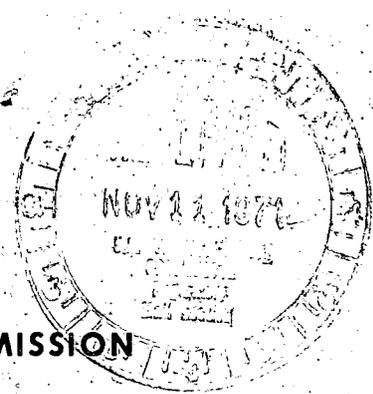


Regulatory Docket File



UNITED STATES ATOMIC ENERGY COMMISSION

IN THE MATTER OF:

**CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.,
(Indian Point Station, Unit No. 2)**

Docket No. 50-247

**RETURN TO REGULATORY CENTRAL FILES
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Place - Springvale Inn, Croton-on-Hudson, N.Y.

Date - November 8, 1971

Pages. 2885 - 3000

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UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter of: :
CONSOLIDATED EDISON COMPANY OF NEW YORK : Docket No.
INC. : 50-247
(Indian Point Station, Unit No. 2 :

Springvale Inn
Croton-on-Hudson, N.Y.

Monday, November 8, 1971

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

BEFORE:

SAMUEL W. JENSCH, Esq., Chairman,
Atomic Safety and Licensing Board.

DR. JOHN C. GEYER, Member.

MR. R. B. BRIGGS, Member.

APPEARANCES:

On Behalf of the Applicant:

LEONARD M. TROSTEN, Esq., LEX K. LARSON, Esq.,
1821 Jefferson Place, N.W., Washington, D.C.
20036.

On behalf of the Regulatory Staff:

MYRON KARMAN, Esq., and KARL KNIEL, Esq.,
Office of General Counsel, U. S. Atomic Energy
Commission, Bethesda, Maryland.

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APPEARANCES (Continued):

On behalf of Intervenor, Citizens' Committee
for the Protection of the Environment, and on
behalf of the Environmental Defense Fund:

ANTHONY B. ROISMAN, Esq., 1910 N Street, N. W.,
Washington, D.C.

On behalf of Intervenor, Hudson River
Fishermen's Association:

AGNUS MACBETH, Esq., 36 West 44th Street,
New York, N.Y. 10036.

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Witness

James S. Moore

Cross

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M O R N I N G S E S S I O N

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CHAIRMAN JENSCH: Please come to order.

Are the parties ready to proceed? Are we going to consider the further evidence from Mr. Moore or are we ready to receive the evidence from the State of New York?

MR. TROSTEN: No, we are ready for further cross-examination of the witness Moore by the Citizens' Committee for the Protection of the Environment.

CHAIRMAN JENSCH: Are you ready to proceed with this proceeding?

MR. FORD: Yes, sir.

CHAIRMAN JENSCH: Mr. Moore, will you resume the stand, please.

MR. TROSTEN: Mr. Chairman, before Mr. Moore resumes the stand, may I take just a moment to comment on a matter that was reported in the press on Friday, which I felt I ought to inform the Board about, and this concerns a fire which occurred in an auxiliary building for the Indian Point 2 plant which occurred on Thursday evening. This was reported in a press release which Con Edison published on November 5th and it was also reported in the press.

Essentially what happened, Mr. Chairman, was that there was a fire which occurred in a construction toolshed which is located in a steel frame structure which is 300 feet to the rear of the building which houses the Indian point 2 turbine

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1 generator.

2 Now the fire did not involve any radioactive release.
3 The fire started about seven p.m. and was put out about nine-
4 thirty p.m. As I say, this was a matter which was reported in
5 the press. The AEC Staff, of course, is fully aware of this.
6 I mentioned this to Mr. Roisman, mentioned it to him Friday
7 evening, and I thought it appropriate for me to mention this to
8 the Board this morning before we get started with the cross-
9 examination of Mr. Moore.

10 CHAIRMAN JENSCH: Very well.

11 One other matter that perhaps might be mentioned be-
12 fore we proceed.

13 On Friday last I received a further telephone call
14 from Congressman Dow who indicated that Dr. Sternglass was ready
15 to proceed to attend this hearing and make some statement. I
16 informed him that since Congressman Dow had been here in the
17 proceeding that schedules had been arranged in an endeavor to
18 compress into two weeks a pretty long list of witnesses and
19 examination. I endeavored to indicate to Congressman Dow that
20 the readiness of Dr. Sternglass to appear did not necessarily
21 mean that there was convenience for his appearance and neces-
22 sarily the demands of this case and the necessity of moving for-
23 ward with the presentation of evidence would have to take
24 priority in any consideration for an appearance.

25 I thereafter telephoned staff counsel and gave him

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1 the substance of this conversation that I have now reported to
2 you.

3 If there is nothing further--

4 MR. KARMAN: Mr. Chairman.

5 CHAIRMAN JENSCH: Yes.

6 MR. KARMAN: Continuing in that vein, I spoke with
7 Congressman Dow Friday afternoon after having received your
8 telephone message. Congressman Dow indicated that he was not
9 at that time aware when Dr. Sternglass would care to appear
10 and exactly what might be entailed in any appearance he makes,
11 and I tried to explain to him what I thought would be involved
12 in Dr. Sternglass either submitting a limited appearance state-
13 ment or if he was desirous of doing so, and the Board so desired
14 to have him read into the record a limited appearance statement
15 which I thought which would not take up too much time, so that
16 we might get on with the evidentiary part of the hearing which
17 had been scheduled.

18 Congressman Dow then indicated to me that he was going
19 to speak with Dr. Sternglass and that he would communicate again
20 either with the Chairman of the Board or with me at the hearing
21 in Croton.

22 CHAIRMAN JENSCH: Very well. I think that the sug-
23 gession about any presentation by Dr. Sternglass was really an
24 endeavor to see if the further data could be supplied to
25 Congressman Dow himself. Maybe that's a method by which that

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1 could be done, so that any further questions that may be in
2 Congressman DOW's mind may be answered some other way.

3 But as to that I will leave it to arrangements by
4 those.

5 (Discussion off the record.)

6 MR. TROSTEN: Mr. Chairman, Applicant's position with
7 regard to Dr. Sternglass' making a statement in connection with
8 this proceeding is as stated in the last time we discussed this.
9 We will simply have to await developments to see what our
10 position is with regard to this matter.

11 CHAIRMAN JENSCH: Very well. Let us proceed.

12 Mr. Moore, will you resume the stand, please.

13 (Witness Moore resumes the stand.)

14 MR. ROISMAN: Mr. Chairman, the cross-examination
15 this morning will begin with material which is contained in
16 certain reports that have been designated by the Westinghouse
17 Corporation as proprietary. We have no suggestion to the
18 Board as to what the procedure should be for doing this, but
19 we'd be glad to accommodate whatever the Board thinks is
20 appropriate.

21 CHAIRMAN JENSCH: You have discussed this with the
22 Applicant, have you?

23 MR. ROISMAN: Yes, we have discussed the subject
24 matter of the cross-examination.

25

end

1 CHAIRMAN JENSCH: Before we proceed --

2 MR. TROSTEN: Mr. Chairman, we have discussed this
3 matter with Mr. Roisman in the past. The Citizens' Committee
4 for the Protection of the Environment, an applicant, are
5 agreeable to an in camera cross-examination by the Citizens'
6 Committee for the Protection of the Environment of Mr.
7 Moore with regard to the proprietary documents involved.

8 As far as the Intervenor and the Applicant are
9 concerned, this is entirely acceptable procedure. At the
10 last hearing session the Chairman indicated an interest in
11 some further presentation with regard to this matter. We are
12 prepared to go forward with such a presentation, if you wish.
13 If you feel it is necessary before we may have an in camera
14 session, that is.

15 CHAIRMAN JENSCH: What is the contention about the
16 proprietary matter? Is it anything we can discuss on the
17 public hearing record?

18 MR. TROSTEN: Yes. The contention, fundamentally,
19 Mr. Chairman, is that the three or four reports which
20 Mr. Roisman, assisted by Mr. Ford, wished to cross-examine
21 Mr. Moore about our Westinghouse proprietary reports. The
22 cross-examination on the public record with regard to these
23 reports would result in the divulgence of Westinghouse
24 propriety information. Hence, it is the Applicant's position
25 that the Westinghouse proprietary information should be

1 protected by not being disclosed in a public hearing.

2 I want to emphasize, Mr. Chairman, that the
3 Applicant and Westinghouse have furnished to the Citizens'
4 Committee for the Protection of the Environment -- that is to
5 Mr. Roisman as attorney for the Citizens' Committee. -- and
6 to two consultants to the Citizens' Committee under a
7 suitable protective agreement of the proprietary reports
8 involved. They have these documents. They have examined
9 them fully. These documents have, I might add for the record,
10 been furnished to the Board. Of course, they have been
11 furnished to the AEC Staff.

12 So there is no question here about the willingness
13 of the Applicant and the Westinghouse Electric Corporation
14 to furnish this information to the Intervenor for purposes
15 of trial preparation.

16 In accordance with the agreement between the
17 Westinghouse Electric Corporation and the Intervenor, the
18 Intervenor has agreed that any proceeding in which these
19 documents are discussed will be held in camera. That is the
20 point at which we find ourselves today, Mr. Chairman.

21 CHAIRMAN JENSCH: Is there any question among the
22 parties respecting the adequacy of the showing concerning
23 the proprietary character of the material?

24 MR. TROSTEN: I can answer that for the Applicant,
25 and I suppose Mr. Roisman will have to answer for himself.

1 CHAIRMAN JENSCH: Are these all data developed
2 solely by the proprietor without any funding of the research
3 by the Atomic Energy Commission and that sort of thing?

4 MR. TROSTEN: As far as the Applicant and the
5 Intervenor are concerned -- and I am stating this correctly
6 for Mr. Roisman. -- there is no disagreement by us as to the
7 proprietary character. We see no disagreement. Mr. Roisman
8 has not raised any question about the proprietary character
9 of this.

10 We are prepared, Mr. Chairman, if you wish, to
11 introduce testimony today, if you desire it, to further
12 explain why these reports are proprietary, the reports
13 involved.

14 CHAIRMAN JENSCH: I think any change in procedures
15 would require some sort of a showing on the record as to why
16 we need to go into an in camera session. I think the public
17 are entitled to have those data.

18 MR. TROSTEN: Let me try to explain this on the
19 record and maybe it won't be necessary to have testimony in
20 this respect. In addition to the explanation I have already
21 given to regard to why it is we feel an in camera session
22 it is appropriate here, I should add that the Applicant's
23 position is that all of the necessary data for the evaluation
24 of the safety of this plant are contained in nonproprietary
25 documents which are fully available to the public, have been

1 available throughout the course of this proceeding. Hence,
2 the particular proprietary information which is contained
3 in these reports is not necessary to be divulged to the
4 public because there is already adequate information in the
5 record for the safety evaluation to be made. So the public
6 has access to all of the necessary safety information as
7 does the Board and the parties.

8 CHAIRMAN JENSCH: Those conclusions I think are
9 the ones that need be supported by fact. As to what the
10 public has adequate data or not, they may disagree. I think
11 the important issue here is were the data which are claimed
12 to be proprietary developed solely by the alleged proprietor
13 of the information? So it constitutes the solely the
14 information and data of the alleged proprietor thereof.
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1 MR. TROSTEN: Good morning.

2 Mr. Chairman, in view of your suggestion that we
3 need a factual presentation here of the testimony, I think
4 it would be appropriate for me to offer a witness now to
5 offer testimony in this respect.

6 CHAIRMAN JENSCH: I think that will be well.
7 Will you do that.

8 Mr. Moore, step down temporarily. Thank you.

9 MR. TROSTEN: Mr. Chairman, with regard to this,
10 our interest of course, was attempting to get the cross-
11 examination in. It is our intention it will complete the
12 radiological safety proceeding. We had thought perhaps that
13 a procedure that could be used -- although we hadn't spoken
14 with Applicant about it, that if the session is closed, if
15 we have it in camera, that the Applicant, after a short
16 period of time after the transcript is prepared, advise the
17 Board which portions of that transcript could be taken and
18 turn the in camera session into at least a part of the public
19 session. It is very difficult to sort the material out in
20 advance. We did not want to have a long period of time in
21 which that would be done. That might at least get onto the
22 record all of the nonproprietary discussions on the record.

23 There will be a substantial portion of it that
24 will be nonproprietary. We have a proprietary version of
25 one of the reports. The major thing that is missing are the

1 numbers. The discussions virtually are the same, but all
2 the numbers are missing.

3 So there may be the same sort of deletions from the
4 transcript, by making the transcript available to the general
5 public and the discussions contained in there will be fully
6 available to the public.

7 But we would hope that this wouldn't get into a
8 question that would require a delay in the presentation of
9 our case, if at all possible.

10 CHAIRMAN JENSCH: We share that view and we hope
11 this matter will be expedited. Before we close this hearing
12 to the public, we will have to have something on the record
13 first.

14 MR. TROSTEN: As Mr. Roisman has pointed out, we
15 really have not had an opportunity to discuss the precise
16 procedures for this. We are, of course, exceedingly anxious
17 to expedite the presentation of the Citizens' Committee case.

18 CHAIRMAN JENSCH: Everybody has the same premise.
19 Let's go from there.

20 MR. TROSTEN: May I suggest that after the testimony
21 is offered, assuming the Board agrees, we will have an
22 in camera session, that the Board could determine after that
23 session whether any portions of the --

24 CHAIRMAN JENSCH: Yes, that's perfectly all right.
25 Call your first witness, please.

1 MR. TROSTEN: I would like to call Mr. Robert
2 Wieseemann to the stand.

3 CHAIRMAN JENSCH: He has been previously sworn
4 and need not be sworn again. Will you proceed, please.

5 MR. TROSTEN: Mr. Wieseemann, are you familiar with
6 the procedures utilized by Westinghouse Electric Corporation,
7 and in particular, by Westinghouse Nuclear Energy Systems,
8 for classification of certain information as proprietary?

9 MR. WIESEMANN: Yes, I am.

10 MR. TROSTEN: Are you generally familiar with the
11 documents classified as proprietary to which we are referring?
12 That is the ones to which cross-examination is to be directed.
13 I am referring to the following documents: WCAP 7379-L,
14 Volume 1; WCAP 7495-L, Volume 1; WCAP 7495-L, Volume 2; and
15 unnumbered document dated June 1, 1971, which is entitled,
16 "Emergency Core Cooling Performance"?

17 MR. WIESEMANN: Yes, I am.

18 MR. TROSTEN: Mr. Wieseemann, does Westinghouse
19 have procedures which it utilizes in classifying such
20 documents as proprietary?

21 MR. WIESEMANN: Yes, we do.

22 MR. TROSTEN: Would you describe these procedures,
23 please.

24

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1 MR. WIESEMANN: Yes. An initial determination is
2 made by the author of the particular report as being the person
3 most knowledgeable with respect to the context, nature of the
4 sensitivity of the information concerned, the state of the art,
5 and the knowledge in the industry of the particular subject
6 matter and the usefulness or the potential usefulness of that
7 information to people who are in competition with Westinghouse,
8 or the extent to which that information would give Westinghouse
9 a competitive advantage over its competitors.

10 This preliminary determination is reviewed by the
11 management level supervisors of the person originating the
12 material and then if that preliminary determination is agreed
13 to by the management level supervisors, that determination
14 holds if the determination is that it should not be proprietary
15 or if the original determination by the author is that the
16 material should be non-proprietary, the report then is reviewed
17 by management up to and including the level of the general
18 manager of the division involved in order to determine whether
19 or not the material is indeed non-proprietary.

20 And if it is found that the report is in fact proprie-
21 tary in nature, the report is then returned to the author,
22 either to make the report proprietary or to make changes neces-
23 sary in order to make the report non-proprietary in nature.

24 MR. TROSTEN: Now in determining whether information
25 is to be made proprietary what criteria and standards are

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1 utilized by Westinghouse?

2 MR. WIESEMANN: The questions that have to be in-
3 vestigated in determining whether or not a report is proprietary
4 or not are these following questions:

5 Does the report reveal distinguishing aspects of a
6 process whose exclusive use constitutes a competitive advantage
7 to Westinghouse?

8 Does it consist of supporting data relative to the
9 process constituting competitive advantage?

10 Does it contain information, the use of which by our
11 competitors, would reduce his expenditures of resources?

12 Does the report reveal cost or price information,
13 production capabilities, budget levels or commercial strategies?

14 Does the report reveal aspects of past, present or
15 future or customer-funded development plans and programs of
16 commercial value?

17 And, does the report contain patentable ideas?

18 MR. TROSTEN: Mr. Wiesemann, does each of the docu-
19 ments to which I referred earlier contain information in one
20 or more of the categories you have mentioned?

21 MR. WIESEMANN: Yes.

22 MR. TROSTEN: With regard to their proprietary nature,
23 what is the status of these documents?

24 MR. WIESEMANN: They are presently deemed to be
25 proprietary by Westinghouse.

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1 MR. WIESEMANN: Yes. An initial determination is
2 made by the author of the particular report as being the person
3 most knowledgeable with respect to the context, nature of the
4 sensitivity of the information concerned, the state of the art,
5 and the knowledge in the industry of the particular subject
6 matter and the usefulness or the potential usefulness of that
7 information to people who are in competition with Westinghouse,
8 or the extent to which that information would give Westinghouse
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15 or if the original determination by the author is that the
16 material should be non-proprietary, the report then is reviewed
17 by management up to and including the level of the general
18 manager of the division involved in order to determine whether
19 or not the material is indeed non-proprietary.

20 And if it is found that the report is in fact proprie-
21 tary in nature, the report is then returned to the author,
22 either to make the report proprietary or to make changes neces-
23 sary in order to make the report non-proprietary in nature.

24 MR. TROSTEN: Now in determining whether information
25 is to be made proprietary what criteria and standards are

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1 MR. TROSTEN: Would you summarize why the documents
2 are considered proprietary by Westinghouse?

3 MR. WIESEMANN: Each document involved is considered
4 proprietary because it contains information which is customarily
5 held proprietary by Westinghouse. Each document reports on
6 research and the development programs, including experiments,
7 tests, analyses and development of analytical techniques, and
8 each document sets forth in detail equipment, procedures,
9 results and/or conclusions of such experiments conducted with
10 Westinghouse funds for its exclusive benefit.

11 MR. TROSTEN: Are those documents customarily held
12 in confidence by Westinghouse?

13 MR. WIESEMANN: Yes.

14 MR. TROSTEN: Are those documents customarily made
15 available to the public by Westinghouse?

16 MR. WIESEMANN: No.

17 MR. TROSTEN: Have those documents previously been
18 transmitted by Westinghouse to the Atomic Energy Commission?

19 MR. WIESEMANN: Yes.

20 MR. TROSTEN: In connection with such transmittal
21 what, if anything, was requested of the Atomic Energy Commission?

22 MR. WIESEMANN: We requested that the Atomic Energy
23 Commission withhold the documents from public disclosure.

24 MR. TROSTEN: Have those documents previously been
25 transmitted to representatives of the Citizens' Committee for

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1 the Protection of the Environment, an Intervenor in this pro-
2 ceeding?

3 MR. WIESEMANN: Yes.
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1 MR. TROSTEN: Can you tell us what procedure was
2 used with respect to such transmittal?

3 MR. WIESEMANN: Basically the reports were
4 transmitted to the persons you identified under the terms of
5 an agreement. When the question initially came up regarding
6 the production of proprietary documents we entered into
7 discussions with the Intervenor in question and developed an
8 agreement which limited the use of the document and provided
9 protection for the proprietary material contained in the
10 documents, and this agreement was agreeable to all parties
11 and was subsequently signed by the parties to whom the
12 documents were produced.

13 MR. TROSTEN: Mr. Chairman, I have no further
14 questions of this witness.

15 CHAIRMAN JENSCH: I wonder if I could see the
16 documents.

17 MR. TROSTEN: The Board, of course, already has
18 copies of these documents. Mr. Wiesemann has in his possession
19 the documents involved.

20 MR. WIESEMANN: Those are the three.

21 Is there a copy of the 6-1-71?

22 MR. FORD: I have the copy.

23 MR. WIESEMANN: Oh, here it is.

24 MR. TROSTEN: Mr. Wiesemann has the 6-1-71 document.

25 CHAIRMAN JENSCH: Does anybody desire to interrogate

1 the witness in reference to this matter? Intervenors?

2 MR. TROSTEN: No, Mr. Chairman.

3 CHAIRMAN JENSCH: Staff?

4 MR. KARMAN: No, we have no questions.

5 CHAIRMAN JENSCH: Is it your view, Mr. Wiesemann,
6 that none of the funds from the Atomic Energy Commission have
7 been utilized in any respect pertaining to the development
8 of the data revealed in these four documents to which you have
9 referred?

10 MR. WIESEMANN: Yes, sir. If you would look on the
11 cover page, title page of any one of those three documents
12 that are bound, just past the blue sheet, you will see a line
13 about one-third or two-thirds, I am sorry, down the page,
14 which says "Work was performed under DGR." The DGR in that
15 letter series refers to Division General Research funds
16 which are moneys exclusively Westinghouse funds.

17 CHAIRMAN JENSCH: And none of the information
18 revealed in these documents is related in any respect to the
19 previous R & D work undertaken by Westinghouse for the
20 Atomic Energy Commission, is that correct?

21 MR. WIESEMANN: I am not sure I understand the nature
22 of your question. They certainly are related in the sense
23 that they relate to the same -- to some of the same problems
24 for which other work has been performed. But the work
25 itself is separate and independent.

1 CHAIRMAN JENSCH: I notice in the acknowledgment
2 that you acknowledge receipt of some data from General
3 Electric Company. Is this something that's shared with
4 General Electric Company?

5 MR. WIESEMANN; No, sir.

6 CHAIRMAN JENSCH: What was shared with General
7 Electric Company?

8 MR. WIESEMANN: To my knowledge only the data that
9 was obtained from General Electric Company is the data that
10 was obtained as the result of performing -- I believe we
11 discussed earlier in the record the fact that there were
12 certain tests performed in order to get a comparison of the
13 results from our test facility with the General Electric test
14 facility, and to my knowledge that is the only data that was,
15 if you want to call it shared.

16 CHAIRMAN JENSCH: It says "We wish to acknowledge the
17 assistance of" so-and-so, and then goes on to Messrs.
18 J-u-e-n-k-e and J. F. White of the General Electric Company
19 who directed the experimental program reported in Volume 2.

20 Are these data shared with General Electric, do you
21 know, or did they shut off their transmission of data from the
22 experimental program as far as submitting it to General
23 Electric, do you know?

24 MR. WIESEMANN: No. I think you are talking about
25 the program where we performed tests on certain General Electric

1 Company fuel rods to get comparison data, and the General
2 Electric Company directed the tests of that portion, since
3 it involved their fuel rods.

4 MR. TROSTEN: Mr. Chairman, I am informed by a
5 representative of Westinghouse that perhaps your question
6 refers to Volume 2 of 7379.

7 MR. WIESEMANN: Yes, it does.

8 MR. TROSTEN: Which is not proprietary, I am
9 informed.

10 CHAIRMAN JENSCH: There is no interrelationship
11 between the two experimental programs reflected in Volume 1
12 or 2, is that correct?

13 MR. WIESEMANN: That's correct.

14 CHAIRMAN JENSCH: In your opinion is this a legally
15 sufficient test to determine the proprietary character of
16 these exhibits, Applicant's counsel?

17 MR. TROSTEN: Mr. Chairman, in our opinion the
18 testimony which has been given is legally sufficient to
19 establish that this proceeding wherein Mr. Moore is to cross-
20 examined with respect to the documents involved should be
21 held in camera.

22 CHAIRMAN JENSCH: I didn't hear any testimony as to
23 whether or not these data have been of a kind that have had
24 general distribution.

25 MR. TROSTEN: Mr. Chairman, in response to that point

1 it is our view that the testimony which has been offered by
2 Mr. Wieseemann establishes that this information is
3 proprietary and is of a sort which is entitled to protection
4 through the means of an in camera proceeding. It is
5 Applicant's position that under the applicable statutes and
6 regulations that the testimony that has been offered is
7 sufficient to establish that point.

8 CHAIRMAN JENSCH: Yes. I think that is what you
9 just stated a moment ago. I understand you have now
10 repeated it.

11 My question, however, was what general distribution
12 of these data have been made, or have these data had general
13 distribution either in this country or abroad, do you know?

14 MR. WIESEMANN: This data has not had general
15 distribution, Mr. Jensch. It is classified as proprietary,
16 and having been classified as such it is only disseminated
17 where there is need and also where there is protection in the
18 form of an agreement between the receiving party and
19 Westinghouse to protect the proprietary nature of the
20 material.

21 CHAIRMAN JENSCH: And none of these data have
22 appeared in technical journals that have had general public
23 distribution, is that correct?

24 MR. WIESEMANN: Of the data that we are holding
25 proprietary.

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As Mr. Roisman mentioned earlier, we have identified the material which is proprietary and the report which consists primarily of data and the description of photographs describing the tests and description of test set-ups.

CHAIRMAN JENSCH: I think my question was have these data been contained in any technical journals that have had general public distribution?

MR. WIESEMANN: No.

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1 CHAIRMAN JENSCH: I will return these documents to
2 Mr. Wiesemann. The Board will be giving some further
3 consideration to this matter. Before doing that, the Board
4 has some questions on pressure vessel integrity they would
5 like to more or less propound at this time for which you will
6 perhaps be desirous of securing some additional information
7 or presentation within the next few days. At the end of
8 this presentation of these further concerns on pressure
9 vessel integrity, the Board will make its determination
10 respecting the proprietary contentions which we have discussed.

11 MR. WIESEMANN: Excuse me, Mr. Jensch. Did you
12 intend to return the fourth copy?

13 CHAIRMAN JENSCH: I will, but just a moment. I do
14 intend to do it. Dr. Geyer was reviewing it. He has now
15 completed his review. It is received thereof. Will you
16 acknowledge receipt for the record.

17 MR. WIESEMANN: I received all four proprietary
18 reports.

19 MR. TROSTEN: Did you say you were going to defer
20 your ruling until when, sir?

21 CHAIRMAN JENSCH: In just a few minutes. You may
22 step down, Mr. Wiesemann.

23 MR. ROISMAN: Just so the record is clear, as we
24 have indicated before, we have no objection to the closed
25 session. We will want to have an opportunity to argue, based

1 upon the closed session. the portions of the session are
2 all that should be made public based upon the nature of the
3 evidence.

4 Just for the record, I would like to direct the
5 Board's attention to the two rulings of the Atomic Safety and
6 Licensing Board in the matter of Midland Nuclear Power
7 Station, Units 1 and 2, 50-329, 50-330, decided September 2
8 and September 22nd of this year, which dealt with the
9 question of when documents which are proprietary still are to
10 be released to the general public. We are not after release
11 of the documents per se, but we may wish to argue at a
12 subsequent date that the transcript or portions thereof should
13 be released. That will be after filing of our brief and
14 proposed findings of fact and conclusions on law.

15 CHAIRMAN JENSCH: What prevents you from making that
16 argument now without having the specific figures in mind?
17 I think the proprietary character, to some extent, should be
18 determined before we start the interrogation. If it should
19 later be determined that a portion of these data should be
20 indicated to the public, they should hear it now.

21 MR. ROISMAN: Our argument is not that the documents
22 are not proprietary. The decisions here that I have just
23 referred to, in the matter of Consumers Power Company, indicate
24 that even if the material is proprietary, it may be that it
25 should be released because it would be in the public interest.

1 We are not prepared to argue and it would not be our position
2 that the release of the documents would necessarily be in the
3 public interest, but we wish to reserve the right to argue
4 that release of all or a portion of the transcript will be
5 in the public interest. We think that it would be difficult
6 now to establish the public interest's allegations in the
7 context of documents until the cross-examination has taken
8 place.

9
10 Again, we are anxious to have the hearing go ahead.
11 We did not feel it was necessary to tie it up on a technical
12 point. There are problems, if there is a disagreement on that
13 issue, about certification to the Appeals Board and so forth.
14 And frankly, we have our expert here now and are anxious to
15 proceed with it.

16 MR. TROSTEN: Mr. Chairman, as Mr. Roisman has
17 called attention to the Atomic Safety and Licensing Appeal
18 Board decision, I feel that I should also call the Board's
19 attention to the decision of the Atomic Safety and Licensing
20 Appeals Board in the matter of Northern States Power Company,
21 Docket No. 50-263, dated August 20, 1970, and specifically
22 pages 19 and 20 thereof, in connection with what we believe
23 is the propriety of the course of action that is being
24 proposed here. That is an in camera session. Of course, this
25 procedure is also, we believe, Mr. Chairman, entirely
consistent with procedure that has been adopted in two other

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proceedings with which the Chairman, I am sure, is familiar.
One involves the Jersey Central Power and Light Company,
Oyster Creek Reactor, and the other involving the Commonwealth
Edison's Company, Dresden-1 Facility.

CHAIRMAN JENSCH: We will go forth and proceed with
the questioning of the Board.

D2Wt1

1 MR. BRIGGS: In the interest of expediting the testi-
2 mony later in the week, I believe the Applicant's counsel asked
3 that the Board indicate what witnesses we might like to have
4 here. I don't believe we can indicate what witnesses, but may
5 be able to indicate some of the questions that we would like
6 to ask to discuss, and some information that might be provided
7 ahead of time. This will be to the Staff and to the Applicant
8 both. Some of the questions are concerned with the Staff's
9 proposed testimony, and some are concerned with the Applicant's
10 testimony.

11 The first one has to deal with the Staff testimony.
12 In that it is indicated that ninety-five nuclear pressure
13 vessels of commercial pressurized and boiling water reactor
14 plants have been operated, and talks about the hours of opera-
15 tion and the lack of problems.

16 The Board would like to be provided with a list of
17 those ninety-five nuclear pressure vessels, roughly the number
18 of hours that each has operated, indicating in the list where
19 the vessels have received more than a superficial volumetric
20 in-service inspection, and then, at the time of the discussion,
21 be prepared to indicate any problems anticipated or unantici-
22 pated that have been experienced with those vessels.

23 In the Staff testimony there is also discussion of
24 burst stresses and pressures. We would like to have these
25 compared with the numbers that Mr. Wiesemann indicated for the

D2Wt2 1 Indian Point 2 vessel, to be sure that there is no significant
2 difference.

3 Great stress is put on the point that the reactor
4 vessel will be operated under ductile conditions but there are
5 temperatures at which the vessel material will not be ductile.
6 Could the Applicant or the Staff provide some discussion about
7 what causes the nil ductility transition in steel, nil ductility
8 temperature in steel; and why does radiation cause this tempera-
9 ture to change. Also, how certainly it is known that the change
10 found in the surveillance specimens will be duplicated in the
11 thick wall of the reactor vessel.

12 Now I would like for there to be a discussion in some
13 detail about the pre and the post hydro test ultrasonic inspec-
14 tion of the Indian Point 2 vessel. In other words, prior to
15 the hydrostatic tests was the ultrasonic testing done on a grid
16 that where a test was run here and then two or three feet away
17 over here, just how fine was the grid on which the vessel was
18 inspected both before and after the hydrostatic test?

19 If it is at all possible, we would like to be pro-
20 vided with information concerning the ten largest indications
21 of flaws in the vessel. That is, what was the nature on the
22 indication, how were these indications interpreted? These are
23 the ten largest flaws in the vicinity of Wells, and the ten
24 largest in the base material. Also, how these locations com-
25 pare with locations that will be examined during the in-service

D2Wt3

1 testing of the reactor or in-service inspection, I should say.

2 It is pointed out in several places that the vessel,
3 if it were to develop flaws, could be expected that leaks would
4 appear before the flaws became large enough to cause failure
5 of the vessel. This is also indicated for piping and other
6 places.

7 With regard to the vessel, how certain is it that
8 flaws that are foreign in the carbon steel will penetrate the
9 cladding before the flaws are large enough to cause failure of
10 the vessel? The cladding is of a different material, has dif-
11 ferent characteristics. How certain is it that these flaws
12 will penetrate the cladding?

13 I would like for some agreement to be reached during
14 the discussion of the failure of the vessel, on the consequences
15 of such failure if it did occur. I would like some agreement
16 on what the likely consequences of a melt-down of the core would
17 be, however remote the possibility is, if such melt-down were
18 to occur.

19 Finally, I believe during the previous testimony,
20 testimony on October 5th, a question was asked concerning
21 whether there had been an experimental stress analysis of the
22 reactor vessel during the hydrostatic testing, whether the
23 stresses were measured during the hydrostatic testing on a
24 reactor vessel. The thought seemed to be that combustion had
25 done such a test, and I believe it was agreed that if it had

D2Wt2

1 been done, the Applicant would provide a reference, if such
2 reference existed, and would like to have that reference if
3 there is one available.

4 There certainly will be other questions that will be
5 asked. I hope that these will give some idea of the kinds of
6 questions and the people that ought to be here to reply to them.

7 MR. KARMAN: Mr. Briggs, I was wondering whether it
8 would be possible, if after receiving a copy of the transcript
9 this evening and carefully noting the several questions which
10 you propounded this morning, whether it would be possible for
11 us to communicate with some of our technical staff in Bethesda,
12 the ones who are primarily responsible for submitting the
13 response which we did distribute to the Board and parties on
14 pressure vessel integrity. If it is at all possible, we can
15 then come back to the Board with an additional statement
16 clearly and comprehensively responding these inquiries without
17 the necessity, if that is possible, of bringing an additional
18 witness to the hearing.

19 Of course, we would leave this to your judgment. I
20 indicated to our people back home that if it is at all possible
21 and if they can respond to your questions by way of a written
22 statement, it will be much appreciated.

23 MR. BRIGGS: I think certainly I would have no objec-
24 tions to the answers provided in writing. I don't know
25 whether the full answers can be provided, and I would hope that

J2Wt5

1 the questions would considerably limit the number of people that
2 you would want to bring here.

3 MR. KARMAN: I will discuss this with my people back
4 at the office. If there is any problem, I will get back to you,
5 sir.

6 MR. BRIGGS: If it means that you have to bring one
7 witness or two witnesses, I think this could be expected. I
8 would hope that it wouldn't require that you would have to bring
9 a half dozen.

10 MR. KARMAN: I did not anticipate doing so. This
11 week is ACRS week.

12 CHAIRMAN JENSCH: Maybe the ACRS could come and help
13 us.

14 MR. KARMAN: I have very little control over the ACRS
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1 CHAIRMAN JENSCH: In view of the information that
2 was given about the attendance of other witnesses, I hope
3 we can give it further consideration to this matter at a
4 later time.

5 The Board recognizes the rules of the Atomic
6 Energy Commission provide that proprietary information
7 developed by an inventor or manufacturer is entitled to
8 protection. I think the language in some of the legal
9 journals in dealing with proprietary information and the
10 necessity of the protection thereof is to avoid and maybe
11 this won't apply to this case, but to avoid parasitic use
12 of the information, that people who have not undertaken
13 research and development would be inclined to utilize the
14 benefits of others' labor to the disadvantage of those who
15 have exercised initiative, ingenuity, in developing data.

16 And just perhaps not in the same extent or scope,
17 but just as the patent system endeavors to protect ideas
18 which are developed to permit the abuse of new and novel
19 techniques of manufacturers, likewise the proprietary
20 information is entitled to a protection of perhaps a different
21 kind, but of the same general character.

22 The Atomic Energy Commission will respect
23 proprietary information of any party to the proceeding,
24 whether it be the Applicant, the Intervenors. It is the
25 Board's determination that upon the basis of the record

1 presented here that the data described and identified by
2 Applicant's counsel is within the scope of the protection
3 intended by the rules of the Atomic Energy Commission.
4 Further consideration will be given to the release of this
5 information or a portion thereof at later sessions but at this
6 time the Board will recess the proceeding to reconvene within
7 ten minutes at which time only the parties, that is the
8 Intervenors and the State of New York and the Hudson River
9 Fishermen's Association and the Staff, of course, and their
10 attorneys and their technical assistants will be permitted to
11 attend. This transcript on the matter will be prepared in
12 what is known as an in camera session and the data developed
13 at that session will be the subject of consideration as to the
14 extent of its release at a later time before recessing, however,
15 inquiry was made as to how long do you think this in camera
16 session will last so that we may now inform the public to
17 return to the public hearing? Can the Intervenors indicate?

18 MR. ROISMAN: Mr. Chairman, it appears it will surely
19 run until lunch. It would be possible for us to make a more
20 definitive judgment at 12:30 as to whether it will be running
21 after lunch. We will be starting with the proprietary documents
22 and try to dispose of them in the course of the discussion, but
23 as was apparent last week it's difficult to predict exactly.
24 My guess is --

25 CHAIRMAN JENSCH: Well, we don't have to stop at 12:30;

1 if you can go through to 1:30 or something without lunch and
2 finish up the proprietary character the Board would prefer to
3 indicate now to the public when the public session of the
4 hearings will be available.

5 MR. ROISMAN: Perhaps why don't we agree now that
6 we will go for a certain number of hours. If that isn't
7 enough, we can pick it up later, like the first thing in the
8 morning, or something like that.

9 CHAIRMAN JENSCH: We will perhaps have to issue
10 further public notices to the public. If you are not done
11 with the proprietary interrogation I think it would be better
12 to continue with that now and if necessary issue a further
13 public notice. I was hoping to avoid any inconvenience to
14 the public, but at this time let us state that we will recess
15 this public hearing, to reconvene at 3 o'clock this afternoon.
16 We expect from what indications have been given that the
17 proprietary data will be developed by that time and we will
18 resume the public hearings. And if that is not correct, we
19 will have to formally convene a public hearing and then recess
20 the public hearing to a time later to be determined.

21 At this time let us recess this public hearing to
22 reconvene this afternoon at 3:00 o'clock in this room. And
23 the in camera session will begin at 10:05 this morning.

24 (Hearing recessed.)
25

1 A F T E R N O O N S E S S I O N
2

3 CHAIRMAN JENSCH: Please come to order.

4 Mr. Moore, would you resume the stand, please.
5

6 J A M E S S. M O O R E, resumed.

7 CHAIRMAN JENSCH: Intervenors, are you ready to
8 proceed?

9 MR. FORD: Yes, sir.

10 CHAIRMAN JENSCH: Will you proceed.

11 MR. FORD: Mr. Moore, is it correct that in the
12 BWR FLECHT tests negative heat transfer coefficients were
13 observed at axial levels in a number of different instances?14 MR. MOORE: They were recorded as negative heat
15 transfer coefficients. What they actually indicate is
16 reverse heat transfer from the coolant to the cladding.17 MR. FORD: For purpose of this discussion and since
18 they are plotted as heat transfer coefficients, would you just
19 accept the definition of terms, that is a negative heat
20 transfer coefficient?21 MR. MOORE: I guess I'd prefer reverse heat transfer,
22 which is more descriptive.23 MR. FORD: I see. It is correct, though, that the
24 reverse heat transfer coefficients are represented in your
25 data as negative heat transfer coefficients, is that correct?

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MR. MOORE: Yes, yes.

MR. FORD: Thank you.

Do you agree that if you passed a saturated vapor, saturated steam through a furnace that you'd create superheated steam?

MR. MOORE: If I pass saturated steam through a furnace I create superheated steam?

MR. FORD: Yes.

MR. MOORE: Yes.

end

QWt1

1 MR. FORD: Do the codes that you use for analyzing
2 the loss of coolant accidents explicitly consider the formation
3 of superheated steam or do they regard the coolant at different
4 axial levels being simply liquid entrained in steam, period?

5 MR. MOORE: It depends on which calculation you are
6 talking about.

7 MR. FORD: In the calculations that you have used
8 for Indian Point 2 to calculate the maximum clad temperature,
9 have you separately considered the role of superheated steam
10 in precipitating, or yielded the maximum clad temperature?

11 MR. MOORE: In terms of reflooding, yes.

12 MR. FORD: In terms of the code analysis that you have
13 done, do you use negative heat transfer coefficients under any
14 assumptions of flooding rate or pressure?

15 MR. MOORE: If they would exist, yes. For the hot
16 spot calculation, such a condition never does exist.

17 MR. FORD: I see. In terms of the negative heat
18 transfer coefficients that were observed, can you tell me at
19 what axial levels these were observed?

20 MR. MOORE: They were well above the hot spot. That
21 is specifically the point. They were where the temperature was
22 quite low of the cladding.

23 MR. FORD: Have you done any calculations which
24 guarantee that the superheated steam, a negative heat transfer
25 coefficient would always occur above the mid point?

QWT2

1 MR. MOORE: Yes.

2 MR. FORD: Where are those calculations presented?

3 MR. MOORE: Any one of these core cooling analyses
4 were computed with the hot spot temperature. You can see the
5 temperature itself is much greater than any saturated or even
6 superheated condition that could exist.

7 MR. FORD: Those are the calculations that you have
8 presented. What I am asking is whether you have performed
9 parametric calculations that indicate under no circumstances,
10 that is, under no combination of parameters, which you get
11 superheated steam at lower than the ten-foot elevations that
12 it was observed at in the FLECHT test?

13 MR. MOORE: Yes.

14 MR. FORD: You performed these parametric calculations
15 specifically for the point of determining the axial location of
16 superheated steam?

17 MR. MOORE: To determine the energy balance, yes.

18 MR. FORD: I am trying to ascertain whether or not
19 you have paid particular attention to the phenomena of super-
20 heated steam and whether you have performed calculations
21 specifically on that question.

22 MR. MOORE: Yes.

23 MR. FORD: Can you indicate where these calculations
24 are reported?

25 MR. MOORE: I don't know that there is any specific

QWt3

1 reporting of temperatures of steam in the core during the course
2 of the transient. I know of no specific report.

3 MR. FORD: And am I to interpret that as an indica-
4 tion that the calculations which you said had been performed
5 on superheated steam--you change your opinion to say they have
6 not been performed.

7 My question was for a specific reference.

8 MR. MOORE: I said there was no specific reference.
9 That's a different question.

10 MR. FORD: There is no specific reference--let me
11 get this straight--in which you specifically focused on the
12 question of superheated steam and determined the extent of
13 superheating and its role in loss of coolant accident?

14 MR. MOORE: Can we go back to the fundamentals and
15 the way we calculated the heat transfer? That is what you are
16 really getting at.

17 MR. FORD: Can you answer that question directly?

18 MR. MOORE: I can't directly, no. We have to under-
19 stand how the analysis is performed.

20 MR. FORD: Can you tell me, in your calculations of
21 the metal-water reaction rate, that the reaction is the function
22 of the cladding temperature? Is that correct?

23

24

25

1 MR. MOORE: Yes.

2 MR. FORD: Have you performed any calculations
3 defining the role of steam temperature in rate of reaction?

4 MR. MOORE: We just determined that the rate of
5 reaction is a function of cladding temperature.

6 MR. FORD: Yes. That's what I said. That's the way
7 in which you do calculate?

8 MR. MOORE: No. That is the basis for the rate
9 equation.

10 MR. FORD: I understand that. What I am asking is
11 whether you have performed calculations that indicate the
12 extent to which that rate equation would have to be modified
13 if you considered variations in the temperature of the steam.

14 MR. MOORE: It would not be modified. The
15 temperature of the cladding in terms of the rate.

16 MR. FORD: What I am asking for is the evidence for
17 that hypothesis.

18 MR. MOORE: I am afraid we are back to our previous
19 discussions on the metal water reaction kinetics where I
20 thought we ascertained that the metal water reaction was the
21 function of cladding temperature, not steam temperature.

22 MR. FORD: Yes. I am clear that that is the
23 position that you have taken. Can you tell me what experiments
24 you have performed with different temperature steam to verify
25 the fact that the metal water reaction rate is not a function,

1 in addition to your cladding temperature, of the temperature
2 of the steam?

3 MR. MOORE: We are back to the previous discussions
4 on the FLECHT tests where we had steam, we had temperature
5 of cladding. The temperature of the cladding was determined
6 and the reaction rate was determined on the basis of that
7 temperature and we fell below the Baker-Just relationship.

8 MR. FORD: Could the reporter read my question
9 back again, please.

10 (The last previous question is read by the reporter.)

11 MR. FORD: Now, in the test that you referred to
12 was the temperature of the steam varied to a range including
13 superheat?

14 MR. MOORE: We are talking about the FLECHT tests
15 now? That's the test I referred to.

16 MR. FORD: Yes.

17 MR. MOORE: As it said in the FLECHT Report, there
18 was.

19 MR. FORD: Did you in specifically ascertaining the
20 data in order to do sensitivity analysis on the superheat
21 steam -- is it correct that you'd have to measure the
22 temperature of the superheat steam?

23 MR. MOORE: In order to determine what?

24 MR. FORD: The sensitivity of steam temperature to
25 the metal water reaction rate.

1 MR. MOORE: To get a precise quantity for
2 sensitivity, yes.

3 MR. FORD: Did you measure the temperature of
4 superheat steam?

5 MR. MOORE: I believe there were some measurements
6 made.

7 MR. FORD: I have looked. Can you cite any measure-
8 ments here and explain how they were made?

9 MR. MOORE: No. We were not specifically measuring
10 the temperature steam. I believe there were some measurements
11 made in some of the tests. I don't even know if they are
12 reported in the report.

13 MR. FORD: Can you explain to me or can you document
14 any experiments that have been done to determine the
15 capability of the thermocouple used to measure accurately the
16 temperature of superheat steam?

17 MR. MOORE: No.

18 MR. FORD: Is it possible that the thermal inertia
19 or the mass of the thermocouples could interfere with their
20 ability to measure temperature of superheat steam?

21 MR. MOORE: Yes.

22 MR. FORD: Is it correct that the initial steam
23 temperature in the FLECHT test was uncontrolled?

24 MR. MOORE: Could you give me the reference, please?
25

R2Bt1

1 MR. FORD: The reference is Page 4.2 of the final
2 FLECHT report WCAP 7665. I will read the paragraph that I am
3 concerned with. It says, "Although prescribed reactor con-
4 ditions were accurate when produced, it is worth noting that
5 initial steam temperatures within the bundle were not con-
6 trolled in the PWR FLECHT tests. Reactor losses coolant acci-
7 dent calculations indicate that in some cases steam temperatures
8 at the start of reflooding may be within 100 degrees of the clad
9 temperature. As discussed in Section 3.6 PWR FLECHT steam
10 temperatures were in the superheat range at the start of
11 flooding but were generally several hundred degrees below the
12 clad temperature. This could be expected to have some effect
13 on the value of the initial heat transfer coefficient. How-
14 ever, it is not believed to have had a significant effect on
15 subsequent test behavior."

16 With regard to this statement it indicates here
17 reference to Westinghouse calculations that steam temperatures
18 at the start of reflooding may be within 100 degrees of the
19 clad temperature. Can you tell me for the FLECHT tests what
20 was the relationship of the temperature of steam to the tempera-
21 ture of the clad, initial temperature of the clad?

22 MR. MOORE: As stated in the report they were several
23 hundred degrees below the clad temperatures.

24 MR. FORD: But do you know exactly how many hundred
25 degrees below the clad temperature?

RQbt2

1 MR. MOORE: No. If we look at Section 3.6 which is
2 referenced.

3 The temperature of the steam is indicated in Figure
4 373 and 374 for a couple of runs.

5 MR. FORD: Yes. I am aware of the fact that it's
6 measured for a couple of runs, but in view of the fact as
7 asserted on Page 4.2 that this has a potential significant
8 influence on initial heat transfer, I am wondering if you can
9 find for me further data in addition just for a couple of runs
10 on what the initial steam temperature was during the FLECHT
11 tests.

12 MR. MOORE: No, I believe not.

13 MR. FORD: Do you believe that this--I mean that
14 this data is available, that you don't know whether it's
15 available? Because as I look over all of the FLECHT charts,
16 and there are dozens and dozens of heat transfer coefficients,
17 I don't find listed the specific parameter at all.

18 MR. MOORE: The specific parameter being the--

19 MR. FORD: Initial steam temperature.

20 MR. MOORE: --temperature at the beginning of the test.
21 I believe the data is available but not in this report.

22 MR. FORD: In terms of the argument that is advanced
23 on Page 4.2, the first premise that steam temperatures at the
24 start of reflooding may be within only a hundred degrees of the
25 clad temperature, do you know what specific calculations the

R2Bt3

1 document is referring to?

2 MR. MOORE: I don't know of the specific cases to
3 which this is referenced, no.

4 MR. FORD: Do you know in terms of calculations in
5 general the relationship between initial steam temperature to
6 initial clad temperature? Do you know whether the specific
7 relationship here is to be considered statistically representa-
8 tive of a whole population of relationships or is this aberrant
9 or what?

10 MR. MOORE: I really can't comment. I guess I would
11 have to determine at what point in time this particular cal-
12 culation was made and by what type of analysis.

13 MR. FORD: Assuming that it was at the defined end
14 of blowdown, could you give an answer in that case?

15 MR. MOORE: Well, the way we do the calculation at
16 the end of blowdown we assume that the situation is adiabatic
17 in the core and so there is no heat transferred to the steam
18 at all and so all the heat goes into heating up the rod. So
19 it's very difficult to then comment on what the temperature of
20 the steam is, because I am not taking any heat transfer into
21 the steam. That's the confusion I have here.

22 MR. FORD: I see. Now if I made the question, if I
23 put the parameter in terms of distance of the accumulator or
24 flooding water, if I put the parameter in terms of distance
25 between that water level and the bottom of the core, now that

R2Bt4

1 I am starting to provide for steam to be available, to be
2 heated up by the furnace, would you under those conditions given
3 distance of the water level from the bottom of the core, with
4 that as a parameter could you make the calculations we have been
5 discussing?

6 MR. MOORE: Yes. As soon as you reach the bottom of
7 the core with accumulator water you get intrainment of water.
8 Entrainment of water.

9 MR. FORD: Yes.

10 MR. MOORE: With the steam. This entrained water is
11 carried up through the core and the calculations show that at
12 the hot spot, which is at the core mid-plane, there is enough
13 heat transferred to the entrained water to boil it away.

14 So we always have a quality at the hot spot. We
15 don't have superheated steam at the hot spot during any part
16 of the transient, which is of course where we are looking for
17 the peak clad temperature.

18 MR. FORD: Is it possible that the quality of the
19 steam changes below and above the hot spot such that you would
20 have superheated steam below the hot spot changing the phase at
21 the hot spot and then turn to superheat at higher levels?

22 MR. MOORE: No.

23 MR. FORD: Have you any experimental observations
24 or any attempts to simulate, to make superheated steam below
25 it and watch what happens to it?

R2Bt5

1 MR. MOORE: Well, that's just a physical effect,
2 that the power level as I rise in the core is always increasing
3 with respect to the hot spot. In other words, adding heat on
4 the way up. I am not taking heat away and there is always
5 more and more heat being added per unit length as I go up the
6 core.

7 So you can't have a situation where I would get super-
8 heated steam and then revert back to a quality situation,
9 adding heat all the time.

10 MR. FORD: Yes.

11 MR. MOORE: It's just a physical impossibility.

12 MR. FORD: Can you tell me in terms of the steam
13 probes that you use whether the information from them is suf-
14 ficient to confirm your hypothesis, namely, that there is no
15 superheated steam below mid-plane during the FLECHT test?

16 MR. MOORE: I am not sure. I would have to check the
17 data. I would be doing it just on the basis of a heat balance,
18 a physical heat transfer relationship. We calculate the heat
19 transfer coefficients along the rods and, you know, the heat is
20 going out of the rod.

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1 MR. FORD: In terms of the heat transfer calcula-
2 tions that you do, have you ever predicted negative heat
3 transfer coefficients?

4 MR. MOORE: Which calculations are we speaking
5 about?

6 MR. FORD: I am talking in terms of any of the
7 analysis that you do on the loss of coolant accident situation,
8 have you predicted, in terms of theoretical models that you
9 have available, any of them, are they negative heat transfer
10 coefficients?

11 MR. MOORE: Do you understand what negative heat
12 transfer coefficients are? It is really a misnomer. It is
13 a calculation of the cladding and the temperature of the
14 coolant. If the coolant temperature is higher than the
15 cladding, we have heat transfer in the reverse direction.
16 I am not aware of any loss of coolant situation where that
17 obtained.

18 MR. FORD: I am talking in more general theoretical
19 sense.

20 MR. MOORE: So am I.

21 MR. FORD: I am talking about the extent to which
22 the models that you have available for analyzing behavior
23 and loss of coolant accident, whether they have given you an
24 indication that this reverse heat flow, negative heat
25 transfer coefficient, that it would be a phenomenon occurring

1 in a loss of coolant accident.

2 MR. MOORE: Yes. I don't expect, under the
3 conditions of the loss of coolant accident, except perhaps at
4 the very upper parts of the core, which are very low power
5 regions, to have any kind of a reverse heat transfer.

6 MR. FORD: What I was asking was not what your
7 expectation was.

8 MR. MOORE: Based on the analyses performed.

9 MR. FORD: What I am asking is whether the
10 analytical models that you have, whether you have taken them
11 and you assigned them the task of analyzing the sign of
12 heat transfer coefficients during an accident. Have you ever
13 taken the models and explicitly analyzed the question and the
14 answer somewhere we can study it?

15 MR. MOORE: Certainly any heat transfer calculation
16 performs part of the loss of coolant accident analysis. It
17 takes the heat and the cladding and calculates the heat
18 removed at the surface of the cladding. If the temperature
19 gradient is in the reverse direction, heat will come back
20 into the cladding in the analysis.

21 CHAIRMAN JENSCH: The question is, have you made
22 any calculations that give you the prediction?

23 MR. MOORE: At some time or another I am sure we
24 have had those kind of calculations. I think it is an
25 academic question.

1 CHAIRMAN JENSCH: Academic, theoretical, realistic
2 or anything. It is just a question. Do you have calcula-
3 tions that predict it?

4 MR. MOORE: Do I have calculations that predict
5 reverse heat transfer during a loss of coolant, is that the
6 question?

7 CHAIRMAN JENSCH: That is what I understand is the
8 question.

9 MR. MOORE: No, I don't predict reverse heat
10 transfer during loss of coolant.

11 MR. BRIGGS: May I ask a question, too?

12 MR. FORD: Certainly.

13 MR. BRIGGS: What is the quality of the steam leaving
14 the highest power bundle during the loss of coolant accident?
15 Just what is the quality of the steam? Do you know?

16 MR. MOORE: It is very close to one.

17 MR. BRIGGS: So it is less than one, is it?

18 MR. MOORE: If I recall, it just about reaches one
19 as a maximum.

20 MR. BRIGGS: So on that basis the steam temperature
21 is pretty much constant all the way through the bundle; is
22 that correct?

23 MR. MOORE: Yes.

24 MR. FORD: Mr. Briggs' question anticipates a
25 question of mine with regard to a statement on page 3-126 of

1 WCAP-7665, which explicitly talks about the steam that is
2 leaving the top of the bundle in which it states, and I quote:
3 "An unreasonably high effluent steam temperature was
4 required from the amount of carry-over reported in Reference
5 3 for similar conditions."

6 In terms of your answer to Mr. Briggs' question,
7 does that data on steam effluent temperature referred to here
8 provide a basis for your answer, a contradiction of your
9 answer or what?

10 MR. MOORE: Well, it is a basis for my answer. On
11 page 3-126, "10 per cent of the coolant supplied to the
12 inlet was carried over so that there was a steam-water
13 mixture coming out of the bundle."

end

14 That's my point.
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1 MR. FORD: What about the point about the unreasonably
2 high effluent steam temperature? Is the analysis that you
3 have sufficient, since you weren't specifically looking for it,
4 and sufficiently able to distinguish in terms of the quality
5 of mixture coming out, whether part of it is saturated steam
6 and so forth?

7 MR. MOORE: I believe the reference in context,
8 reading from page 3-123 on, is to try to correlate the amount
9 of carry-over that was measured with the carry-over measurement
10 system to a heat balance to see whether they made sense.
11 There was some question about the previous carry-over measure-
12 ments. When the improved carry-over measurements were made,
13 they checked reasonably well with the heat balance. In order
14 to get the carry-over that was previously measured and check
15 it, you had to add, I gather from the statement, your heat
16 balance effectively required and much higher steam temperature
17 than you would have had expected.

18 MR. FORD: What I am concerned with is the question
19 of whether or not this problem that occurs in estimating the
20 carry-over water, whether this problem is due to the fact that
21 this unrecognized heat condition in the effluent is possible.
22 Is that possible?

23 MR. MOORE: I find it difficult to have superheated
24 steam in contact with saturated or subcooled water entrained.
25 Now, I don't think that condition existed.

1 MR. FORD: In terms of the thermal dynamic here
2 and in terms of the time it would take to get, instead of
3 superheated steam and jets of two-phase fluid, in terms of the
4 time it would take to get a homogeneous mixture there, is it
5 unreasonable to have both of them existing as effluent from
6 tops of bundles?

7 MR. MOORE: Yes, I believe that's unreasonable

8 MR. FORD: In terms of the thermodynamics here and
9 in terms of the time it would take to get, instead of
10 superheated steam and jets of two-phase fluid, in terms of
11 the time it would take to get a homogeneous mixture there, is
12 it unreasonable to have both of them existing as effluent
13 from tops of bundles?

14 MR. MOORE: Yes, I believe that's unreasonable.

15 MR. FORD: Can you set forth experimental data
16 pertaining to the time history of mixing between superheated
17 steam of whatever the temperature is here, and the two-phase
18 liquid of whatever the temperature is. Can you set forth
19 experiments that explicitly address themselves to the time it
20 would take to reach an amount of equilibrium for that flow?

21 MR. MOORE: I'm sure there must be experiments in
22 the field of thermodynamics and heat transfer related to that,
23 yes.

24 MR. FORD: The question was, can you set them forth?

25 MR. MOORE: No. I don't understand the relevance

1 either to the line of questioning.

2 MR. FORD: I'm sorry.

3 Back to the line of questioning.

4 The temperature of the superheat steam, do you have
5 any upper bound for that, what it could possibly be?

6 MR. MOORE: It won't be any higher than the peak
7 clad temperature.

8 MR. FORD: In terms of simply the thermodynamics of
9 superheated steam, what is the maximum possible temperature
10 that you have as a temperature in superheated conditions?

11 MR. MOORE: Under what conditions?

12 MR. FORD: Simply under the conditions of the higher
13 part of the bundle during loss of coolant accident. Is there
14 any limit up -- I'm sure there is. What is the limit to the
15 temperature that could occur?

16 MR. MOORE: It is a function of the heat transfer
17 from the fuel rods themselves.

18 MR. FORD: I appreciate that. What I am asking is,
19 as a function of the heat transfer from the fuel rods, the
20 time involved and the velocity of the superheated steam, I am
21 asking what is the upper bound for the temperature of the
22 superheated steam?

23 MR. MOORE: As I said, we are very close to
24 saturation at low flooding rates at the exit of the core. I
25 don't have a number for how much above saturation I could be.

1 I think you have to be more specific under the conditions you
2 are asking me to answer the question.

3 MR. FORD: Under the conditions that are listed,
4 given your hottest rod, given the axial co-sign power
5 distribution, given the velocity of the superheated steam,
6 under those conditions, those aren't enough conditions, is that
7 your problem?

8 MR. MOORE: If I look at the FLECHT results under
9 those conditions, I still have steam - water discharging.
10 Under the conditions of the hottest rod, the water, the heat
11 transfer --

12 MR. FORD: In terms of the FLECHT results for
13 specific bundle measurements of the quality of the fluid, can
14 you cite in the FLECHT reports the question of whether or not
15 there is superheated steam there that has been explicitly
16 answered? Do they say they looked in every case and measured
17 the quality of the effluent and made sure there was no
18 superheated steam and used such and such a technique to decide
19 that?

20 MR. MOORE: I don't believe I could find a reference
21 to that directly. I can't directly right now.

22 MR. FORD: Just to have the record have some actual
23 examples of negative heat transfer coefficient, I'd like to ask
24 you simply just about a number of figures in the report,
25 whether they show the presence of these negative heat transfer

1 coefficients.

2 On WCAP 7665, I refer to page C-43. Does the data
3 from that FLECHT run, does that indicate between zero and
4 30 seconds after flooding? Does that indicate the presence
5 of a negative heat transfer situation?

6 MR. MOORE: Yes.

7 MR. FORD: The FLECHT then reported on page C-39,
8 does that represent that situation? Is there a negative heat
9 transfer coefficient there?

10 MR. MOORE: No.

11 MR. FORD: You don't think so?

12 MR. MOORE: No.

13 MR. FORD: On page C-21, that is, I take it, a
14 clear negative heat transfer coefficient?

15 MR. MOORE: Which one?

16 MR. FORD: Page C-21.

17 MR. MOORE: Yes.

18 MR. FORD: In terms of the directions on the heat
19 transfer coefficient indicated on the quotation earlier on
20 page 42, it indicates that the superheated steam could have
21 some effect on the value of the initial heat transfer
22 coefficient. For the record, can you clarify the direction
23 of the effect?

24 MR. MOORE: I believe that would give us a somewhat
25 larger heat transfer coefficient. It would be an additional

1 90 degrees or so below the clad temperature.

2 MR. FORD: You mean the superheat would contribute
3 to a positive heat transfer coefficient rather than a
4 negative one?

5 MR. MOORE: Yes. In this case, if the steam
6 temperature is built below the clad temperature, the heat is
7 coming from the clad to the steam.

8 MR. FORD: That is how you are interpreting it.
9 The 90 degree difference, does that refer to the difference
10 they are talking about between superheated steam in the clad
11 or the difference at the start of the reflooding simply
12 between clad and the initial temperature of the steam?

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1 MR. MOORE: This is at the start of the reflooding
2 where the steam temperature is below the cladding temperature.

3 MR. FORD: Right. Now this doesn't say here, am
4 I correct, that the superheat temperature relative to
5 cladding is in constant difference of a hundred? This is just
6 initial conditions for this test.

7 MR. MOORE: That's right.

8 MR. FORD: Without reference to superheat.

9 Now, my question is in terms of superheat steam is
10 it correct that if we had superheat steam in the accident as
11 opposed to steam at lower temperature, that the effect of
12 this would be to decrease the initial heat transfer
13 coefficient as stated here.

14 MR. MOORE: Not the way we have used the data. I
15 think that is where you are probably confused.

16 MR. FORD: Excuse me. Not the way you used the
17 FLECHT data?

18 MR. MOORE: That's right.

19 MR. FORD: I see. So that the negative heat
20 transfer coefficients here, you never actually plug these into
21 your computer codes, is that correct?

22 MR. MOORE: Yes. Let me explain. We take the
23 FLECHT heat transfer where we determine the heat transfer from
24 a backward calculation of the heat balance. So that we know
25 the heat into the rod. We know the cladding temperature and

1 we assume for purposes of obtaining the data that the
2 temperature around the rod is saturation temperature, not
3 superheat. O.K.?

4 Now, we calculate then based on the heat input into
5 the rod and FLECHT and its temperatures, the equivalent H or
6 heat transfer coefficient to transfer that heat with a
7 temperature gradient equivalent to the clad temperature minus
8 the saturation temperature of the steam.

9 Now, when we do the analysis for the reactor we do
10 it in a completely consistent way. We again take the hot
11 channel, hot spot. We assume that the sink temperature is
12 saturation and get the equivalent heat transfer coefficient
13 in order to transfer the heat. This way we have obviated
14 any consideration with respect to superheat per se.

15 MR. FORD: I see. Then in terms of the computer
16 code then before you put in heat transfer coefficients am I
17 correct you have already calculated what the sink
18 temperature is?

19 MR. MOORE: Yes. For the calculation of the peak
20 clad temperature we assume the sink temperature is saturated,
21 that's right.

22 MR. FORD: No. That is what I am trying to get
23 through. You say you assumed that the sink temperature is
24 saturated.

25 MR. MOORE: Just that we assumed it was saturated

1 for the FLECHT test in deriving the basic heat transfer
2 coefficient in the first place. So we are consistent.

3 MR. FORD: I see. Yes. I appreciate the con-
4 sistency. But the thing that interests me is to get clear
5 on what it means to assume that the sink has a saturation
6 temperature.

7 MR. MOORE: Oh.

8 MR. FORD: I mean does the computer code go through
9 and before you put in heat transfer coefficients, before you
10 do heat up does the computer code go through and compute what
11 the sink temperature is or do you, as you seem to be
12 indicating, at some point in the accident, assume such-and-
13 such a sink temperature, take the heat transfer coefficients
14 from FLECHT data pertaining to that sink temperature and
15 then go on with the calculations? I am giving you a
16 dichotomy.

17 MR. MOORE: It's the latter, in that we take the
18 temperature according to the pressure that exists at the end
19 of blowdown and during the reflood. We take that pressure
20 and the saturation temperature associated with that
21 pressure to get the heat transfer.

22 MR. FORD: Could you repeat that? You take the
23 temperature associated with the pressure predicted, this
24 average core pressure.

25 MR. MOORE: Yes. At the end of blowdown. It's

1 effectively containment pressure.

2 MR. FORD: Do you assume the entire core is in
3 thermodynamic equilibrium?

4 MR. MOORE: You are talking about the fuel at the
5 cladding and everything?

6 MR. FORD: Yes.

7 MR. MOORE: No.

8 MR. FORD: I am talking about the state of the fluid.

9 MR. MOORE: The fluid is assumed to be saturated
10 throughout, yes.

11 MR. FORD: When you compute the relationship between
12 the temperature and the core pressure do you consider the
13 subsaturation temperature metastable states, as Van der waal's
14 equation of state?

15 MR. MOORE: Would you repeat the question, please?

16 MR. FORD: When you relate temperature to core
17 pressure, you know, at the subsequent move before plugging
18 a heat transfer coefficient do you in terms of the way in
19 which you regard a thermodynamic state of the coolant, do
20 you regard it as being in at the subsaturation temperatures
21 as being in the metastable equilibrium that you get from
22 Van der waal's isotherms?

23 MR. MOORE: No. For the analysis of the peak clad
24 temperatures we assume it's as saturated.

25 MR. FORD: Yes. But do you understand what

1 Van der waal's isotherm is?

2 MR. MOORE: We just follow the steam tables of
3 temperature and pressure and thermo equilibrium.

4 MR. FORD: Yes. Do you understand what Van der waal's
5 isotherm is?

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T2Bt1

1 MR. TROSTEN: Object to the question. The witness
2 has been asked the question. He has answered it. Mr. Ford is
3 asking the same question again.

4 CHAIRMAN JENSCH: Yes. I suppose it would be more
5 direct if he'd answer yes or no.

6 The question was do you understand Van der wall's
7 isotherms, and he purported to explain something. I don't know
8 whether it had anything to do with Van der wall or not.

9 Do you understand Van der wall's isotherms or not?
10 Yes or no?

11 MR. MOORE: No.

12 CHAIRMAN JENSCH: Thank you.

13 MR. FORD: Thank you.

14 Now, can you tell me in general terms what the relation-
15 ship is between core pressure and the formation of superheated
16 steam.

17 MR. MOORE: We bring water in, sub-cooled. We heat
18 it up. It flashes. It entrains water. You add additional
19 heat. If you have enough heat to boil all the entrained water
20 off and continue to add heat it will superheat the steam.

21 MR. FORD: My question was what is the general
22 relationship between the quantity of superheat steam formed and
23 the core pressure?

24 MR. MOORE: The core pressure determines where my
25 saturation temperature is.

1 MR. FORD: So then what is the general relationship
2 between superheat formation and core pressure?

3 MR. MOORE: I don't understand the question.

4 MR. FORD: Well, you have the logic for it, but I
5 was just trying to make you go all the way.

6 Is it correct that the lower the pressure there is
7 the great quantity of superheat steam, all other things being
8 equal?

9 MR. MOORE: All other things being equal, yes.

10 MR. FORD: Thank you.

11 Now in terms of the range of pressures expected in
12 containment, I think we got into this a little bit earlier, can
13 you tell me what is the lowest pressure in the vessel during
14 brief flood. What is the lowest pressure in the vessel that
15 is consistent with all the experimental and theoretical data
16 you have on that subject?

17 MR. MOORE: During reflood?

18 MR. FORD: Yes.

19 MR. MOORE: The lowest pressure in the vessel would
20 be equal to the containment pressure plus the driving head
21 associated with the hydrid downcomer which is about fifteen or
22 sixteen feet of water. So it's within a few psi of the con-
23 tainment pressure. It's above the containment pressure. About
24 seven psi.

25 MR. FORD: So in order to answer this you have to

T2Bt3

1 tell me or I might as well as what is the lowest containment
2 pressure that would occur under variations in all the parameters
3 which influence it?

4 MR. MOORE: Again, during the refloods? The reflood
5 phase?

6 MR. FORD: Yes.

7 MR. MOORE: We consider that the containment pressure
8 would not be below 80 per cent of the calculated rise in
9 pressure due to the blowdown.

10 In other words, we take the peak pressure, calculated
11 due to the blowdown and the pressure during the reflood will be
12 a rise of 80 per cent of that additional rise. So that you
13 will drop the pressure by that much.

14 MR. FORD: Now in terms of variations in parameters
15 of blowdown, extremely slow blowdowns, extremely fast ones, and
16 so forth, I understand the standard is sort of a medium speed
17 blowdown. Now can you tell me in terms of the range of all
18 of the various factors influencing blowdowns what is the lowest
19 pressure psi that you will get in the containment during this
20 period? I realize you say it will be 80 per cent of whatever
21 the peak was, peak pressure was during blowdown itself.

22 Now given all the variations in that what is the
23 lowest pressure that we will get to in the containment?

24 MR. MOORE: Given all the variations in what? I am
25 having trouble following the question.

T2Bt4

1 MR. FORD: Given all of the variations and factors
2 influencing the rate of blowdown, influencing the maximum
3 pressure, at the highest pressure during blowdown.

4 MR. MOORE: Well, the peak pressure in the contain-
5 ment is not a very strong function of the blowdown time, be-
6 cause the blowdown time is relatively short with respect to
7 any heat transfer mechanisms in the containment itself, so if
8 our blowdown in fifteen seconds versus eighteen seconds versus
9 thirteen seconds, I don't expect to get a significant change of
10 containment pressure.

11 MR. FORD: Well, let's suppose that we calculate
12 containment pressure, assuming, for example, that all of the
13 energy, all of the heat in the containment, is dissipated
14 readily, just to put a lower bound or at least upper bound, I
15 guess, on it. You have this lower bound on containment. If
16 you create this lower bound on containment pressure do you
17 have anyscoping calculations which would indicate what that
18 greatest lower bound would be?

19 MR. MOORE: We have determined that containing
20 pressure is a function of the heat sinks and to some extent
21 then early in the transient the engineers' safeguards come
22 into play and the number I have quoted for the 80 per cent
23 factor for containment pressure assumes greater heat transfer
24 capability in the containment than is normally provided or
25 normally taken credit for for the design.

T2Bt5

1 In other words, we have overestimated the amount of
2 heat removal in the containment to do just what you are saying,
3 determine a lower bound for pressure, and that is the basis for
4 the 80 per cent.
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MR. FORD: Now what does this come out to in psi? What is the lowest value of this lower bound out of all calculations that you have done of different accident situations?

MR. MOORE: It was no lower than the 80 per cent number.

MR. FORD: Yes, I realize 80 per cent of another pressure, but what is the psi?

MR. MOORE: In psi? I'd have to check the containment design pressure. I could get the number if you want to take the time. It's there.

MR. FORD: We will be happy to just let you give us the number during the break or later.

But in terms of the general relationship between superheat formation and core pressure is it clear that the lower the pressure the more superheat you would be expected to have, all other things being equal?

MR. MOORE: Yes.

MR. FORD: In terms of the possible eutectic formation during the course of a loss of coolant accident did the tests that you performed on eutectic formations involve study of superheat effects?

MR. MOORE: No. As described in the report they were heated up in air and it was an attempt to get a larger than expected time at peak temperature. Larger than expected

1 during loss of fluid accident.

2 MR. FORD: In terms of the ability of superheated
3 steam liquid droplets to exist in the channel, would you refer
4 to page 3-117 of W 7665. Is it correct as it's stated here
5 that, "The amount of initial superheat increased with initial
6 clad temperature but lacked the clad temperature by several
7 hundred degrees. During the run superheated steam was found
8 to be present for long periods of time, indicating that the
9 coolant was a non-equilibrium mixture of steam and liquid
10 droplets."

11 Do you agree with that? Is there a qualification
12 you would make to that?

13 MR. MOORE: I have no reason to dispute that. I
14 agree with that.

15 MR. FORD: Is it correct that as observed on page
16 3-123 "that the presence of superheated steam during the run
17 was consistent with the negative heat transfer coefficient
18 calculated by the datar code to the 10-foot elevation in
19 some runs? The peak steam temperature and the time of super-
20 heat observed tended to increase with decreasing flow rate
21 and increasing blockage." Excuse me. That was decreasing
22 flooding rate and increasing blockage.

23 MR. MOORE: Yes.

24 MR. FORD: Have you analyzed in the flow blockage
25 tests that you have performed, have you specifically analyzed

1 the relationship between the increase in blockage and the
2 superheat observed?

3 MR. MOORE: Have we related a lot of superheat to
4 amount of blockage?

5 MR. FORD: Yes.

6 MR. MOORE: Not directly, to my knowledge. We were
7 mainly interested in the heat transfer coefficient.

8 MR. FORD: Now this data indicates that superheat
9 increases would increase in blockage. Can you tell me do you
10 have any data pertaining to the flow channel blockage that
11 disputes this statement?

12 MR. MOORE: No. I think the pertinent information
13 is the heat transfer you get at the hot spot with blockage,
14 which was measured directly. As I said before, we have not
15 wanted to get into a complication with respect to superheat,
16 so we have produced the data consistently and used consistently
17 for cooling analyses just for that very reason.

18 MR. FORD: Am I correct that in terms of the
19 multi-rod burst tests that you have done that the blockages
20 and the swelling, ruptures, that that would be expected along
21 the one-seventh of the axial length of the rod located near
22 the middle of the hottest section?

23 Is that correct?

24 MR. MOORE: Well, I can't tell whether you are asking
25 a broader question. We expect the blockage to occur over a

1 one to two feet section because of the power distribution.

2 MR. FORD: Right. At the highest parallel of the
3 rod.

4 MR. MOORE: Yes.

5 MR. FORD: So that the statement here that increasing
6 blockage increases the amount of superheat formation, that
7 means that there can be, therefore, superheat formation near
8 the maximum temperature point because that's where the
9 blockage is.

10 MR. MOORE: Perhaps. But apparently the results
11 show this was an improvement in heat transfer.

12 MR. FORD: I see. Now, in terms of blockage being
13 described here is the datar code talking about the particular
14 orifice that you used to simulate blockage or are they
15 talking about blockage in general resulting actually from
16 different geometry of rod swelling and rupturing?

17 MR. MOORE: Any references to the datar code would
18 be the specific data obtained in our own blockage test.

19 I think the answer is yes, if that was the question.

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end

1 MR. FORD: In terms of the thermodynamics of the
2 conversion of uranium dioxide to U3O8 during course of loss
3 of coolant accident, with superheated steam, would that
4 increase that reaction rate or decrease it?

5 MR. MOORE: I really can't comment on that. That
6 is a subject that you went into at some length with Dr. Roll
7 earlier.

8 MR. FORD: Thank you.

9 Does the flooding rate vary with time and actual
10 loss of coolant accident situation?

11 MR. MOORE: Yes.

12 MR. FORD: In terms of the variable flooding rates
13 that were used during the FLECHT test, is it correct that
14 in only seven of the 73 tests that variable flooding as
15 opposed to constant rate flooding was used?

16 MR. MOORE: I presume your numbers are correct.
17 They are all reported in the report.

18 MR. FORD: Is it correct that the flooding rate in
19 the data here has been indicated as influential in the
20 formation of superheat?

21 MR. MOORE: There is a tendency to form superheat at
22 low flooding rates because of just the heat input along the
23 channel.

24 MR. FORD: Is it correct in this regard as analyzed
25 by page 340 of WCAP-7665, that, "Negative heat transfer

1 coefficients were generally found at the ten-foot elevation
2 below flooding rate runs two inches per second or less at
3 early times from around five to a maximum of around 120
4 seconds after the flood"?

5 MR. MOORE: Yes.

6 MR. FORD: Can you give us the equations that were
7 used to predict the variable flooding rates used in the
8 FLECHT test?

9 MR. MOORE: Which predictions are you referring to?

10 MR. FORD: In the Idaho nuclear report, their
11 overview report of the FLECHT test, Document IN-1386 entitled,
12 "Pressurized water reactor full length emergency cooling
13 heat transfer, BWR test FLECHT project, April 1970." They
14 gave a figure 5 predicting the variable flooding rate
15 versus time. I have two questions:

16 First, what is the basis of this prediction?

17 Secondly, is this the variable flooding rate used in the test,
18 because the data that I have just says flooding rate variable.

19 It doesn't give it.

20 MR. MOORE: May I see the reference, please?

21 MR. FORD: Sure.

22 MR. MOORE: You are referring to figure 5 which is
23 a predicted reactive variable flooding rate versus time?

24 MR. FORD: Yes.

25 MR. MOORE: I don't really know who predicted that

1 particular curve.

2 MR. FORD: I don't know who did. The thing I am
3 concerned with is, I cannot find, in your own FLECHT reports,
4 any clear indication as to either how, A, you predict
5 flooding rates during the accident, or, B, how you predict
6 flooding rates for the FLECHT test. I am looking for data in
7 this area.

8 MR. MOORE: I see.

9 MR. FORD: Can you respond in a general way to that
10 concern?

11 MR. MOORE: Yes. The flooding rate prediction for
12 the reactor is described in some detail in the July 13th
13 submittal. What we do is calculate the head generated in the
14 downcomer, the height of water. The height of water in the
15 downcomer acts as a force to drive steam-water through the
16 core up through the hot legs, through the steam generators,
17 back through the pumps, in the annulus and out through the
18 break. So there is a relationship between the driving head
19 generated by the downcomer and the amount of mass or steam
20 flow that you can push through with that pressure drop. So
21 we calculate using the assumptions indicated in the report,
22 a low value or a lower value than expected for the flooding
23 rate into the core. From that we determine the heat transfer
24 coefficients using the basic FLECHT data. The FLECHT data
25 was determined on a parametric basis and was not intended to

1 be any specific representative flooding rate versus time
2 transient.

3 MR. FORD: So that when you use the FLECHT data, the
4 main determinant of which FLECHT heat transfer coefficient
5 you use is what core pressure that you predict for reflood;
6 is that correct?

7 MR. MOORE: No. Pressure per se is not the
8 significant parameter with respect to FLECHT transfer. It has
9 a related effect in that the pressure determines the velocities,
10 and therefore the pressure drops around the system. So that
11 the pressure you have in the coolant system determines the
12 density of the steam. For a given mass flow, determines
13 the velocity of the steam. That's mainly the effect of
14 pressure on flooding.

15 MR. FORD: As I understand your calculations, is
16 it correct that when you compute core pressure at the
17 beginning of reflood in order to select the temperature and
18 maximum cladding and in order to select the heat transfer
19 coefficients, that is the pressure that you compute for the
20 hot spot and is the same pressure along the entire length
21 of the rod; is that correct?

22 MR. MOORE: Yes.

23 MR. FORD: So when you choose the heat transfer
24 coefficients, do you use the same heat transfer coefficient
25 over the entire length of the rod?

1 MR. MOORE: Yes.

2 MR. FORD: So that the heat transfer coefficients
3 that you derive for different axial levels in the FLECHT
4 data, you don't actually heat them in the computer code; is
5 that correct?

6 MR. MOORE: That's correct, we do not.

7 MR. FORD: I see.

8 MR. TROSTEN: Mr. Chairman, while Mr. Ford is
9 preparing the next question, I wonder if perhaps under this
10 type of highly technical questioning it wouldn't be preferable
11 if we could have a break for the witness every hour or so for
12 five minutes.

13 CHAIRMAN JENSCH: Certainly, anything that will be
14 a revival activity for lawyers as well as the witness will
15 be appreciated. If you can tell us what the computer time
16 is in your code, we will be glad to run through our code.

17 At the moment, let us recess and reconvene in this
18 room at 4:25.

19 MR. TROSTEN: Thank you very much, Mr. Chairman.

20 MR. MOORE: Thank you, Mr. Chairman.

21 (Recess.)

22

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24

25

end

1 CHAIRMAN JENSCH: Please come to order.

2 Mr. Moore has resumed the stand. Are you ready to
3 proceed?

4 MR. FORD: I will be ready in just a second.

5 Excuse me. I am making a diagram.

6 I am ready to proceed.

7 I have reproduced on the paper here Figure 3 from
8 the Idaho Nuclear Report 1386, Pressurized Water Reactor Full
9 Length Emergency Core Cooling Heat Transfer Tests Project
10 Report. The caption for Figure 3 is Heat Transfer Coefficient
11 for PWR FLECHT Test Conditions Representative of Those in
12 Large Pressurized Water Reactors During A Loss of Coolant
13 Accident, and I will give the figure to Mr. Moore to ask him
14 to confirm whether more or less I have properly drawn and have
15 not misrepresented the figure in any ghastly way.

16 MR. MOORE: No. I agree.

17 MR. FORD: Fine.

18 CHAIRMAN JENSCH: In case there is any doubt, use
19 the one in the book, of course.

20 MR. FORD: Right. I am sure Mr. Moore would use the
21 one in the book. This is so everyone else can follow what we
22 are discussing, and of course, if I were to expand this chart
23 to take into consideration negative heat transfer coefficients
24 we would be going in this direction here.

25 Now, I would refer to the FLECHT Test Report, page
340, which I have quoted a number of times.

end

WWT1

1 MR. MOORE: Yes.

2 MR. FORD: It mentions that negative heat transfer
3 coefficients were generally found at the ten-foot elevation
4 for low flooding rate run, two inches per second or less at
5 early times, from around five up to a maximum of about 120
6 seconds after the flood.

7 This means that, in terms of this graph, in terms
8 of point of reference of typical values for the heat transfer
9 coefficients--am I correct that this means that this curve
10 here, about, I believe, five seconds after the flood to up to a
11 maximum of 120, that this entire curve would be below the zero
12 point for the entire range given at Idaho Nuclear of typical
13 heat transfer coefficient values code?

14 MR. MOORE: The question is if we had a negative heat
15 transfer coefficient as defined in the report?

16 MR. FORD: Yes. My question is, in terms of how I
17 represent this negative heat transfer coefficient, in terms of
18 the range of typical coefficients in typical conditions that
19 have been given at Idaho Nuclear summary, PWR FLECHT data, if
20 I wanted to represent this typical heat transfer coefficient
21 that is cited in the document, is this an accurate representa-
22 tion of approximately the way it would look on the curve? I
23 mean its relationship to the rest of the data.

24 Is that correct?

25 MR. MOORE: I really don't know. It is in the right

Wwt2

1 sign. I don't know about the magnitude compared to the others.

2 MR. FORD: Fine. Simply in terms of the fact that is
3 it clear that in terms of the definition of the maximum length
4 of time over which this negative heat transfer coefficient was
5 reported, is it clear that that length of time goes the entire
6 length and more of the typical way in which heat transfer co-
7 efficients are reported?

8 DR. GEYER: Is the bottom dotted curve for the upper
9 portion of the core, the top of a rod?

10 MR. FORD: Yes, sir. No. It is for the ten-foot
11 elevation. In terms of the claims in which the core is
12 divided, as indicated on Page 340 here, this is the ten-foot
13 elevation for a specific FLECHT test.

14 DR. GEYER: Thank you.

15 MR. MOORE: I refer to the figure on Page 342 of the
16 FLECHT report.

17 MR. FORD: Yes.

18 MR. MOORE: The top figure, the flooding rate of one
19 inch per second. That should be the ten-foot elevation as
20 shown there with a very slightly negative coefficient. Then
21 it rises, as you can see.

22 MR. FORD: That's true. It is negative until the
23 point of, approximately, am I correct, one hundred seconds after
24 the time of reflooding?

25 MR. MOORE: Yes.

WW3

1 MR. FORD: My point is, that is another case in which
2 the coefficient is negative for one hundred seconds. Does that
3 contradict this at all?

4 MR. MOORE: Yes. I'm trying to get this in the
5 right perspective on the scale, that's all.

6 MR. FORD: Your test here is negative for one hundred
7 seconds; is that correct? I am talking about one hundred and
8 twenty.

9 MR. MOORE: You are drawing a curve with respect to
10 the Idaho report which is a flooding rate of six inches per
11 second. You see, their ten-foot elevation never had negative
12 coefficients. You are comparing that to--you see, they did
13 not have a negative coefficient.

14 MR. FORD: Excuse me. If I am referring to the chart,
15 can I point here and ask you whether or not that is below--

16 MR. MOORE: That is what I am talking about. The
17 Idaho report that you have sketched up there--

18 MR. FORD: That's true. Excuse me. Can I explain
19 my point in putting on this Idaho chart? My point is to show
20 that when we get to negative heat transfer coefficients, it is
21 into just a tiny dip that is reported in the pages I read you
22 earlier for negative heat transfer coefficients; that you can
23 get negative heat transfer coefficients all the way across the
24 critical initial one hundred seconds or so after reflooding;
25 is that correct? Your additional case, I believe, is a second

WWT:3

1 instant of this negative heat transfer coefficient for a long
2 time, the case on Page 342.

3 MR. MOORE: Yes.

4 MR. FORD: Thank you.

5 CHAIRMAN JENSCH: Which question did he answer? You
6 gave him two. I think he may have had a second question in
7 mind. The first question was, would you get a line all across
8 for the time scale depicted with a negative coefficient.

9 MR. MOORE: The answer is yes. Instead of using the
10 freehand curve, let's use the one where it actually exists in
11 the test.

12 CHAIRMAN JENSCH: Very well.

13 MR. FORD: Fine.

14 In terms of our discussion before the break, in which
15 you explained how you selected these transfer coefficients, is
16 my understanding correct that you, first of all, compute average
17 core pressure; is that correct?

18 MR. MOORE: Yes.

19 MR. FORD: Then the model assumes that that same core
20 pressure is the same along the entire length of the rod; is that
21 correct?

22 MR. MOORE: It assumes it is and it also is very
23 similar across the length of the core.

24 MR. FORD: Then the model goes and chooses a heat
25 transfer coefficient; is that correct?

WWt5

1 MR. MOORE: Based on a flooding rate, yes.

2 MR. FORD: And based on the temperature that exists
3 at the hot spot with the pressure that you have calculated; is
4 that correct?

5 MR. MOORE: I get a heat transfer coefficient from
6 the flooding rate. I have the saturation temperature at the
7 hot spot.

8 MR. FORD: Is it correct that in the sequence you
9 compute the pressure and then you compute what temperature
10 would exist with that pressure, and then knowing that saturation
11 temperature, you go and get a heat transfer coefficient; is that
12 correct?

13 MR. MOORE: Yes.

14 MR. FORD: And the heat transfer coefficient you pick
15 since you are concerned with the maximum temperature, and that
16 is the coefficients along the six foot elevation; is that
17 correct?

18 MR. MOORE: Yes, that is associated with the hot
19 spot.

20 MR. FORD: You assume, when you pick the temperature
21 coefficient, do you not--when you pick the heat transfer
22 coefficient, rather, that you apply the same heat transfer
23 coefficient over the entire axial length of the rod; is that
24 correct?

25 MR. MOORE: Yes.

Wwt6

1 MR. FORD: So that what you do, referring to these
2 heat transfer coefficients here, you pick, at a different time
3 after the beginning of reflooding, that at all lengths of the
4 rod you would be at whatever heat transfer coefficient on the
5 six-foot elevation that corresponds to that time after reflood;
6 is that correct?

7 MR. MOORE: I'm sorry. Would you repeat that?

8 MR. FORD: Yes.

9 My question is, when you go and choose a heat transfer
10 coefficient, you go and you look at what time after the flooding
11 is for a chart like this computed for a given flooding rate.
12 If it is thirty seconds after the flood, it would have a heat
13 transfer coefficient of about thirty-three; is that correct?
14 That is just in terms of using this chart.

15 MR. MOORE: Yes. If you had the exact flooding rate
16 condition, that's right.

17 MR. FORD: If you had the exact flooding rate?

18 MR. MOORE: Yes.

19 MR. FORD: According to the FLECHT tests, is it
20 correct that at some elevations there would be much higher heat
21 transfer coefficients than the one you are actually using in
22 the calculations; is that correct?

23 MR. MOORE: Yes.

24 MR. FORD: Is it also correct that at higher eleva-
25 tions there will be much lower heat transfer coefficients than

WWt7

1 the one you actually use?

2 MR. MOORE: Yes, they could be lower.

3 MR. FORD: Is it possible, under the flooding rate
4 assumptions, the low flooding rate assumptions of about two
5 inches a second, is it possible that you are using a positive
6 six-foot elevation heat transfer coefficient when in fact it
7 is predicted from the FLECHT data that the heat transfer co-
8 efficient for that axial level would be negative?

9 MR. MOORE: It is possible in the very low power
10 regions of the core, yes.

11 MR. FORD: Is it a correct interpretation of this
12 data and of the more accurate data that you have in front of
13 you, that heat transfer coefficient is a clear function of
14 axial level; that as you increase the axial level you greatly
15 decrease the heat transfer coefficient?

16 MR. MOORE: I guess I quarrel with the representation
17 of "greatly decreased," but it is decreased.

18 MR. FORD: In terms, specifically, of the more
19 accurate data that we have here--let us read it together. Is
20 it clear that the heat transfer coefficient at the two-foot
21 elevation, approximately ten seconds after the accident, is
22 around sixty Btu's per hour per square foot? Is that correct?

23 MR. MOORE: That's correct. We have quenched.

24 MR. FORD: Is it correct that the heat transfer co-
25 efficient two feet up are only ten Btu, or a factor of six lower

WWT8 1 than the heat transfer coefficients for the second foot eleva-
2 tion?

3 MR. MOORE: At that point in time, yes.

4 MR. FORD: Is it also possible, from the data that we
5 have reviewed on superheat, that as you get up to the ten-foot
6 elevation, that you're actually talking about potentially
7 negative heat transfer coefficient?

8 MR. MOORE: We are talking about potentially reverse
9 heat transfer over a part of the transient, yes.

10 MR. FORD: So in terms of this curve, the ten-foot
11 elevation would be represented on the other side of zero?

12 MR. MOORE: As shown on the curve on Page 342.

13 MR. FORD: Can you explain what calculations you have
14 done to determine the effects and sensitivity of maximum clad
15 temperature to this use of an intermediate heat transfer co-
16 efficient along the entire axial length rather than to use
17 specific heat transfer coefficients for all the specific axial
18 lengths.

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1 MR. MOORE: The primary concern is the behavior of
2 the peak cladding temperature as a function of time. So that
3 is the calculation that we want to get closely represented,
4 representing the transfer period.

5 The regions at the higher elevations are at very
6 low power levels so we are not concerned about the specific
7 temperatures of the cladding in that region. I think it's of
8 interest to look at the figures on page 343 of the FLECHT
9 report.

10 MR. FORD: Yes.

11 MR. MOORE: The top figure shows the temperature
12 rise that occurs during the reflood. If you will look at the
13 triangles depicted there, the triangles are for a low
14 flooding rate, one inch a second, which is the only kind of
15 flooding rate where you may get this reverse heat transfer
16 effect. You notice that the peak rise in temperature at the
17 ten-foot elevation is about 650 degrees Fahrenheit, whereas
18 the peak rise at the six-foot elevation where the peak power
19 occurs is about 450 degrees Fahrenheit. So we have picked
20 up an additional 200 degrees or so increase in temperature,
21 which is insignificant with respect to the initial
22 temperature of the cladding in that region because it's at
23 a low power level.

24 MR. FORD: Yes. Now, you indicated in describing
25 the data that it's only at a flooding rate of an inch a second

1 that we get the superheat phenomenon that I am discussing.
2 Is that what you just said?

3 MR. MOORE: Well, I am just looking at this data
4 in front of me. If you look at the squares on the same
5 curve and the temperature rise you notice that the ten-foot
6 elevation, the rise is less than the rise.

7 MR. FORD: I see.

8 CHAIRMAN JENSCH: Wait a minute. I wonder if we
9 could have the question answered. Is it true that the one-
10 inch per cent reflooding rate is the only time that you are,
11 going to get the superheat phenomena?

12 MR. MOORE: Loading flood rates like one inch a
13 second. Not exactly one inch a second and only one inch a
14 second, but low flooding rates.

15 My point, Mr. Chairman, was we have curves here
16 for 1.9 inches a second, which show a very small effect, and
17 it looks like we probably didn't have this reverse heat
18 transfer.

19 MR. FORD: Isn't it correct in the previous
20 quotation at page 340, we were talking about a flooding rate
21 of two inches per second or less and we had negative heat
22 transfer coefficients for 120 seconds there?

23 MR. MOORE: It's not clear from that statement that
24 the 120 seconds applies for two inches. It could apply for
25 the "or less" flooding rates. As would be seen in looking

1 at the curves on 343.

2 MR. FORD: I see. Now, the codes that you have
3 from a mathematical point of view, are they capable of giving
4 us the simplification of using simply one average heat
5 transfer coefficient? Do they have the capability of
6 incorporating all of the heat transfer coefficients from the
7 FLECHT data?

8 MR. MOORE: Yes.

9 MR. FORD: Have you performed any calculations that
10 used all of the heat transfer data from FLECHT rather than
11 just from the six-foot elevation data?

12 MR. MOORE: Not that I am aware of.

13 MR. FORD: Now, in terms of the proprietary report
14 that we were discussing this morning, is it correct that
15 Point 3, your change in the design basis calculation, your
16 proposed changes in the design basis calculation, based on
17 the use of FLECHT heat transfer, am I correct in that this
18 proposal of yours was not accepted?

19 MR. MOORE: You are incorrect.

20 MR. FORD: This proposal of yours was accepted?

21 MR. MOORE: Yes.

22 MR. FORD: Can you explain to me the computation
23 performed on FLECHT data to derive the heat transfer
24 correlation, the heat transfer coefficient, rather?

25 MR. MOORE: I am sorry. Which computations?

1 MR. FORD: I believe that in order to get the heat
2 transfer coefficients from all of the measurement equipment
3 readings during the tests that you calculated the heat
4 transfer coefficient as a function of, a) given rod power,
5 and, d), measured clad temperature, is that correct?

6 MR. MOORE: That's correct.

7 MR. FORD: Is the characterization of these
8 computations given in the Idaho nuclear report IN-1386? Is
9 the characterization given on page 22 accurate? I will both
10 read it and allow you to study it. And by the subcontractor
11 PWR FLECHT, they are referring to Westinghouse Electric
12 Corporation. It says, and I quote, "The subcontractor for
13 the PWR FLECHT project is processing the experimental data
14 and analyzing the test results for a given set of
15 experimental conditions, broad data in the form of rod
16 power and temperature measurements at the insulation
17 cladding interface is used in standard heat conduction
18 equations to determine the heat flux of the insulation
19 cladding interface, and to describe the temperature
20 distribution of the heater rod. By solving the heat
21 reduction equations for the cladding, the temperature heat
22 flux and coefficient of heat transfer at the outer surface
23 of the cladding are studied."

24 Would you care to study this or is it clear?

25 MR. MOORE: Yes.

1 MR. FORD: Now, the Idaho Nuclear proposes another
2 method or discusses another method, I should indicate more
3 precisely, for calculating heat transfer coefficients in
4 their later document IN-1390 titled EXPERIMENTAL RESULTS OF
5 FUEL HEATUP SIMULATION TESTS TO EMERGENCY CORE COOLING
6 TESTS SERIES on page 24. And they make the following
7 statement as the alternative method of calculating heat
8 transfer coefficient, and I quote.

9 "The transient nature of this experiment makes the
10 heat transfer analysis very complex. A detailed analysis
11 would require the coupled thermal hydraulic models that are
12 capable of handling the heat thermal transient, the transient
13 cooling thermal properties, and the nonequilibrium which
14 exists between the coolant phases, steam and water. Another
15 type of analysis that could be used is the empirical
16 correlation of surface heat transfer coefficients or heat
17 flux as a function of systems parameters such as initial
18 temperature, inlet water temperature, inlet flow rate, rod
19 power output and axial position."

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1 MR. TROSTEN: While Mr. Moore is studying that,
2 what is the outstanding question? You have read an excerpt
3 from this Idaho Nuclear Report.

4 CHAIRMAN JENSCH: I don't think there is any. I
5 think he is waiting till he studies it.

6 MR. FORD: No, no. I am waiting till he studies it.

7 MR. MOORE: Go on.

8 MR. FORD: My question is if we compared the two
9 different ways of computing heat transfer coefficients from
10 experimental data, the empirical correlation that was used,
11 given the broad data observation versus the coupled thermo-
12 hydraulic models capable of handling the heat thermo transient,
13 transient cooling thermal properties and the nonequilibrium
14 which exists between the coolant phases from a theoretical
15 point of view, which of these two methods of calculating heat
16 transfer coefficients could we expect to be more accurate and
17 to more closely simulate the conditions?

18 on the grounds of no showing of
19 relevance, Mr. Chairman.

20 MR. FORD: The relevance, I believe, is clear.
21 There are two methods of calculating heat transfer coefficient.
22 One was used, one wasn't, and I'd like to ascertain the
23 justification for the specific technique that was used, as
24 my first question here concerns simply from a theoretical
25 point of view which of the two techniques simulates more

1 closely the phenomenom that we are concerned with?

2 CHAIRMAN JENSCH: I don't think that was quite the
3 question that was propounded, however. May we have the last
4 question previous read.

5 (The last previous question is read by the reporter.)

6 CHAIRMAN JENSCH: Well, the Board is having some
7 difficulty with the form of the question and I think it's
8 incumbent upon this witness to support the method he has used,
9 and presumably his data has been directed to that thesis.
10 There is a little complication in this situation, because as
11 I understand some of the statements just made by the
12 interrogator, Westinghouse is a subcontractor to Idaho Nuclear,
13 which is the main contractor, and it isn't as if Idaho Nuclear
14 were some distant stranger to the transaction in relationship
15 to Westinghouse. So there is some relationship between the
16 two theories, presumably.

17 But let me before the Board makes a ruling voir dire,
18 if I may, the witness a bit.

19 Is it your view, Mr. Moore, that the method of
20 computing the heat transfer coefficient more closely simulates
21 the conditions likely to be encountered in the loss of coolant
22 accident than other theories might be?

23 MR. MOORE: Yes.

24 CHAIRMAN JENSCH: And without analyzing somebody
25 else's theory, unless you have, you would prefer your theory

1 to other theories, as far as you know them, is that correct?

2 MR. MOORE: Yes. In the context of getting some-
3 thing usable and that can be applied in an engineering sense.

4 CHAIRMAN JENSCH: On that basis the Board will
5 sustain the objection, but believes that the inquiry within
6 the range of the voir dire would be appropriate inquiry.

7 MR. FORD: Can you tell me does the model that you
8 use to calculate the heat transfer coefficient consider the
9 transient coolant thermal properties?

10 MR. MOORE: No.

11 MR. FORD: And does it consider the non-equilibrium
12 that exists between the coolant phases?

13 MR. MOORE: No.

14 MR. FORD: Does it consider the non-equilibrium
15 which exists between saturated steam on the one hand and a
16 combination of steam with entrained water droplets on the
17 other?

18 MR. MOORE: As I told you before, it's derived,
19 the heat transfer coefficient is derived on the basis of a
20 saturation temperature. These effects are not included.

21 MR. FORD: Can you tell me in terms of the variety
22 of thermal dynamic complexities which are not simulated in
23 the empirical computation method that you used, can you tell
24 me what estimate is there, what well-supported estimate is
25 there of the difference in a method which considers these

1 non-equilibrium thermal dynamic conditions and your method
2 which does not?

3 MR. MOORE: One must consider the use of the data,
4 its intended use. The purpose of these experiments is not to
5 derive a theoretical derivation of this complicated heat
6 transfer phenomena. It is to derive appropriate heat transfer
7 relationships for the use in the loss of coolant analysis.
8 The results have been derived on the basis of saturation
9 temperature assumptions and have been applied consistently
10 on the same assumption to the reactor situation, and we feel
11 this most closely then represents the expected condition in
12 a reactor.

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1 MR. FORD: Is this scenario correct: The data that
2 we have from the FLECHT tests consist of the raw data at
3 Idaho Nuclear noted rod power under: one hand, and measure-
4 ments of cladding temperature on the other? Is that the
5 data that you have when your FLECHT tests are finished?

6 MR. MOORE: And in the flow rate, yes.

7 MR. FORD: And the flow rate?

8 MR. MOORE: Yes.

9 MR. FORD: So in the data, the raw data that comes
10 out of the FLECHT tests are heat transfer coefficients part
11 of the raw data?

12 MR. MOORE: In my opinion, I would say yes.

13 MR. FORD: When I asked you for raw data, I think
14 there were three pieces of data listed. Was one of them
15 heat transfer coefficient?

16 MR. MOORE: We are arguing about semantics now.
17 The heat transfer coefficient is directly calculated from raw
18 data, directly calculated.

19 MR. FORD: Directly calculated from raw data?

20 MR. MOORE: Yes.

21 MR. FORD: Is it correct that between the raw data
22 and the final heat transfer coefficients that we get, that
23 assumptions with thermal dynamic consequences or thermal
24 dynamic assumptions are involved in intermediate steps
25 between the raw FLECHT test data and final heat transfer

1 coefficients that we get?

2 MR. MOORE: Which assumptions are you referring to?

3 MR. FORD: I mean, for example, assumptions with
4 regard to the coolant thermal properties in the non-
5 equilibrium that exists. Do you have to make some assumption
6 on those parameters in order to calculate heat transfer
7 coefficients?

8 MR. MOORE: Yes. As I said before, we use
9 saturation conditions.

10 MR. FORD: So that whereas you would say, for
11 example, that under certain flooding rates at the 10-foot
12 elevation, there will be superheated steam. Nevertheless,
13 when you calculate the heat transfer coefficient there, is it
14 correct that you pretend as if it were a saturated liquid?

15 MR. MOORE: Yes, and as we would also apply it to a
16 reactor calculation.

17 MR. FORD: Can you tell me, when you make this
18 assumption that you have a situation where you have a super-
19 heated steam and instead you assume that it is a saturated
20 liquid, can you tell me what kind of error you introduce into
21 your heat transfer coefficient?

22 MR. MOORE: With respect to my use of the correlation,
23 I only have my measurement. I am using the correlation
24 consistently.

25 MR. FORD: In terms of the assumption that you have

1 a measurement of the rod power under one hand and a measurement
2 of the interface of the rod and the cooling sink, and the
3 third thing you do is make an assumption about the thermal
4 dynamic stage of the coolant, of the sink, are you saying
5 that calculation of heat transfer coefficient
6 you come up with is insensitive to whatever assumption you
7 make about the thermal dynamic state of the coolant sink?

8 MR. MOORE: No. It is sensitive to the assumptions
9 for the sink.

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1 MR. FORD: So if you made the assumption that it
2 was superheated steam versus the assumption that it was
3 saturated liquid, you would compute a different heat transfer
4 coefficient; is that correct?

5 MR. MOORE: That's correct, but that's not
6 relevant to our situation.

7 MR. FORD: I'm simply talking in terms of general
8 terms of how this algorithm translate raw data into heat
9 transfer coefficients. Relative to our situation, is it
10 correct that the heat transfer coefficient that you gave us
11 at the ten-foot elevation, the negative one, is it correct
12 that they were computed assuming that there was a saturated
13 liquid at that level rather than superheated steam?

14 MR. MOORE: Yes.

15 MR. FORD: If you were to assume that it was
16 superheated steam, what would the heat transfer coefficient
17 have been? What direction would it have changed in? Would
18 it have been more negative?

19 MR. MOORE: It would have been improved heat
20 transfer, higher coefficient.

21 MR. FORD: Can you explain that to me, please.

22 MR. MOORE: Certainly. If the temperature of the
23 cladding in the test is at, say, one thousand degrees
24 Fahrenheit, if the assumption is made that the steam
25 temperature is saturation at 600 degrees Fahrenheit, then the

1 way the calculation is performed, we will get a heat transfer
2 coefficient which will be based on the power going into the
3 rod with that delta T of 400 degrees Fahrenheit. Whereas,
4 if in fact the delta T, in that the steam temperature was
5 1200 degrees and transferring heat to one thousand degrees
6 cladding, you would have to get a higher heat transfer
7 coefficient in order to transfer the same amount of heat
8 because the delta T has been reduced.

9 MR. FORD: So that in terms of the assumption that
10 you make regarding the thermodynamic state of the coolant,
11 it is possible for you to compute negative heat transfer
12 coefficients and indicate the superheated steam when in fact
13 there is no superheated steam?

14 MR. MOORE: I don't think I follow that. I don't
15 think that's the case, no. If we don't have superheated
16 steam and the temperature of the clad is higher than the
17 temperature of the steam, we don't get this negative, quote,
18 heat transfer coefficient.

19 MR. FORD: Excuse me.

20 Can you tell me, is there any thermodynamic
21 assumption that you could make that would increase the heat
22 transfer coefficient? You assumed it is saturated liquid.
23 If you assumed it is subcooled liquid, what happens to the
24 heat transfer coefficient?

25 MR. MOORE: The way we compute it from the data?

1 MR. FORD: Yes.

2 MR. MOORE: The heat transfer coefficient, to
3 transfer the same amount of heat would be smaller if you had
4 subcooled liquid than if it was saturated.

5 MR. FORD: So that, am I correct, according to your
6 analysis, that assuming two pieces of raw data constant,
7 namely, the axial rod power given at axial level, and its
8 temperature at axial level, the changing thermodynamic
9 assumptions from subcooled through saturated through super-
10 heated changes as you progress through those thermodynamic
11 assumptions, and you progress from smaller to larger heat
12 transfer coefficients; is that correct?

13 MR. MOORE: That's correct, to transfer the same
14 amount of heat.

15 MR. FORD: A model that considered the coolant
16 thermal properties at nonequilibrium, is it correct that
17 that model will compute more accurate transfer coefficients
18 than your model which assumes one thermodynamic state and
19 applies to all of the raw data?

20 MR. MOORE: More accurate with respect to what?

21 MR. FORD: That the coefficients, the large
22 coefficients that you compute, assuming saturated liquid,
23 that would not be computed if you had assumed subcooled
24 liquid.

25 MR. MOORE: If we are talking about just a pure

1 number, that's right. That's not relevant on two counts.
2 We don't have saturated liquid or subcooled liquid at the
3 hot spot. We use the same assumption to derive the heat
4 transfer in both cases, the reactor and the FLECHT test. So
5 we are not looking for a pure scientific number here.

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1 MR. FORD: I understand that you have geared the
2 algorithm to the hot spot. But I am concerned with the
3 significance of all of the rest of heat transfer coefficients
4 for different axial levels. I am correct that in all of the
5 different axial levels you assume the same thermal properties
6 and same equilibrium stated in the coolant as you do in the
7 hot spot for the 6-foot elevation calculation?

8 MR. TROSTEN: I object on the grounds of lack of
9 materiality, lack of relevancy, and notwithstanding the
10 scope of the voir dire.

11 CHAIRMAN JENSCH: May we have that question reread,
12 please.

13 (The last question was read by the reporter.)

14 CHAIRMAN JENSCH:
15 The objection is overruled. While there is a
16 pause for this purpose, let me inquire.

17 I was wondering whether this step in Idaho Nuclear
18 1386 -- or is it Idaho Nuclear 1390? Does that constitute a
19 report in some sort of sequence from the work that was done
20 by Westinghouse? so that the Idaho Nuclear Report really
21 represents the final determination of the work that was done
22 by Westinghouse, and thereby would in a sense precede it?
23 Is there some contention of that fact by the Intervenors?

24 MR. FORD: I'd like to take a look to answer the
25 question in detail. I might explain there are a number of
complex relationships between the Idaho Nuclear Report and the

1 actual FWR FLECHT report. One relationship seems to be in
2 terms of time. The final FLECHT report seems to come out a
3 good bit after the actual tests that are conducted. The
4 Idaho Nuclear tests seem to come out in closer time to the
5 actual tests.

6 As I understand the relationship between Idaho
7 Nuclear and the FLECHT program, that the over-all design
8 responsibilities for the program rest with Idaho Nuclear as
9 the main contractor.

10 CHAIRMAN JENSCH: What I had in mind was, does
11 Westinghouse have a worker in the field, in a sense, and
12 Idaho Nuclear, kind of the master designer of the thing, and
13 whether Westinghouse likes it or not, Idaho Nuclear has
14 determined how it should be handled and that thereby gives
15 its conclusion, i.e., Idaho Nuclear's conclusions as to what
16 theory should be applied to the data. I don't know whether
17 these factors are reflected in any other documents or not.

18 If Westinghouse is kind of a worker in the field
19 and gathering data but going off on a frolic of its own, if
20 I use the term, to say that the theories it is going to
21 concoct are more applicable than the fellow doing the work,
22 then you kind of wonder if the worker in the field was having
23 his own revolution against the establishment and that sort of
24 thing. I don't know whether there is some necessity of
25 Westinghouse complying with the directions of the group for

1 which it was doing its work.

2 MR. FORD: I think there is a definite hierarchy in
3 terms of theoretical responsibility between Idaho Nuclear
4 and Westinghouse, and there is either a hierarchy above that,
5 namely that the Idaho Nuclear work is part of the Atomic
6 Energy Commission's water reactor safety program, its full
7 relation in reactor development technology.

8 I read you the paragraph at the beginning of report,
9 IN-1386, which may answer some of your questions. This is
10 page 1. It says, "The PWR FLECHT PROJECT is an experimental
11 project designed to provide data necessary to determine
12 emergency core cooling system performance following a loss
13 of coolant accident. The project, which is part of the
14 water reactor safety program of the Atomic Energy Commission,
15 will provide data from which heat transfer core correlations
16 can be developed to predict the thermal response of PWR cores
17 from the time the emergency core coolant fills in lower core
18 plenum until the core is reflooded. Westinghouse Electric
19 Corporation is conducting the test program under subcontract
20 to the Idaho Nuclear Corporation."

21 And there is a further use for the FLECHT test.
22 The Idaho Nuclear Corporation has a program which is called
23 "Technical Assistance in Reactor Safety Analysis." It is
24 reported in the document, IN-1383. The purpose of this
25 program is for the Idaho Nuclear Corporation to provide, and

1 I quote on page 1, "Analytical assistance to the AEC and its
2 Regularity Agencies."

3 It goes on to describe in this test how part of the
4 purpose of the technical consulting that Idaho Nuclear
5 performs is to review data from a variety of programs, which
6 include semi-scale blowdown and emergency core cooling, the
7 pressurized water reactor, full length emergency cooling,
8 heat transfer tests, the PWR FLECHT test, the Carolina -
9 Virginia tube reactor in plant testing, and so forth.

10 So that part of the responsibility that Idaho
11 Nuclear, as I understand it, from a specific document, is to
12 review the data that becomes available from the water reactor
13 safety program, to analyze it from a theoretical point of
14 view and to try to conclude, in terms of its advice to the
15 Regulatory Staff, to conclude whether or not data is sufficient
16 to provide the requisite information required for the Staff
17 to evaluate.

18 I intend, in my cross-examination of the Staff, to
19 discuss this entire relationship and to discuss the manner
20 in which Idaho Nuclear, when and after reviewing all of the
21 safety data, comes to the conclusion that information on
22 heat phenomena associated with the loss of coolant accident
23 is not yet available.
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1 CHAIRMAN JENSCH: Excuse me for interrupting. Could
2 we go back and have the question read.

3 MR. MOORE: Mr. Chairman, I would like to clarify the
4 record. Mr. Ford is perhaps somewhat misled. The report we
5 referred to--we started on this discussion on the approach to
6 be used to reduce the data from the FLECHT test. Our method
7 of data reduction was performed with the complete cognizance and
8 agreement of the Idaho Nuclear people. In fact, the paragraph
9 that Mr. Ford read that said there are other ways of correlating
10 the data, at the end of that paragraph the author from Idaho
11 Nuclear states that the approach being used for FLECHT is the
12 empirical approach.

13 MR. FORD: Excuse me. Is it correct that the approach
14 that you used is that it creates an imperical computation?

15 MR. MOORE: As described in that report that you
16 referenced earlier.

17 MR. FORD: The quotation that I read earlier from
18 Page 24 of IN-1390, the last sentence says, "The latter
19 approach is expected to be used," the latter being the approach
20 that you did use?

21 MR. MOORE: Yes.

22 MR. FORD: Can you tell me whether Idaho Nuclear has
23 given us a judgment on the matter as to whether or not there
24 is any superiority or whther they simply select the latter
25 method because that is the only one that we are presently

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1 capable of using?

2 MR. MOORE: The discussions with Idaho Nuclear in-
3 volved trying to determine what was the best way and the most
4 practical way to evaluate the data. I think it was one of
5 practicality in getting an applicable useful correlation as
6 opposed to a generally applicable theoretical evaluation.

7 CHAIRMAN JENSCH: Is it your interpretation from
8 that statement that was read that since the Idaho Nuclear
9 report says that method X will be used, you interpret that as
10 being some endorsement of it, or is that just a statement of
11 what is going to occur?

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1 MR. MOORE: I know he agreed with the approach that
2 we used to process the data.

3 CHAIRMAN JENSCH: They didn't disagree with what
4 you did?

5 MR. MOORE: That's right.

6 CHAIRMAN JENSCH: That's about as far as it went,
7 isn't it?

8 MR. MOORE: Well, we performed the tests under
9 subcontract to them and as part of our final report that is
10 the way we treated the data with their concurrence.

11 CHAIRMAN JENSCH: And you collected their money?

12 MR. MOORE: And we collected their money.

13 CHAIRMAN JENSCH: Very well.

14 Mr. Reporter, please don't go away. Will you come
15 back and reread your question.

16 MR. WAGA: Yes.

17 (The previous question is read by the reporter.)

18 MR. MOORE: Yes.

19 CHAIRMAN JENSCH: I think it's about 5:30. As I
20 understand it, we have got the question answered and this is
21 the time of a previous commitment. Is there anything
22 further we can take up before we recess?

23 MR. FORD: I think simply with regard to Idaho
24 Nuclear perspective on the superiority of the coupled
25 thermal hydraulic model it takes into detailed consideration

1 the coolant thermal transient properties and its thermo-
2 dynamic equilibrium. I think that's about as clear from their
3 over-all June 1970 statement from a loss of coolant
4 analysis program, I think it's clear that they regard the
5 coupled set of thermal hydraulic equations as clearly the
6 more preferable way of doing it, because they announce that
7 that is what they wanted to develop, and I'd like to ask
8 Mr. Moore to consider their state-of-the-art summary and
9 solicit from it his judgment as to whether or not it indicates
10 their preference for the much more detailed thermal hydraulic
11 model versus the empirical correlation. The statement that
12 I read is from the document LOSS OF COOLANT ANALYSIS PROGRAM
13 I.N.-1382, in June of 1970, page 3, and I will give this to
14 Mr. Moore to study. It says, and I quote, "The purpose of
15 the loss of coolant accidents analysis program is to
16 provide broadly applicable analytical tools for predicting
17 the thermodynamic, hydrodynamic, and mechanical events
18 which result from a loss of coolant accident, including
19 the subsequent action of various engineered safety systems.
20 The analytical and experimental results to date have
21 clearly demonstrated that this task is unique, because
22 unlike other accident situations, such as boiler explosions
23 or reactivity excursions, the loss of coolant accident
24 involves the simultaneous interaction of several mass and
25 energy redistribution processes, including nuclear,

1 thermal-hydraulic, chemical and structural processes. The
2 task is complicated by the need to represent the accident
3 process dynamically and at many positions in space for
4 certain of the processes such as the sonic decompression
5 subcooled liquid in a PWR system analysis techniques dealing
6 with a distributed rather than a lumped system are required
7 to define energy and mass redistribution. The spatial
8 representation to date has generally been in one dimension.
9 The apparent need now is to extend certain of the
10 representations to two and three dimensions in order to
11 establish sufficient precision to assure that fluid
12 availability to a core is properly taken into account. The
13 task also is complicated by the need to incorporate a
14 considerable number of improved two-phase heat transfer
15 relationships and two-component fluid-flow relationships.
16 Many thermal hydraulic energy transfer processes are
17 currently represented by empirical correlations because of
18 the difficulty in describing the process on a purely
19 theoretical basis. Further, these empirical correlations
20 are based primarily on steady state data from tubes and
21 annuli rather than the transient data from rod bundles."

22 And they go on to list in the area of core
23 thermal response the specific recommendations that they make,
24 including a thermohydraulic code to predict a localized
25 and total system fluid response during a LOCA.

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1 MR. TROSTEN: Mr. Chairman, I object to the question
2 which preceded the long reading from the Idaho Nuclear
3 Corporation report.

4 CHAIRMAN JENSCH: What is the question?

5 MR. TROSTEN: He asked the question in which he wanted
6 Mr. Moore to comment on the approach as I heard his point, asked
7 Mr. Moore to comment on the approach and the relative merits of
8 one system versus another system. I object to his question.
9 I object to the long reading into the record of that excerpt
10 from an Idaho Nuclear Corporation report which is time-consuming
11 and a burden upon the time of the Board and the parties and I
12 believe is an improper procedure to follow in a hearing of this
13 sort, Mr. Chairman. We have covered this ground before with this
14 interrogator, and I reiterate my objection, and as I say I
15 object to the question on the grounds of no showing of relevance.

16 CHAIRMAN JENSCH: Will you show the document to the
17 witness.

18 MR. FORD: Yes.

19 CHAIRMAN JENSCH: Miss Reporter, can you go back to
20 the portion prior to the quotation.

21 (The previous question by the interrogator is read by
22 the reporter.)

23 CHAIRMAN JENSCH: Let me ask you have you finished
24 reading that, Mr. Moore?

25 MR. MOORE: Yes.

Z2Bt2
1 CHAIRMAN JENSCH: Are you able to discern from that
2 what is the judgment of the Idaho Nuclear people in this regard?

3 MR. MOORE: No. I think it's very difficult from just
4 what is stated there.

5 CHAIRMAN JENSCH: You don't discern any preference
6 in that statement as to the selection by Idaho Nuclear, is
7 that correct?

8 MR. MOORE: That's correct. They refer to an apparent
9 need. They seem to imply there is something wrong with empirical
10 correlations, which I don't understand but--

11 CHAIRMAN JENSCH: On that basis the objection is
12 sustained.

13 At this time is there anything further before we
14 recess?

15 MR. TROSTEN: Just one point, Mr. Chairman. I told
16 the Board last Thursday that we would advise the Board today
17 whether we planned to have any redirect testimony with respect
18 to the ECCS cross-examination that had occurred to date. It
19 appears we will require some redirect. We will be able to advise
20 the Board shortly as to its scope and of the amount of time
21 that will be required for this.

22 I would also like to inquire of Mr. Roisman at this
23 time as to the general scope of the cross-examination tomorrow,
24 if that would be satisfactory to you, Mr. Chairman.

25 CHAIRMAN JENSCH: I think that kind of thing you can

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1 take up with him off the record. We want to save the record.

2 Is there anything further we can take up?

3 MR. ROISMAN: Mr. Chairman, I would just like to get
4 the record straight, because the pauses, of course, are not on
5 the record, but I believe that the Chair requested that we stop
6 at what was on my watch twenty-five after five. It was at that
7 time that the question asked by Mr. Ford was read, which I think
8 took about a minute and a half, and I calculated. It will not
9 show in the transcript since it's read.

10 Mr. Trosten then raised an objection which included
11 a statement that Mr. Ford's reading of that half page of the
12 Idaho Nuclear report was burdensome on the record. I merely
13 want the record to show that we spent seven minutes dealing
14 with Mr. Trosten's objection. If we are interested in speed
15 I suggest those with the kind of technical excess which had
16 nothing to do with the Board's ruling, as I understood it, on
17 the question of whether the question should be answered or not
18 is more likely to delay the hearing. Mr. Ford merely read the
19 paragraph so that all of the parties, including Mr. Trosten and
20 the Board, had an opportunity to hear what it is the witness and
21 the interrogator had read.

22 MR. TROSTEN: Mr. Roisman, as you are aware--

23 CHAIRMAN JENSCH: I think when you propound a question
24 to a witness seeking opinion evidence you have to lay the founda-
25 tion for the question. Reading something from a document as to

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1 which you are seeking an opinion is not any burden on the record
2 or burden on the Board.

3 At this time let's recess to reconvene in this room
4 tomorrow morning at nine o'clock.

5 (Hearing adjourned to Tuesday, November 9, 1971, at
6 nine a.m.)

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