed of that, as requested.

11 JUDGE WOLFE: He was informed of that as re-
12 quested.

13 All right, fine.

14 Thank you very much.

15 Is there still some snag in the transcript
16 lodging in the University library?

17 MR. DOHERTY: Well, I think it's very essential
18 for us to get it done before the end of the week. That's
19 all.

20 DR. MARRACK: Do we know who's going to be the
21 first witness on the stand tomorrow morning?

22 MR. NEWMAN: Dr. Wolfe, as indicated on the
23 record previously, we will have Applicant's panel,
24 consisting of Drs. Tischler, Armstrong and Schlicht
25 tomorrow.

12-12

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1 I would note, however, for the record that if,
2 as the Board has done, Drs. Sanders and Gotchy are
3 excused temporarily, the next order of business
4 following completion of Applicant's panel tomorrow will
5 be the cross-examination of Dr. Marrack on Contentions
6 2 and 4.

7 JUDGE WOLFE: All right.

8 MR. SCOTT: Chairman Wolfe, I must have been
9 absent when you made some ruling that indicated that
10 any particular person had to be here at a particular
11 time.

12 Did you rule that? Was that a suggestion or
13 what?

14 MR. NEWMAN: Mr. Chairman, I must say something
15 for the record. I think the Chair probably can't do it.

16 Mr. Scott has been in and out of this hearing
17 room all day, at times when the Chair has made absolutely
18 crucial rulings with respect to the scheduling of this
19 proceeding.

20 I am concerned that this constant process of
21 question and answer as to matters about which he is not
22 aware, because he has absented himself from the room, is
23 going to lead at some point to reversal in the record.

24 JUDGE WOLFE: Yes, Mr. Newman. It's a concern
25 to me too.

12-13

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1 I have noticed Mr. Scott coming in and out of
2 the hearing room. As a matter of fact, I noticed at
3 two o'clock Mr. Scott was at the door, which is far
4 removed from here.

5 But I noticed that he was looking in through
6 the slot in the door and did not come down to the
7 courtroom -- to the hearing room -- the well until
8 about 2:30.

9 So it's a problem to me.

10 The Board has to repeat itself so many, many
11 times to the individual parties that are here, aren't
12 here or straggle in/straggle out, do not notice their
13 appearance, do not notice that they're leaving the
14 hearing room.

15 I'm going to -- as of now -- I'm not going to
16 repeat any order that I give during a day.

17 If any Intervenor or counsel is missing, absent
18 for whatever reason, they're not going to be allowed to
19 ask the Board to restate what has been stated during the
20 course of that day's hearing.

21 At best, they will have to consult some other
22 party. They will have to read the transcript the next
23 morning.

24 I'm tired of it. I will not engage in this
25 futility any longer.

1 MR. SCOTT: Mr. Chairman, I would also like the
2 record to note that Mr. Scott has been here all day
3 despite the fact he has not done any cross-
4 examination --

5 JUDGE WOLFE: And that's your obligation as a
6 counsel for your party. You are counsel.

7 I am talking to you as a lawyer, not as a pro
8 se intervenor.

9 You have certain -- I don't have to lecture
10 you on that.

11 But I'm saying that you should be here, and you
12 were in and out all the day. I'm just simply not going
13 to repeat myself.

14 MR. SCOTT: I wasn't asking you to repeat it --

15 JUDGE WOLFE: You most certainly did because
16 you said you had an understanding on some concern and you
17 asked what I had said on the record.

18 I'm not going to repeat it.

19 MR. SCOTT: I was going to make the assumption
20 that you had made such an order and then make a statement.

21 Are we still allowed to let individual inter-
22 venors, if agreed amongst other parties -- other inter-
23 venors -- exchange as we have just done with this
24 panel, even though the examination is not finished.
25 We dismissed the panel in the middle for cross-examination.

12-15

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1 Now, surely the cross-examiners get the same
2 right as the individuals that are being cross-examined?

3 JUDGE WOLFE: I don't know -- I can't judge
4 that. I don't know what you're talking about.

5 You're not bringing any concrete situation before
6 me.

7 You're asking me -- I have told you repeatedly,
8 and I don't know why you can't get through your head.
9 I do not make decisions or rulings in a void.

10 I have made decisions when the occasion has
11 arisen, upon the facts of the situation.

12 There might be 101 different facts in the
13 situation that you're bringing to my attention, which is
14 hypothetical.

15 I'm not going to decide that sort of matter.
16 I have already suggested to the parties that they get
17 together and make any informal arrangements, and if it's
18 convenient with the Board, the Board will go along with
19 it.

20 But you can't ask me -- and I refuse to make
21 rulings in a void.

22 I hope I don't have to make that sort of
23 ruling upon that type of situation again.

24 Anything else before we recess?

25 Yes.

12-16

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1 DR. MARRACK: In your ruling about the exposure,
2 am I precluded from inquiring or trying to demonstrate
3 that there are groups of the population who might acquire
4 larger quantities of water or other material from this
5 lake than the average?

6 MR. NEWMAN: Mr. Chairman, again, may I have a
7 moment to speak to that?

8 I will be very brief. I think the point you
9 just made couldn't be more on target. And I think in
10 particular this is an illustration of the type of ruling
11 which if made in a vacuum would lead to trouble on the
12 record.

13 I think the way for this matter to be raised
14 is for Dr. Marrack to ask a question, for there to be
15 any objection to that question, and thence a Board
16 ruling.

17 MR. SCOTT: Mr. Chairman, I think the situation
18 here is one -- this issue has already been brought up.
19 The Board has made it very unclear -- I think Dr.
20 Marrack is asking that it be clarified.

21 DR. MARRACK: I'm just asking for a clarifica-
22 tion. I'm not sure whether your ruling excluded the
23 possibility of my inquiring and trying to demonstrate
24 that there are groups of the population who might acquire
25 more-than-average quantities of cooling lake water or

; 20; 8

1 radionuclides.

2 JUDGE LINENBERGER: Dr. Marrack, you are asking
3 us to project in advance a direction that your course of
4 examination might take.

5 That's well nigh of an impossibility for us.
6 If you think you have a strong reason for going a certain
7 direction on future examination, then cite your basis
8 for it, make your case for it at the time and we'll rule
9 at the time.

10 We can't do it in advance of your having
11 established a basis and the specifics of what it is that
12 you want to accomplish.

13 Thank you.

14 DR. MARRACK: All right.

15 MR. NEWMAN: Judge Wolfe, just before closing,
16 I did note that the next order of business following
17 completion of the Applicant panel would be the cross-
18 examination of Dr. Marrack.

19 I would expect that that might occur as early
20 as Friday morning, if not late tomorrow.

21 I would ask the Board to inform counsel for
22 TexPirg -- I believe that Dr. Marrack is a witness for
23 TexPirg in this regard -- that he will be expected to be
24 here.

25 MR. SCOTT: Mr. Chairman, I can see where he's

17-18

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1 going. As counsel having an expert witness here, I will
2 do and expect the same consideration you have shown for
3 other people's expert witnesses.

4 We'll get Dr. Marrack here as soon as we can,
5 considering his other business obligations.

6 Now I don't want to be ordered that he has got
7 to be here on a particular day in a vacuum.

8 MR. NEWMAN: I'm really not asking for an
9 order, Mr. Chairman.

10 I wanted to raise the question with the Board.
11 I intend to discuss the matter, as you have suggested,
12 with the other parties.

13 And if we are unable to arrive at a resolution
14 on that matter this afternoon, then it's something that
15 we will take up with you, if we may, the first thing
16 tomorrow morning, sir.

17 JUDGE WOLFE: Certainly.

18 (Whereupon, at 5:30 p.m. the hearing was re-
19 cessed, to reconvene at 9:00 a.m., Thursday, January 22,
20 1981, in the same place.)

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This is to certify that the attached proceedings before the

U. S. NUCLEAR REGULATORY COMMISSION

in the matter of: HOUSTON LIGHTING & POWER COMPANY,
Allens Creek Nuclear Generating Station, Unit 1

Date of Proceeding: January 21, 1981

Docket Number: 50-466

Place of Proceedings: Houston, Texas

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)