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UNITED STATES ATOMIC ENERGY COMMISSION

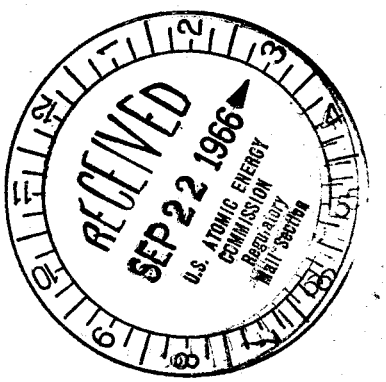
REGULATORY DOCKET FILE COPY

In the Matter Of:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

Docket No. 50-247

(Ruppel)



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BEFORE THE

ATOMIC ENERGY COMMISSION

In the matter of

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. — Docket No. 50-247

Buchanan Engine Co. # 1 Inc.
Albany Post Road
Buchanan, New York.

Thursday, 15 September 1966

The conference came on for hearing, pursuant to notice, at 10:00 a.m.

BEFORE:

SAMUEL W. JENSCH, Chairman,
DAVID B. HALL, Member,
JOHN C. GEYER, Member, Atomic Safety and Licensing Board.

APPEARANCES:

(As heretofore noted.)

DB-1

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P R O C E E D I N G S

CHAIRMAN JENSCH: Please come to order.

I believe at the conclusion of the session yesterday we had concluded the presentation of all of the direct evidence except that from a witness from the State of New York. Are you ready to proceed in that regard?

MR. SCINTO: Yes, Mr. Chairman.

CHAIRMAN JENSCH: Will you call your witness, please.

MR. SCINTO: I call Dr. Harald Rossi.

CHAIRMAN JENSCH: Will you come forward, Dr. Rossi, and be sworn.

Whereupon,

DR. HARALD H. ROSSI

was called as a witness and, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. SCINTO:

Q Dr. Rossi, have you prepared a statement to be presented at this hearing?

A I have.

Q I show you a statement entitled "Statement of Dr. Harald Rossi, Chairman, Mayor's Technical Advisory Committee on Radiation." Is this the statement you prepared?

A It is.

Q Do you present this statement as your testimony in this proceeding?

A Yes, sir.

Q Are the statements contained therein true and correct?

A Yes, they are.

MR. SCINTO: Mr. Chairman, I move this statement be incorporated into the record as if read.

CHAIRMAN JENSCH: Any objection by the applicant?

MR. UPTON: No objection.

CHAIRMAN JENSCH: The staff?

MR. CONNER: No objection.

MR. SCINTO: Mr. Chairman, if we may be allowed, I request the cross-examination of Dr. Rossi be deferred until we cross-examine the rest of the witnesses.

CHAIRMAN JENSCH: First we will put the statement in evidence. If there is no objection, the statement of this witness Rossi may be incorporated into the transcript as if read.

(Statement of Dr. Harald H. Rossi follows.)

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the Matter of	)	
	)	
CONSOLIDATED EDISON COMPANY	)	DOCKET NO. 50-247
OF NEW YORK, INC.	)	

STATEMENT OF DR. HARALD H. ROSSI, CHAIRMAN
MAYOR'S TECHNICAL ADVISORY COMMITTEE ON RADIATION

Upon the recommendation of the Mayor's Technical Advisory Committee on Radiation and the Mayor's Science and Technology Advisory Council, the City of New York has conducted an independent limited review of Indian Point Nuclear Generating Unit No. 2. The committee made the recommendation because of the proximity of the proposed site to the Croton watershed and the Chelsea Hudson River pumping station, both sources of drinking water for New York City.

In conducting the review, the City has engaged the services of a group of experts in the field of power reactor technology. The group is studying the available documents and has submitted a preliminary report, expressing the opinion that the general reactor design is sound, and making certain recommendations. Since the report is preliminary the recommendations are necessarily tentative, and, in any event, are matters relating to details of final design. The Mayor's Advisory Committee finds nothing in them which would justify opposing the issuance of a construction permit for the proposed nuclear generating unit.

CHAIRMAN JENSCH: In accordance with a request previously made, the cross-examination of this witness is deferred. Therefore you are temporarily excused, subject to recall for cross-examination.

(Witness temporarily excused.)

MR. CONNER: If the Board please, as a preliminary matter, Dr. Hall had requested a copy of the letter of the ACRS dated November 24, 1965. The applicant has reproduced copies of that letter and I now have them available for the Board if you wish.

CHAIRMAN JENSCH: Is that letter in the public document room of the Atomic Energy Commission?

MR. CONNER: Yes, sir, and it is generally available in public print.

CHAIRMAN JENSCH: Well, it won't be necessary to have it marked as an exhibit. If there is no objection, the Board would appreciate having a copy, and it is being used as if it were solely a public document in the public document room. Is there any objection to that reference to the document by the applicant?

MR. UPTON: No objection.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No objection.

CHAIRMAN JENSCH: Staff counsel is handing to the Board, then, three copies of this letter which is shown in

a publication by a 1965 issuance from the Commerce Clearing House.

Is there any other direct evidence to be presented in this proceeding by the applicant?

MR. UPTON: None, sir.

CHAIRMAN JENSCH: Regulatory staff of the Commission?

MR. CONNER: No, sir, except to respond to the questions raised by the Board in the form of cross-examination.

CHAIRMAN JENSCH: Yes.

State of New York?

MR. SCINTO: Mr. Chairman, only one matter. In connection with the Commissioner of Health's statement introduced yesterday afternoon there is reference therein to five survey reports made over a period since 1959 by the New York State Department of Health, a surveillance program conducted by the Department of Health for Indian Point No. 1.

The documents are filed with the Commission in Docket 50-3. But I do have further copies of these reports with us here today if the Board would like me to introduce them into evidence in this proceeding.

CHAIRMAN JENSCH: Until we make a specific request, we will note the availability of the documents only.

There is another matter in reference to the request for intervention. I take it -- I see Mr. Bogart

in the audience. The gentleman is now standing. Will you state your name?

MR. CABELL: William B. Cabell. I am associated with Harold West who appeared for Mr. Bogart yesterday.

CHAIRMAN JENSCH: What is your address, please?

MR. CABELL: 51 West 51st Street, New York.

CHAIRMAN JENSCH: And you are a lawyer?

MR. CABELL:: Yes, I am.

CHAIRMAN JENSCH: Will you proceed, please?

MR. CABELL: We have prepared a petition for leave to intervene in this matter, and Mr. Bogart has it down here in the town now having it notarized. We expect it to be here any moment. As soon as it comes in, with the permission of the Chairman, I would like to present copies of it to counsel, and to the members of the Board here. The statement, a copy of which I have here --

CHAIRMAN JENSCH: Upon your representation that it is being notarized, maybe this provides a convenient time to give some consideration to the petition. Have you given a copy to the parties even without notarization?

MR. CABELL: No, sir. I think all of the copies are down before the notary now. There are fifteen copies being brought up here. We expect it at any moment.

CHAIRMAN JENSCH: Until there has been service upon the parties, I don't think we are in a position to give consideration to the petition. Therefore, upon your receipt of the copies which you are awaiting, if you will make service upon the parties thereafter, this matter can be considered. So until that time arrives -- we will await your notification that you have completed service -- we will defer consideration of this matter to which you refer. Is that agreeable?

MR. CABELL: Yes. Thank you, Mr. Chairman.

CHAIRMAN JENSCH: Very well. I think then we are ready to proceed with cross-examination of the witnesses, the first of whom I believe is Dr. McCullough, aside from the panel. As I recall the statement by staff counsel, he requested the presentation of his panel to be available for cross-examination with the applicant's panel of witnesses. The Board has given consideration to that matter, and it seems to be a feasible procedure, and we will proceed upon that basis.

But prior to doing that, we must complete the presentation of evidence through Dr. McCullough. Dr. McCullough, will you come forward, please?

Whereupon,

C. ROGERS McCULLOUGH,

resumed the stand, and having been previously duly sworn, upon examination further testified as follows:

CHAIRMAN JENSCH: Dr. McCullough has resumed the witness stand. Is there cross-examination by the staff?

MR. CONNER: No, sir. Our questions will be deferred to the panel.

CHAIRMAN JENSCH: Very well. Cross-examination by the State of New York?

MR. SCINTO: No, Mr. Chairman.

CHAIRMAN JENSCH: The Board has some questions of Dr. McCullough.

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EXAMINATION

MR. HALL: Dr. McCullough, in your statement, or at least in the statement that is in the partial summary -- no, I believe it is in your statement -- you described and listed the sessions with the staff and with the ACRS, in which you participated. In checking that over, were you in attendance at the last meeting between the applicant and the ACRS, at which the Committee prepared the letter which has been submitted as a part of the evidence here?

THE WITNESS: Yes, sir, I was present at that meeting. To be sure there is no mistake, please identify the date of that meeting.

MR. HALL: All right. That meeting was August 4, I believe. And I think in your testimony that date was not included.

THE WITNESS: Yes, sir, I was at that meeting on August 4.

MR. HALL: Thank you. In the letter as prepared by the ACRS at that time, there is a statement on page 3 of the letter which I will read, and I will ask for your interpretation of the meaning of this. I will also invite the staff to comment on this. "The applicant has made studies of the reactivity excursions resulting from the improbable event that

structural failure leads to expulsion of a control rod from the core. Such transients should" -- that is my emphasis -- "should be limited by design and operation so they cannot result in gross primary system rupture or disruption of the core". And the sentence continues. How do you interpret the word "should"? Is it permissive -- is it must -- is it probable? This is a semantic problem.

THE WITNESS: My interpretation of the word "should" is that it is a requirement.

MR. HALL: This is a requirement that the ACRS is imposing upon a system that they consider suitable?

THE WITNESS: This is my personal interpretation of the word, yes, sir.

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MR. HALL: May I ask the Staff how they interpret this?

MR. CASE: We agree with this. This is a criteria in the sense that the ACRS has expressed it here, the same criteria which the Staff has used in its evaluation of this facility.

MR. HALL: In view of this, is there any problem with the positive coefficient of reactivity that has been assigned or described in this core?

THE WITNESS: Dr. Hall, I can give you an opinion, but it would be and off-the-cuff opinion.

The people who have made the detailed studies of this are the Westinghouse people and I would think it would be more appropriate to have them comment than I, unless you insist.

MR. HALL: May I ask then the Westinghouse members of the panel who are prepared on this, if there is any comment on the nature of the, or the effect of the positive coefficient of reactivity?

MR. MOORE: Dr. Hall, the effect of the positive moderator coefficient is included in the analysis of the rod ejection transient and it does have an influence on the results. And in the course of the detailed design, we will show that we can in fact meet this criteria.

MR. HALL: Thank you.

Returning to Dr. McCullough, you were quoted yesterday in some of the submissions placed before the Board -- if you will bear with me a moment until I can find this -- this was a letter addressed to the Atomic Energy Commission, attention Mr. Samuel W. Jensch, Chairman, from Smith W. Brookhart.

Do you have a copy of this?

THE WITNESS: I have a copy in front of me, yes, sir.

MR. HALL: And it is referring to hearings before the Joint Committee on Atomic Energy and an article entitled, "These Days -- Would Atom Plant Create Peril Here," by John Chamberlaine, and it is quoting from a book entitled, "Safety Aspects of Nuclear Reactors," by Dr. C. Rogers McCullough and others. Included in the references is the statement:

> "It is also desirable to have the reactor site not be located on a main watershed. From the point of view of the hazard alone it is of course desirable to have the reactor site far from populous or vital industrial areas."

And there is again a second quotation accredited to you at the bottom of the page.

Would you care to comment on both of these quotations?

THE WITNESS: I would be very happy to. If I may, I would go back to the original document, the book which is "Safety Aspects of Nuclear Reactors," which was prepared subsequent to the 1955 Geneva Conference. I was the editor of this book.

I think that it is worth commenting that the 1955 conference was held very shortly after the declaration of a very large amount of material which dealt with reactors and their operation, design and safety. I should also like to observe that at this conference which was an international one there were in attendance representatives from nations who had very little or no knowledge of nuclear matters and nuclear safety matters particularly as they pertained to reactors.

I think this all has to be taken into context when you look at the things, at the papers which were presented, not only by representatives of the United States, but by those from Russia, England, and France, which countries had considerable knowledge of nuclear matters at that time.

I think that in order to put the matter in context, it would be worth --

CHAIRMAN JENSCH: What was the date of this? Excuse me, sir. What was the date of this publication and this conference?

THE WITNESS: The conference was in 1955.

CHAIRMAN JENSCH: Thank you.

THE WITNESS: This was the International Conference on the Peaceful Uses of Atomic Energy, held in Geneva, August 8 - 20, 1955.

CHAIRMAN JENSCH: Thank you.

THE WITNESS: The book to which I referred was published the following year as I recall it. It was copyrighted in 1957 by Van Noster and Company.

To put things in perspective, I think it would be worth looking at the preface, of which I was the author.

Now the quotations which are referred to here occur in a paper which was written for this conference and presented. This paper was entitled, "The Safety of Nuclear Reactors," and the authors of the paper were McCullough, Mills and Teller. The quotations occur on page 150 of the book to which I referred and they occur in a paragraph which is entitled, "Consequences of an Accident".

There are many other sentences on both sides of these quotations and I think that if one reads the whole paragraph it puts these quotations in the context in which they were meant by the authors. I believe in the interest of saving time that it might be worthwhile to read the concluding part of this section called, "Consequences of an Accident," if I may.

CHAIRMAN JENSCH: Proceed.

THE WITNESS: This paragraph reads:

"Despite all these possible dire consequences, it is the belief of the Advisory Committee on Reactor Safeguards that nuclear reactors will soon start to produce substantially increasing material benefits for humanity. We believe that useful electric power in large quantities can be generated by nuclear reactors. It is our concern that rapid progress shall be made, but that enough caution shall be observed that no catastrophic events will delay the fruition of reactor development."

Finally, if I may, I would like to read the concluding paragraph of this paper by McCullough, Mills and Teller. This reads as follows:

"Accidents must necessarily be infrequent and so long as they do not involve the release of more than a few tenths of a megawatt equivalent of fission products, remote siting of reactors should be unnecessary. It is considered that this degree of containment can be maintained by adherence to sound principles in the design, construction and operation of nuclear plants. It is therefore concluded that the satisfactory siting of high powered reactors with suitable engineering

safeguards will not present an unsuperable problem in the development of nuclear power."

I would welcome any further questions.

MR. HALL: I wonder if you would care to comment on a statement that is attributed to Dr. Teller, with whom you were a co-author in this, this particular paper, regarding the desirability of locating reactors underground?

THE WITNESS: You are referring to the address that Dr. Teller made before --

MR. HALL: I'm not sure of the particular reference. It was alluded to in the statement made by one of the participants in the limited appearances yesterday morning.

THE WITNESS: I believe that if I am correct that this is from a publication in the Journal of Petroleum Technology, May 1965.

MR. HALL: I think you are right, yes.

THE WITNESS: Which is a record of the March 4th luncheon address by Dr. Teller at the Dallas section's 1965 symposium on Petroleum Economics and Evaluation.

MR. HALL: Good.

I realize this is not your statement. I am inviting you to make any comments you may wish to make on this statement.

THE WITNESS: Well, it is a little difficult for

me to fully understand Dr. Teller's point of view. I am not at all clear as to how thoroughly he has followed the design and evolution of reactors and their containment in the years just preceding this meeting here. So that I am not at all clear whether he has taken all of these factors into consideration.

I am aware that Dr. Teller is-- Well, he has thought about underground as a defense against attack, and I presume that this is his way of solving the containment problem. I am conjecturing.

MR. HALL: Let me suggest that -- or would you care to comment on whether or not a reactor proposed to be built underground at this time would be more experimental than a reactor built in what we may call more conventional means?

THE WITNESS: I would certainly believe that such a location would be much more experimental. There is only limited experience with underground reactors, and they are not comparable with any-- These designs we are using for reactors today involve a large amount of study and evaluation. And I am not aware of any similar evaluation of underground locations and I don't know what the design might be.

MR. HALL: Thank you.

CHAIRMAN JENSCH: Dr. McCullough, in reference to your prepared statement which has been presented as your

direct evidence in this proceeding, you have expressed your opinion concerning the facility for which a construction permit is sought. I wondered if you would tell us, how did you evaluate this proposed design in order to arrive at the opinion you have expressed? What do you do or what did you do based upon existing technology and that proposed for this facility?

THE WITNESS: Well, sir, I considered the proposed design really in its entirety and I related it to the experience and knowledge which had been accumulated on similar designs, namely pressurized water reactors. This reactor is a small extrapolation from previous experience.

CHAIRMAN JENSCH: What is the nearest one to it, the basis for the extrapolation.

THE WITNESS: The nearest one to it that I am aware of is the Connecticut Yankee case.

CHAIRMAN JENSCH: Which is now being constructed?

THE WITNESS: Yes, sir.

CHAIRMAN JENSCH: What is the nearest operating experience that could be sued for extrapolation?

THE WITNESS: Well, there is, of course, Yankee Rowe, and also Indian Point 1.

CHAIRMAN JENSCH: What is the level at Yankee Rowe?

THE WITNESS: I don't recall offhand.

CHAIRMAN JENSCH: Excuse me. Will you proceed? Tell me what you did in considering the design.

THE WITNESS: You look at these general things. Now you look at the reactivity effects within the reactor core and how they are monitored, how they are controlled. Again, there is a small extrapolation, and in listening to the presentations made by Westinghouse, who designed this reactor, I was assured, particularly in view of the statements given by the staff, that these reactivity transients could be controlled within the limits which are necessary and desirable. The other thing you look at is the hydraulic, thermal characteristics, and these are within reasonable extrapolation from the technology, in my opinion. You look at the pressure

vessel and the primary system, and again, these are within reasonable extrapolations.

MR. HALL: Excuse me, Doctor. What is a reasonable extrapolation? Could you enlarge on that a little bit?

THE WITNESS: When you -- I am trying to find words to express it.

MR. HALL: I realize it is difficult.

THE WITNESS: Take a pressure vessel of a certain size, and a certain designed pressure. If you want to make a vessel somewhat larger, a reasonable extrapolation in that field, I would think, is something of the order of not more than 50 percent increase in thickness, diameter, whatever you choose to use as a parameter. On reactivity and shutdown margins, excursions, you look at another thing, you look at the prompt critical value and make sure you can controll it in the time schedule which is necessary to avoid undesirable effects.

In other words, you use your judgment as to what can be reasonable predicted from what you already know. It is a matter of judgment, I grant you. Is that clear?

MR. HALL: Yes.

THE WITNESS: To continue, after examining the primary system -- incidentally, there has been some rather searching scrutiny, both in meetings with Westinghouse and with the staff, as to how well Westinghouse knows these values, or how well they can calculate them. Of course, the design is

not complete, so you have to make judgment as to whether the problems can be solved as the design proceeds. From that, I studied, or rather listened to the presentations on the containment -- how they would protect against leakage from the containment. And I again came to the conclusion that these things were in good sound engineering designs.

Finally, you take -- look into the possibility of removal of heat in case there should be a very major accident, and again, they have redundant provisions for removing this heat. And as a result of all of this discussion and examination, I came to the conclusion which I stated.

CHAIRMAN JENSCH: If I recall correctly, in some of these earlier cases -- maybe I won't use quite the technical words -- but let me see if I can describe it -- in a large reactor, you may have, in a sense, several separate critical units, each of which has its own problems for which protective devices must be arranged. Are you able to consider that type of operation for the projected facility for Indian Point No. 2? For instance, how many separate critical units would you envision for the type of core that you understand, although it is not finally designed, but which is presently contemplated for use in this projected facility?

THE WITNESS: In our discussions, I do not recall any breakdown into these separate critical masses which could exist in the Indian Point 2 reactor. Now, this was not brought up

as an item for specific discussion, I think, because it is recognized that pressurized water reactor cores are much, are quite closely coupled.

In addition, they are providing in-core instrumentation, which will monitor the action of the separate units. Now, to get more detailed discussion of the problems of instability, or variation in power level across the core, I think you should ask -- in order to get more detailed information about the power direction in the core, actually I think you should ask the Westinghouse people.

MR. HALL: I would be interested in hearing from the Westinghouse people any analysis that they have, or may have done, on the spatial instability resulting from xenon or any other cause, which causes modal distortions in the core.

MR. FRENCH: Dr. Hall, we have employed a standard series of diffusion depletion calculations to follow any tendency for an instability to be generated by xenon. We find that even in a core as large as Indian Point --

CHAIRMAN JENSCH: Indian Point 1 or 2?

MR. FRENCH: 2. This is a core which is 12 feet in height and approximately 11.3 feet in diameter -- that our best estimate of calculation is for a damped condition. There is no tendency for diversion oscillation.

So it is our belief this would not occur. There is, however, sufficient uncertainty remaining that we do intend

in the design to develop those procedures necessary in case the oscillation does in fact exist.

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MR. HALL: Reference has been made to in-core monitoring of the power distribution. Will this be dynamic, or could you describe the nature of the in-core monitoring?

MR. FRENCH: The in-core instrumentation is a movable ion chamber device. It cannot be employed as a dynamic measurement. We have performed some work, however which indicates that the information necessary for the control of the oscillations, if they were to exist, can be provided from the out-of-core instrumentation.

MR. HALL: Would you expect any difficulty with the ganged operation of the rods.

MR. FRENCH: The procedures which we have examined to date indicate that the control rod adjustments which would be required are quite simple and do not require any difficult or rapid adjustment.

MR. HALL: I take it from the tone of your comments that you expect this reactor to act as a point source or essentially still as a point reactor rather than as a distributed?

MR. FRENCH: That is correct.

MR. UPTON: Mr. Chairman, Dr. Hall, in addition to what Mr. French said, I just wanted to invite the Board's attention also to the fact that the whole matter of core stability is listed as one of the specific items in our Summary of Application, as a research and development program

item, indicating our recognition of the things that have to be looked into.

MR. HALL: Are we to assume, then, that the core is not for discussion, in your opinion?

MR. UPTON: No, sir. I was just supplementing what Mr. French said. I wasn't by any means objecting to your question.

MR. HALL: Dr. McCullough, may I go back to you? I note in your testimony that you are a member of the ASME, generating the nuclear code?

THE WITNESS: Yes.

MR. HALL: Would you care to comment on the significance of the Section 3 of the ASME pressure vessel code? What is special about it? Why is it being used? And can you make any comments about the safety factors which are incorporated into the code?

THE WITNESS: I can comment, yes, sir. Section 3 was written as a code which would be an additional -- would provide additional safety margins because it was recognized that these margins were required for nuclear service. The old code which had been used prior to Section 3 was Section 8, which is the unfired pressure vessel code. New knowledge has been developed in the course of -- actually in the course of the Navy program using pressure vessel. And they recognized the effects of fatigue had to be incorporated,

used as a basis for design of the system. We are of the opinion, regarding the credibility of pipe breaks, that if these are to occur, they are more likely to occur in the smaller piping.

CHAIRMAN JENSCH: I think the question -- perhaps you were conferring with an associate at the time the question was propounded to Dr. McCullough. I think the question was, if you apply that type of analysis to a coolant pipe, why do you not apply the same type of analysis to your pressure vessel, whether it is a single-ended or double-ended rupture. Assuming it to be a single-ended rupture, would you apply the same analysis to a pressure vessel?

MR. BECKJORD: This question was dealt with at some length in the course of meetings with ACRS. My answer relative to the question of pressure vessel rupture is that this is not -- we did not regard this as a credible occurrence, because under all operating conditions, the reactor vessel is operated in a ductile mode. That is to say, the material is in a ductile mode, and therefore brittle fracture, or this rapid fracture, will not occur. Nonetheless, in the course of the ACRS hearings, we looked at various modes of vessel failure to examine the consequences. And, as I indicated in the ACRS letter of August 16, the consequences of this type of rupture were protected.

CHAIRMAN JENSCH: I understood Dr. McCullough to say

and the real difference between Section 3 and Section 8 is the recognition of fatigue effects which are incorporated into Section 3.

I cannot give you a number of factor safety. I don't think it is that simple a problem. But it does have this additional margin of safety.

MR. HALL: You are suggesting -- you are stating, rather, that Section 3 as applied to nuclear pressure vessels -- let me be more accurate, pressure vessels for nuclear application -- is more conservative than that which is required for the non-nuclear industry?

THE WITNESS: This is my understanding, yes, sir, and this is my opinion.

MR. HALL: Do you consider the brittle failure of the pressure vessel to be a credible occurrence?

THE WITNESS: I am really a bit out of my field. I am not a metallurgist. But being a member of this committee, I think it is appropriate I should comment.

If there are no radiation effects of sufficient magnitude, I do not consider a brittle fracture critical.

MR. HALL: That is under the service assumptions, under the designed conditions?

THE WITNESS: Yes, sir.

MR. HALL: Do you believe the fracture, commonly referred to as a guillotine break of the main coolant

piping, to be a credible accident?

THE WITNESS: If you will pardon me, we have a problem here with the word "credible."

MR. HALL: I agree.

THE WITNESS: This is semantics. A guillotine failure of a main coolant pipe in my opinion is exceedingly improbable, but if you take consideration of all the imagined possibilities, we must admit it is a possible thing, even though I would consider it on the margin of whether you should take it into consideration or not.

I would like to offer a comment here that after all, when you are dealing with the release of the primary coolant, the thing that is important is how fast the release takes place, rather than how it occurs. The rupture of a main line is just a convenient way of pegging where you stop in consideration of the size of the opening through which the material can escape.

MR. HALL: Well, in the accident analysis that has been a part of the Safety Analysis Report submitted by the applicant, it was assumed that the main coolant piping had broken and the consequences then were evaluated. I am really asking your opinion, from your experience in dealing with reactor safety over many years, your opinion of the validity of this assumption. Is this an extreme assumption or is this one which is logical and necessary for the course of safety analysis?

THE WITNESS: You are referring to the rupture of this largest cooling pipe?

MR. HALL: Yes, sir.

THE WITNESS: Although I believe this rupture is on the margin of, shall we say, credibility or possibility -- I think it is a useful thing to examine and therefore -- and it has been customary for I think good and sufficient reasons to examine it in this fashion. So, therefore, I think it is proper that analysis should be made on this basis, even though it is problematical as to whether it is possible to occur.

MR. HALL: Do I conclude, then, from the phrasing you used, that this can be regarded as a standard type exercise which every reactor designer should go through?

THE WITNESS: It is, it has been standardized in that sense. It is an exercise which is used as a yardstick of the ultimate accident that could conceivably happen.

MR. HALL: Its inclusion in the consideration of this particular reactor should have no implication on the probability of occurrence in this design?

THE WITNESS: I agree.

MR. HALL: Do you have any suggestion as to why this particular type of accident is chosen as the standard example, rather than a pressure vessel failure as one example?

THE WITNESS: If you try to examine pressure vessel failures, it is difficult to know where to stop. The ultimate,

of course, would be the instant vaporization of the pressure vessel, which, of course, is not conceivable, not credible. If you begin to back down, then you get into -- I don't think we have the tools at the moment to analyze adequately failures of the pressure vessel itself.

In addition, the pressure vessel is the thing which is covered by Section 3, not the piping. There is a code being written to cover nuclear piping, but it is not yet completed. So we are perhaps in a little more area of uncertainty when we deal with piping. So there is some logic in picking the piping as the failure point, rather than the vessel.

MR. HALL: May I ask if the Westinghouse representatives would care to comment, or Con-Ed? Comment on the relative probabilities of a failure of the pressure vessel versus the piping?

MR. BECKJORD: Dr. Hall, I think my answer to your question would be that we do not regard the double-ended instantaneous severance of the reactor coolant piping as a credible event. I would agree with Dr. McCullough's statement that this is used, as we assume this accident as a basis for designing the engineered safeguard systems, because the key factor relates to this matter of the rate at which coolant is lost from the primary system. The double-ended rupture of the main coolant piping is the biggest break we can conceive in the system. Therefore, the assumption of this accident is

you didn't have the tools to analyze the pressure vessel. Are you able to make any analysis without the tools?

MR. BECKJORD: I am sorry, I was conferring, I didn't hear his statement.

CHAIRMAN JENSCH: Well, do you have any calculations at all on the strength of the pressure vessel for the same type of a single-ended fracture, even though you may not consider it credible?

MR. BECKJORD: Yes. These calculations were done and presented to ACRS.

CHAIRMAN JENSCH: And you do not, therefore, believe the same type of analysis is applicable for a pressure vessel as it is to the main coolant pipe, for instance, is that correct?

MR. BECKJORD: Well, Mr. Chairman, would you rephrase the question? I don't see what --

CHAIRMAN JENSCH: I am just reaching the conclusions I infer from your statement, that you do not believe the same type of analysis that you make for the main coolant pipe is applicable to the pressure vessel?

MR. BECKJORD: Well, there are several kinds of analyses that we utilize in evaluating this accident of the main coolant piping rupture. There is another type of analysis that we use in evaluating the consequences of a hypothetical vessel rupture. These aren't necessarily the same analysis.

MR. GEYER: The ACRS letter refers to analyses assuming

various modes of circumferential cracking. Could you elaborate on that?

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CHAIRMAN JENSCH: I wonder if the witness might have that letter before him, so he may refer to the particular sentence.

Now one of your associates is handing you the letter. You are referring to page 2?

MR. GEYER: Page 2, the next to the last sentence in the second paragraph, or first full paragraph on page 2. It says:

> "This includes missile protection against a highly unlikely failure of the reactor vessel by longitudinal splitting or by various modes of circumferential cracking."

What modes of circumferential cracking have you dealt with?

MR. BECKJORD: The modes that we dealt with in our analysis were a circumferential crack in the region of the core mid-plane. The core mid-plane was selected, because this could be the worst case in that area.

The same type of analysis would apply to a circumferential rupture above or below the mid-plane in the vicinity of the core.

A further-- Another mode that was examined was a circumferential failure above the reactor vessel nozzels but below the flange.

MR. GEYER: Was the assumption made that these

cracks went completely around the vessel?

MR. BECKJORD: Yes.

MR. GEYER: In other words, it failed?

MR. BECKJORD: It failed. The assumption was made that it parted instantaneously.

MR. HALL: What happened to the projectile?

MR. BECKJORD: In the case-- Well, the answer is different depending on the case that we consider. In the case of the circumferential rupture at the core mid-plane, the bottom part was accelerated downward, the upper part was accelerated upward, and it reached a height of about approximately 30 feet above its initial position and in the course of this acceleration, it moved the pipes up and severed them.

MR. HALL: Was the containment, in that analysis, was the containment breached?

MR. BECKJORD: No. The containment height above the initial point of the reactor vessel, I don't recall the exact number, but it is in excess of 100 feet.

MR. HALL: Do I understand you to be saying that the design of this containment, as proposed for Indian Point No. 2, will withstand the consequences of a sudden catastrophic rupture of the pressure vessel?

MR. BECKJORD: Yes.

MR. HALL: Under any mode?

MR. BECKJORD: Under the modes that I have named, the circumferential rupture at the core mid-plane and a rupture on up above the nozzels, but below the flange.

MR. GEYER: Did you assume instantaneous release of all of the energy contained in the pressurized water in this accident?

MR. BECKJORD: Yes, sir. Well, the system opened a very large hole and the pressure rose in a very rapid time. The pressure, the heat pressure, however, is approximately the same as the pressure from the double-ended pipe rupture, because it is the same energy storage in the primary system.

MR. GEYER: In these analyses, practically all of the energy goes into pressure rise?

MR. BECKJORD: Yes, sir.

MR. HALL: Again, to belabor this, because I missed this in the analysis, if it was in your safety analysis report, this would result in a shock, creation of a shock, then, would it not, the sudden release in a sudden fashion of this, which would put a shock loading on the pressure vessel, on the containment sphere.

MR. BECKJORD: Well, there is a great deal of structure surrounding the reactor vessel. There would be a shock on the concrete primary shield and on the missile shielding above the reactor vessel head.

There is a missile shield there for the purpose of preventing the control rod shaft from rising very high vertically. And this structure tends to cushion the shock, would tend to cushion the shock of such an accident.

MR. HALL: May I ask the Staff if they concur in the analysis of this containment, that it would be expected to be safe against a sudden rupture of the vessel?

MR. CASE: Yes, Dr. Hall, for the failures Mr. Beckjord has been talking about. We have made independent calculations. We have also engaged the services of Mr. James Proctor of Naval Ordnance Laboratory who is an expert in this field and we agree with their assumptions and the general results of their analysis on this point.

MR. HALL: This then would seem to answer in detail, in fact even go beyond the intent of the ACRS general letter of advice of November 24, 1965, wherein they suggested that attention should be directed to pressure vessel failures?

MR. CASE: I would believe it was responsive to this part of the letter where it says:

"It seems desirable and possible to make some provisions in future designs against this very unlikely accident."

MR. HALL: Thank you.

CHAIRMAN JENSCH: Dr. McCullough, I wonder if I understood correctly one of your answers. I wonder if there

was a qualification that you implied or intended to imply in response to a question from Dr. Hall. As I recall your answer it was something like this: If there are no irradiation effects in the pressure vessel, there will be no enbrittlement.

Doesn't the consideration necessarily involve the possibilities of irradiation effects, and if so, what is the effect of enbrittlement?

THE WITNESS: There is always consideration of the radiation damage to the steel and there is quite a research program which leads to the increase in NDT temperature, and as long as you keep the neutron dosage below certain values, you are still in the ductile range and provision is made so you stay in the ductile range.

So in that sense the radiation damage is looked at, but is not effective in considering the vessel rupture problem, because we stay within the ductile range.

CHAIRMAN JENSCH: In other words, you have the problem under analysis, but you provide preventive devices in case an unlikely effect does develop. Is that correct?

THE WITNESS: More than that. We don't let the effect develop.

CHAIRMAN JENSCH: How do you do that?

THE WITNESS: By shielding to reduce the neutron dosage to the pressure vessel wall. Water, steel, other

shields.

MR. GEYER: Do you plan to radiate the specimens of the pressure vessel in the reactor while it is operating?

THE WITNESS: I would prefer to let someone else answer that, if I may. They are the people who make the design. I heard what they said, but they do it.

MR. CAHILL: Yes, we do plan to have specimens within the reactor vessel against the interior wall which can be removed periodically for examination of their change in properties over the years. This will assure us that the expected radiation effects which indicate that the NDT properties will still be acceptable at the end of the reactor vessel's life, that this expectation will actually be realized as proven by the examination of the specimens.

CHAIRMAN JENSCH: Are you far enough along in that program to indicate the number of samples you will have within the vessel and the times that you will, within which you will remove them and how will the process be accomplished?

MR. CAHILL: I believe there are presently estimates and somebody will look that up in the records.

CHAIRMAN JENSCH: Are you suggesting that it is already within the material on file?

MR. CAHILL: Yes, sir.

CHAIRMAN JENSCH: If it is, I will defer the question entirely.

MR. BECKJORD: Yes, it is, Mr. Chairman.

CHAIRMAN JENSCH: If it is in the filing, that is adequate.

Dr. McCullough, I wonder if I may return again to this ASME code. And will you identify ASME for the record?

THE WITNESS: ASME stands for American Society of Mechanical Engineers.

CHAIRMAN JENSCH: Is the work on that code far enough along so you can express an opinion as to whether or not -- maybe it is too early for you to say -- the ultimate result of that code is related to the design of this Indian Point No. 2 facility?

THE WITNESS: That code is a published working code.

CHAIRMAN JENSCH: Section 8?

THE WITNESS: No, Section 3.

CHAIRMAN JENSCH: Section 3. That is unfired vessel, is it not?

THE WITNESS: No, sir, excuse me, Section 8 is for unfired. Section 3 is the official code of the ASME and this vessel, I am assured, is being built in accordance with it.

MR.GEYER: Is there any experience with failures of vessels built under this code?

THE WITNESS: There is no experience of any failures

of such vessels.

I may comment, by the way, that under the conditions which we are designing this vessel, there are, as far as I am aware, no failures.

CHAIRMAN JENSCH: The whole matter of transients related to this core will necessarily await the ultimate final design of the core. Is that correct?

THE WITNESS: That is my understanding, yes, sir. That is my opinion.

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CHAIRMAN JENSCH: Maybe this is a question of philosophy of reactor technology, but why is it that we don't get far enough along in the core, when you are at the construction permit stage, that you can consider with some finality the transience that should be considered?

THE WITNESS: I would prefer to let Westinghouse answer this, if I may.

MR. UPTON: Mr. Chairman, I wonder if that isn't really a legal question.

CHAIRMAN JENSCH: Well, it may be, in part. But we are met with a certain quality of evidence here that transients will necessarily await the final design, and we will take it up in the final design.

I think the indications in the regulations are such that if there is a reasonable probability that final design will be developed and the transients can be considered, I think legally that type of approach is within the scope of the regulations.

But I was wondering, the question I had was really a predicate to the next question, Dr. McCullough, and that is how well can you express an opinion on the safety without these several factors, regardless of whether the construction permit would issue without the data on which he feels he can rely.

With that background, Doctor, would you pick it

up from there?

THE WITNESS: The experience we have had with reactors of this type gives us assurance that the analysis which will be made in detail when the core design is finalized will give you all of the necessary data which you need in order to assure the safety of the core, the safety of the reactor, control of transients, so I rely on this background heavily in making this opinion.

There is an additional safeguard, by the way, and that is the design of this machine or any other machine is continuously examined during the design by the AEC staff.

The problem that has to be faced up to is if, in the course of the design and analysis, you get unacceptable trends, what do you do then? And there has been considerable discussion, that there are ways of controlling this, that are reasonable and feasible, so therefore we have excellent assurance that the core can be built which will not experience any unacceptable transients.

CHAIRMAN JENSCH: Do I infer correctly from your statement that as these developments in the design and the related possible transients are considered, if credibility attaches to possible transients, that preventive devices are likewise devised to accommodate the possible transients from the ultimate core design? Is that correct?

THE WITNESS: Yes.

MR. GEYER: Will a study of these transients involve oscillations between different parts of the core, rather than oscillation of the core as a whole?

THE WITNESS: This is considered by the experts who are here. They can deal with this much better than I can.

CHAIRMAN JENSCH: Will you pick that up?

MR. FRENCH: The answer to your question is yes, that part of the research and development program that has been mentioned will be involved with considerations of spatial redistribution.

CHAIRMAN JENSCH: If I may return to Dr. McCullough, there has been mention in your direct testimony of your extended experience in the nuclear field. I wonder, for this record, if you would indicate your opinion as to the philosophy of nuclear technology from the beginning to the present time and your view as to the considerations of safety, particularly as applied to a project such as Indian Point No. 2.

THE WITNESS: In the field of safety for nuclear installations, we have adopted from the very beginning the philosophy that we will examine all of the conceivable hypothetical accidents.

This philosophy is new in industry. Other industries have developed and discovered their difficulties or problems by actual accident experience. In the case of

the nuclear industry, we have tried to foresee these things. As a result, as the technology developed, we have studied more and more possible accident modes and accident consequences.

I should say sometimes I believe that the more we learn the more imagination we stir up, and sometimes it begins to get a little bit shall we say fantastic. Nevertheless, I think the basic philosophy of trying to forestall, foresee these accidents and provide against them is sound until we have enough experience to be sure that these precautions are unnecessary.

I think that in my opinion there has been a real conscientious effort both on the part of the designers of reactors and on the part of the AEC staff, which has grown in size and in competence over the years, so that I believe that each step that we take is adequately monitored and over-monitored, perhaps, but I am not apologizing for the over-monitoring, from a philosophical point of view.

Does that answer your question?

CHAIRMAN JENSCH: Do you think that type of philosophy is reflected in the design as you now see it for Indian Point No. 2?

THE WITNESS: Yes, sir, I do.

CHAIRMAN JENSCH: Perhaps some of my questions are those which have been enumerated in the preharing

conference and will be presented later by responses, but let me inquire whether you have made an analysis of this -- if I use the term correctly -- the heat transfer coefficient. And is that calculation reasonably conclusive of the plutonium elements that may be present as the core is utilized, the fuel is utilized?

THE WITNESS: I am not clear what heat transfer coefficient you are referring to.

MR. HALL: The Chairman has reference to the increased heat rating from the fuel rods over that which is used for the design of Brookwood for example, or other reactors.

I think the maximum over-power condition for this reactor comes to 21.3 kilowatts per foot. Would you be responsive?

THE WITNESS: I have a general yardstick on these things, but I think the people who know the details can answer better.

MR. BECKJORD: You refer to the 20.7 kilowatts per foot which is quoted in the staff analysis?

CHAIRMAN JENSCH: At the top of one of the pages, as I recall it, the figure we have in mind -- let's see if we can find it.

end

MR. CONNER: It is on page 11, Mr. Chairman, paragraph 2. It is also repeated in other places throughout.

CHAIRMAN JENSCH: The figures to which I referred are figures where a comparison was made with Connecticut Yankee, I think it was something like 21.7 and 18.3 for Connecticut Yankee and some other figure for either Rowe or maybe Brookwood. It is in the staff analysis somewhere.

MR. CONNER: It is in the summary statement, Mr. Chairman, that reference, on page 6, the first full paragraph on page 6 of the staff's summary statement.

CHAIRMAN JENSCH: Thank you.

Do the Westinghouse witnesses have that report?

MR. CONNER: I will hand a copy to Mr. Beckjord.

CHAIRMAN JENSCH: Yes. It is in the first paragraph there, the specific power of the Indian Point fuel rods are 20.7 kilowatts per foot.

MR. BECKJORD: Would you repeat the question, Mr. Chairman?

CHAIRMAN JENSCH: My question was -- really it was to Dr. McCullough and he deferred it to you -- is that computation adequately inclusive of the effect from plutonium that will be developed in the utilization of the fuel?

MR. BECKJORD: Yes, sir. The number which is quoted, 20.7 kilowatts per foot, is the peak lineal power density expected in the core over the life of the fuel in the reactor at the peak over-power condition of 112 percent.

I might add that the period of time during which the fuel would actually be operating at this number would be very short. The nominal 100 percent power design is 18.5 kilowatts per foot.

MR. HALL: What is the basis for feeling that one can increase the heat rating?

MR. BECKJORD: Dr. Hall, we do not believe that the fuel is limited below 24 kilowatts per foot in regard to proper performance during service life in the core. It is possible that operation at lineal power densities could be above that. But we do not believe we are limited below that.

MR. HALL: Could you cite the experience on which you make such a statement?

MR. BECKJORD: We have a irradiated fuel in a number of capsule experiments and in the Saxton reactor in excess of 20 kilowatts per foot.

In particular, the Carolina-Virginia test reactor capsule experience, at 24 kilowatts, with no center melting. Further experiments at Westinghouse test reactor, in capsules there in excess of 22 kilowatts per foot, with no center melting. And no significant changes in clad dimensions. Further tests at the Plumbrook -- that is a NASA test reactor -- in capsule tests at power ratings of between 20 and actually up to 60 kilowatts per foot.

MR. HALL: When you use the capsules, are these in the same geometry as the fuel elements intended for this reactor?

MR. BECKJORD: They do not have the salient. However, the section of the fuel in the capsule is identical with, or similar to what we will use in Indian Point 2.

MR. HALL: The cladding and bonding are the same?

MR. BECKJORD: The fuel is not bonded to the cladding, sir.

MR. HALL: Or lack of bonding, then?

MR. BECKJORD: Yes, sir. And further tests at the ETR reactor in capsule experiments at 20 kilowatts per foot and some were operated up to 30 kilowatts per foot. Then finally, in a reactor test at Saxton, with a full length Saxton fuel element at power densities of approximately 24 kilowatts per foot.

MR. HALL: One of the numbers you mentioned was 60? Is my memory correct?

MR. BECKJORD: My eye cast over that. I did say 60. It was operated up to 60. But of course it was beyond center melting at that point.

MR. GEYER: These figures of 20.7 kilowatts per foot, then, are maximum numbers, the highest point of power production within the reactor or for the reactor as a whole?

MR. BECKJORD: That is the peak lineal core density in the reactor at any time during life at the over-power condition, Dr. Geyer.

MR. GEYER: At any point in the reactor?

MR. BECKJORD: Yes, sir.

MR. GEYER: It is not average for the reactor as a whole?

MR. BECKJORD: No, sir. The peak in the reactor.

MR. GEYER: Thank you.

MR. HALL: May I ask the staff if they consider this extrapolation to be reasonable and conservative?

MR. CASE: Well, we believe it is certainly a reasonable extrapolation on the basis of which it is quite adequate to issue a construction permit. We intend to follow the experience of other reactors at this power density, as does Westinghouse, to see the long-term effects of this.

MR. HALL: This won't have long-term effects, if I understand the statements correctly. This will be the over-powered condition, which is not expected to obtain for a long time.

MR. CASE: Yes. But the change in one reactor is the same as the change in another reactor. All of these comparisons are made on the same basis. So the shortness of the time which they expect to be at 20.7

kilowatts is the same short length of time they would be at 18.7 for the other facilities. So it does work with extrapolation.

MR. HALL: Perhaps even less time at Indian Point 2, which has an obligation to perform reliably, where another reactor, more remote or in other circumstances, might be used for experimental work?

MR. CASE: These reactors we compared them with were the same class of reactors.

MR. HALL: Right. So this is related to one of the questions that I was asking earlier, the confidence with which you feel these extrapolations to higher power, both by running at a higher lineal power, kilowatts per foot, and by increasing the flow, and you feel --

MR. CASE: In both respects we consider it to be a reasonable extrapolation.

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CHAIRMAN JENSCH: May I go back to an answer I believe that Mr. Beckjord gave? I think you gave some figures about 22 or something kilowatts per foot. But you mentioned in relation to a lessened time period, if I recall your answer correctly. I wondered what the variance was as to time periods in reaching those kilowatt per foot figures that you enumerated. Do I recall correctly? Is your recollection refreshed by my statement?

MR. BECKJORD: My statement, Mr. Chairman, was that the 20.7 kilowatt per foot lineal power density represented the peak over-power condition at the peak point in the reactor. And this would obtain for a very short time.

CHAIRMAN JENSCH: How long?

MR. BECKJORD: I could give you just an estimate now. It would be less than, substantially less than one percent of the operating time of the reactor.

CHAIRMAN JENSCH: Are you able to put it in relationship to minutes or hours or days, or something like that?

MR. BECKJORD: As I say, I can't give you an exact number. My opinion is that it is substantially less than one percent of the operating time, which would be less than one percent of 8,000 hours a year probably. So less than 80 hours a year.

MR. CAHILL: I would like to supplement that, sir. It is most likely to be zero. The core only, the fuel is only

in the core about three years, and an over-power condition is most unlikely. In our own experience on Unit 1, we have never had an over-power. This is not a condition that is likely to occur at all.

CHAIRMAN JENSCH: No. My question was in reference to the calculations and the time period. My understanding was more consistent with yours, that it would be a very short period of time, or zero time for that operation. Is that correct?

MR. CAHILL: That is correct.

MR. HALL: How good do you think the calculations are? You recite this 12 percent, and you cite the numbers of 20.7. There are three significant figures there. Do you really believe these are to that precision that is indicated by one part in 200?

MR. CAHILL: Well, I know that the power output of the reactor can be determined to within one or two percent by precise measurements. This is a technique well established in steam power plant practice.

MR. HALL: This is taking the total, the steam heat balances?

MR. CAHILL: Steam heat balances, yes.

MR. HALL: It is not, of course, the total power of the reactor, because there are radiations which are absorbed in the vessel and what not?

MR. CAHILL: These can be estimated quite accurately,

sir.

MR. GEYER: This calculation gives you an average power, does it not, for the reactor as a whole?

MR. CAHILL: Well, what I had reference to is the probability of reaching 112 percent over-power. That is very unlikely.

MR. HALL: For the reactor as a whole?

MR. CAHILL: Yes.

MR. HALL: But what I guess I am leading up to -- isn't it possible that there will be variations within the core of several percent differing from that which is predicted by the idealized calculations you performed?

MR. BECKJORD: Dr. Hall, in our opinion, the hot channel factors which directly govern this lineal power density are conservative. We actually expect lower hot channel factors.

MR. HALL: This is related to your specifications and tolerances in the manufacturing procedure, spacing if you will, and what not?

MR. BECKJORD: Yes, sir.

MR. HALL: Density of fuel, many other factors. So that when you use the figure of 20.7 as the peack value under over-power, you feel you have put in safety factors such that this figure will never be reached in fact? Is this true?

MR. BECKJORD: Well, I said a very short time. The probability of reaching it is small, very small. It would not

be exceeded.

MR. HALL: Again, assuming for the moment it does in fact experience an over-power, which I understand and accept your statement on, but let me go back to what I thought you were saying in deriving this figure, that you believed that the hot channel factors -- you believe the derivation of the hot channel factors was so conservative that the actual number would be in fact less than this?

MR. BECKJORD: Yes, sir. That is correct. And this further will be demonstrated by measurements of in-core instruments during operation.

MR. HALL: Do you recall what the margin to fuel melting is under these conditions?

MR. BECKJORD: As I indicated earlier, we do not expect melting below 24 kilowatts per foot. We know of no case where it occurred under the conditions that we are utilizing at less than 24 kilowatts per foot.

MR. HALL: So you are stating on the order of a 20 percent margin?

MR. BECKJORD: Yes, sir.

MR. HALL: Dr. McCullough, I will impose upon you again, because of your long experience with reactor safety. Several times in the preliminarly statements, reference has been made to a document called "WASH-740". Are you familiar with this document?

THE WITNESS: Yes, sir, I am familiar with the documents.

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MR. HALL: Would you care to make any comments on the pertinence of the analysis made in that document as applied to the present consideration of Indian Point No. 2?

THE WITNESS: WASH 740 was a document of the theoretical consequences of an accident and they considered several accidents. These were uncontained accidents.

MR. HALL: Would you enlarge on that for a minute?

THE WITNESS: The assumption was made in WASH 740 that the reactor released its fission products and there was no shell on the containment vessel around the reactor which had released these products and therefore they all escaped and were available to be distributed in the environment.

MR. HALL: In the development of this, what is your impression as to the mechanism by which this is postulated?

THE WITNESS: In WASH 740, they merely postulated it happened. They didn't give a mechanism, as I recall it, as to how it happened. And the attempt was made in this to merely get the outside limits under different meteorological conditions mainly. The variations.

I am a little hazy about some of the detailed calculations they made. So this is merely the outside limit. And when you begin to put a containment around, the conclusions cannot be used, really. You can't ratio them down, even, because there are so many variations here, in my opinion

at least. So I don't think it is really applicable to this case.

CHAIRMAN JENSCH: I have a further question. I don't know whether it should be directed to you, Dr. McCullough, or to the Westinghouse panel, but I will address it generally.

One of the operations contemplated for a maximum credible accident as I understand it is a spray system. I wondered what the experience has been as to whether the spray, which I infer must be continuous, what is the experience that the spray will reach the core? Or the hot location for the core that is producing the MTA?

THE WITNESS: This is a design problem. I would like to refer it to Westinghouse, if I may.

CHAIRMAN JENSCH: Yes, please.

MR. BECKJORD: I believe the spray that is referred to is the containment spray, and the purpose of that system is to cool the containment and condense the steam that would evolve from the primary system.

MR. HALL: Do you not have a core injection spray system?

MR. BECKJORD: We do not call it a core injection spray system, Dr. Hall. It is a core injection system, deluge system.

MR. HALL: Well, it is intended to inject water, treated water, into the hot core, to prevent melt down?

MR. BECKJORD: That is correct.

MR. HALL: I believe the Chairman is really asking your opinion as to can you force this water in against the steaming condition which might exist at that time? Would you get steam blockage, for example?

MR. BECKJORD: We do not expect steam blockage to prevent the entry of cooling water from our core cooling system into the core to prevent melt down.

MR. HALL: Do you have experience to back this up?

MR. BECKJORD: We have done calculations on our core cooling system to a considerable extent based on knowledge of friction, flow friction in pipes, and upon very conservative assumptions regarding the loss of cooling water from the system out of the break in the system as it has occurred to begin this accident.

For example, in our plants, only three out of four injection legs which put water into the system are assumed to be effective. These operate in both hot and cold legs and in our opinion, and from our calculations, we have concluded the core will be adequately cooled.

CHAIRMAN JENSCH: The question was, do you have experience? You said you have calculations. Do you have experience that will support that?

MR. HALL: Would you not agree this is a very difficult thing to calculate?

MR. BECKJORD: It is a difficult thing to calculate, yes, sir.

MR. HALL: Do you have any experimentation or experience of injecting water into a hot channel?

MR. BECKJORD: We have not made-- We have not done experiments on our cooler in our geometry.

MR. HALL: On any geometry?

MR. BECKJORD: That is correct.

MR. HALL: Have you done it on any condition?

MR. BECKJORD: We utilize extensive experimental evidence on the mechanism of fluid flow. But we have not done experiments on an actual core mock-up for this case.

MR. HALL: What experience are you aware of relating to the injection of water into a hot core system?

MR. CASE: There is some experience by other designers of the effects of spraying water on simulated fuel assemblies heated by cal rods. The Westinghouse design floods from the bottom.

MR. HALL: Does that include the ejection, too?

MR. CASE: Yes, although there is of course some effect from the water coming in. The basic concept behind their design is to recover the core. So the question of whether the timeliness of the cooling is not as significant in this type of design as it is in a core spray type design.

MR. HALL: The reason for my inquiring on this is

the comment and recommendation that is contained on page 3 I believe of the ACRS letter of August 16th again, wherein one of the recommendations-- Correction, it is on page 2. ACRS believes an increase in the flow capacity in these systems is needed and improvements in other characteristics, such as pump discharge pressure may be appropriate.

And you feel that this concern of the ACRS is satisfied or can be satisfied?

MR. CASE: Yes. And it is indeed based on the calculated effectiveness of the system as presently proposed, and on that basis, the ACRS considers the calculated effectiveness at this time should be improved. On that basis they recommended an increase in flow or an increase in pressure, each of which would get, or either one of which would get water in there quicker which would improve the effectiveness of the system.

MR. HALL: This improvement was felt to be necessary?

MR. CASE: Yes, sir.

MR. HALL: By you and by ACRS?

MR. CASE: Yes, sir. It is an improvement in degree, rather than in kind.

CHAIRMAN JENSCH: We have extended our session this morning somewhat beyond our usual recess time. At this time let us recess to reconvene in this room at 11:15,

according to the clock on this wall.

(Recess.)

CHAIRMAN JENSCH: Please come to order.

It may be noted that in the recess, or at the start of the recess it was observed that the petition to intervene by the Conservation Center was in final form and distribution was being made of that petition to staff counsel, and I believe it was extended thereafter to the applicant and the State of New York and the Board invited service of the petition so that the recess time could be utilized for some consideration of the petition.

It might be appropriate, if it is not inconvenient to Dr. McCullough, to ask if he would prefer to return to the audience for a moment, so we may give some consideration to this.

Thank you for the interruption, but you are not excused, and are subject to further call.

(Witness temporarily excused.)

CHAIRMAN JENSCH: Would this be a convenient time to proceed to consideration of this petition?

(No response.)

CHAIRMAN JENSCH: Apparently it will be, without objection.

Will you proceed and make your statement in reference to this petition? Have you made service?

MR. CABELL: Yes, sir, service has been made upon the Atomic Energy Commission, Consolidated Edison and

the State of New York.

CHAIRMAN JENSCH: And the Board will note three copies were received by the Board.

For the purpose of this consideration it will be assumed that later copies will be filed with the Secretary of the Commission as contemplated by the rules.

Will you proceed with a statement, if you desire, in reference to your petition?

MR. CABELL: May I ask the Commission to hear Mr. Bogart on the subject of this petition, since he is most familiar with the situation?

CHAIRMAN JENSCH: I was expecting or requesting a statement by you, sir, as a lawyer, in support of your petition. Do you believe your petition adequately sets forth the position of the Conservation Center, and if there is nothing further you desire to add, let me inquire if the parties have had an adequate opportunity to consider the petition, and if so, will they speak to the request set forth in the petition to intervene?

Regulatory staff counsel? Mr. Conner, have you had a chance to review this matter?

MR. CONNER: If the Board please, of course this document was just handed to us at the recess. It is a document of approximately eleven pages. But the last ten of these pages appear to be the same as the last ten pages

of the letter sent to the Secretary of the Commission by Mr. Bogart in a letter dated September 8.

CHAIRMAN JENSCH: Let me inquire on that matter. Is that correct, that your petition, in its last ten pages, are identical with that letter which was transmitted by Mr. Bogart to the Secretary of the Commission on September 8, 1966?

MR. BOGART: Yes, sir.

MR. CONNER: There is in addition a verification by a notary on the last page of the document filed this morning.

CHAIRMAN JENSCH: Yes. Have you had an opportunity to review that document, Mr. Conner?

MR. CONNER: Yes, sir, I have reviewed it. I mean I don't know whether the Board wants argument by counsel now.

CHAIRMAN JENSCH: Yes.

MR. CONNER: Do you want us to go before the applicant?

CHAIRMAN JENSCH: I thought if you were in a position to speak to it, or the applicant, I thought from a regulatory point of view, you addressed yourself yesterday I believe it was, or at the prehearing conference on Tuesday, respecting this matter. If you desire, will you proceed?

MR. CONNER: Very well, sir.

The Commission's rules of course provide, as you pointed out at the prehearing conference, that any person whose interested may be affected -- I will quote from Section 2.714 of the Commission's Rules of Practice, 10CFR2(a). "Any person whose interest may be affected by a proceeding and who desires to participate as a party shall file a written petition under oath or affirmation for leave to intervene not later than seven days before the commencement of the hearing, or within such other time as may be specified in the notice or as permitted by the presiding officer. The petition shall set forth the interests of the petitioner in the proceeding and how that interest may be affected by Commission action and the contentions of the petitioner. A petition for leave to intervene which is not timely filed will be dismissed unless the petitioner shows good cause for failure to file it on time."

That completes the quotation of that subsection.

The notice of hearing published by the Commission specified that "petitions for leave to intervene pursuant to the provisions of Section 2.714 of the Commission's Rules of Practice must be received in the Office of the Secretary, U. S. Atomic Energy Commission, Germantown, Maryland, or in the Commission's public docket, 1717 H Street,

Northwest, Washington, D. C. not later than August 17, 1966, or in the event of a postponement of the hearing date specified, at such time as the Board may specify."

Now the Board did indeed extend the date of the hearing from the originally contemplated August 31, but made no provision for extending the date of intervention.

Now the record in the proceeding also shows that Mr. Bogart wrote a letter to the Chairman of the Commission dated August 13, 1966, on the letterhead of Conservation Center, wherein he noted that -- I will paraphrase this -- that he had learned of the coming public hearing which was then scheduled for August 31, and after referring to some other matters he stated that "We request this hearing be postponed and sufficient time be allowed in setting the date for another hearing to allow parties who desire to be heard a chance to prepare."

So, the record shows that Mr. Bogart was aware of the situation and the existence of the notice on August 13, 1966.

As staff counsel, I replied to that letter, pointing out to Mr. Bogart that the Board action had already resulted in a postponement of the case, and provided him -- and my letter was not sent until August 25, after the prehearing conference. In any event, we sent Mr. Bogart a copy of the pamphlet "Licensing of

Power Reactors" which sets forth our procedures, and of course a copy of Part 2, wherein the procedures for seeking to intervene and so forth are set forth.

I noted that in the event that he wished to appear in the proceeding, that a request filed in accordance with the provisions of the Rules of Practice should be addressed to the Secretary and so forth.

I cite this background because I believe we are obligated to point out under the Commission's rules, that Mr. Bogart was indeed aware of the existence of this proceeding back in August. Accordingly, it would be incumbent upon the Conservation Center and Mr. Bogart to demonstrate some reason which would permit the Board in an exercise of discretion to meet the requirement of the regulations permitting a late intervention upon a showing of good cause.

endll

CHAIRMAN JENSCH: Has he attempted to do that by his petition, saying that they did not get the Safety Evaluation Report from the staff until August 25?

MR. CONNER: Yes, sir. In the fourth paragraph of the document filed at the recess, entitled "Petition to Intervene by the Conservation Center, Inc.", that contention is made by the Conservation Center. As I read the document, it appears to be the only ground to justify the late intervention. Our position on this, Your Honor, is very simple -- that that is not ground, that would not be a showing of good cause for justifying a late intervention. The notice of hearing and the other documents in the case point out that this matter has been pending since the filing of the application in December 1965. The notice of hearing, of course, alludes to the continuing nature of the record, of the availability of all of the material, availability of documents in the Commission's public documents room --

CHAIRMAN JENSCH: Excuse me, Mr. Conner, what did the original letter from Mr. Bogart say about his familiarity with the proceeding?

MR. CONNER: Sir, I submit that the letter speaks for itself. And it should be incorporated into the record.

CHAIRMAN JENSCH: Just for the purposes of our discussion here, would you repeat it again, please?

MR. CONNER: It is a comparatively short letter,

three paragraphs. Perhaps it would simplify it if I read it.

CHAIRMAN JENSCH: Please do.

MR. CONNER: It is addressed to the Chairman of the Commission. I quote: "Notice was recently given by the Atomic Energy Commission that there will be a public hearing on August 31 at Buchanan, New York, in reference to the proposed construction of a large nuclear power at Indian Point by Consolidated Edison.

"Little publicity was given this notice, and we find many interested public organizations are unaware of the hearings. The season of the year makes it difficult for interested parties to do research in sufficient time to have informed representatives at the hearing.

"Because this is such a major step and there appear to be compelling reasons for questioning the safety of such a plant to close to populous areas, unless special precautions are taken, we request this hearing be postponed and sufficient time be allowed in setting the date for another hearing to allow parties who desire to be heard a chance to prepare."

It is signed, "Sincerely, Larry Bogart, Director". As I pointed out in my letter of August 25, I sent Mr. Bogart the staff Safety Evaluation, the pamphlet describing our procedures generally, and the Rules of Practice. For this reason, Your Honor, we feel obligated to take the position, under the Commission's Rules, that no showing of good cause has been made

to justify late intervention. As we have previously indicated at the prehearing conference, the staff would not object to Mr. Bogart's statement being received as a limited appearance, even at this time, or at any time, as an expression of his own views. However, we do not believe that he has met the requirements of the Commission's Rules for a late intervention. Now, as Your Honor well knows, there are several precedent decisions made by the Atomic Energy Commission on this point, generally speaking. I don't propose to cite them.

CHAIRMAN JENSCH: It might be well if you would make reference to them so we may have them as part of the general consideration of this matter.

MR. CONNER: Well, there are many decisions, with respect to the question of late intervention. I regret to say we have several citations of authority, and I am trying to select the best ones. The basic rule was stated by the Commission in the Philadelphia Electric Company case, which is Docket No. 50-171. This ruling of the Commission was appealed to the United States Court of Appeals for the Third Circuit, on June 5, 1962. I do not have the citation from Federal Second. But certiorari was denied on November 13, 1962, by the Supreme Court. This sustained the Commission's holding in the Philadelphia Electric Company case on the motion for late intervention by Mr. Goldberg, and the Commission held: "In the absence of the assertion of any fact which would justify granting leave

to intervene, and after such an unexplained delay, to allow intervention and further delay would be an abuse of discretion".

Similar motions were considered by the Commission in the Elk River case, and several other Commission authorities that I can provide the citations for, but do not have available to me at the moment.

CHAIRMAN JENSCH: Will you address yourself to the portion of the Rule that indicates that a petition to intervene should allege the interests of the petitioner in the proceeding and the showing of whether that interest would be affected by the decision in the proceeding?

MR. CONNER: Very well, sir. There are also several Commission decisions on this, going back to one of the original cases involving the matter of Walker Trucking Company, 1 AEC 103. The essence of the Commission's holding in that case, as related to the question of standing, reads as follows: "The law is clear that a member of the public who may have only an academic or technical interest in a proceeding, or a common concern for obedience to the law, is not such an immediate and substantive standard as to justify standing to intervene. Mr. Earl's" -- parenthetically, I would note this was the name of the person seeking to intervene -- "Mr. Earl's vague statements concerning claimed danger to himself and his family also do not present such an immediate and substantive interest, even in a field where the public health and safety is of paramount

importance and where each proposed intervention usually must be judged on some facts. On the basis of this ruling, petition to intervene was denied".

CHAIRMAN JENSCH: As I recall the situation in that case, the allegation was made that the petitioner might drive by the facility there concerned. There was no question of living nearby. Is that substantially correct?

MR. CONNER: If the Board please, Mr. Earl's contentions in that case were five, which I will summarize quickly. He claimed a right to intervene because of his status as an access permittee of the Commission; second, the interests of the Institute of Nuclear Serology in developing a curriculum and conducting research in the atomic energy field; third, the fact that he lived with his family within 500 yards of the road that may be used for transportation of waste materials; fourth, the statement that his family goes down to the west side of the river to bathe in the summertime, and he would have to change "if I felt there was a hazard in taking my children by this proposed plant"; and fifth, his rights as a citizen and taxpayer and an elector of Manchester County, a resident of the area in which Walker Trucking may operate and a person in body politic who has "some substantial" interest in this matter. That was the basis of the allegations made by Mr. Earl. Similar contentions were raised in other Commission cases, and the rule I have previously alluded to was followed in the matter of Elk

River Power Demonstration Reactor Program Project, 1 AEC 245, Pacific Gas & Electric Company, 2 AEC 173, and the Philadelphia Electric case to which I have referred. There have been two recent cases, one involving an attempt to intervene on the licensing action on Core "B" for Indian Point No. 1, and very recently on a case involving the petition of Long Island Nuclear Service Company to intervene in a case involving the issuance of a waste disposal license to a company known as Atcor, Inc., wherein the same general rule was followed.

CHAIRMAN JENSCH: Based upon those references to the cases, what is your conclusion respecting the sufficiency of the petition by the Conservation Center, Inc.?

MR. CONNER: If Your Honor please, our position is that justification for late intervention has not been provided, nor has there been a showing of such an interest which would justify standing to intervene by the Conservation Center, based on past precedents of the Commission.

CHAIRMAN JENSCH: Very well. Does the applicant desire to speak to this matter?

MR. UPTON: Mr. Chairman, I won't repeat the citations of precedent which Mr. Conner made, but I will make a few observations about the particular circumstances of this situation, if I may. This does not seem to me one of these situations where someone is coming in at the last minute and saying that for some reason or another he was unable to find

out what was going on, and therefore he should be allowed to participate in the proceeding as an intervenor. Mr. Bogart has certainly known about the pendency of this proceeding, at least since August 13, the date of his first letter to the Commission, and he has certainly known what the requirements are for intervening in a proceeding such as this since he received Mr. Conner's letter of August 25. Now, it strikes me that -- and I will get to the purely formal objections in a moment -- but it strikes me that being on notice of all of these matters, that the history of this attempted intervention up to this very day indicates a certain, shall I say, lack of respect for the Commission's procedures on intervention. In the Considerations of Statement of Policy which the Commission issued in January of this year, which I don't think I need to give a citation to, since it is a matter of official notice, the Commission said, "It is the Commission's view that the rules governing intervention and limited appearances are necessary in the interest of orderly proceedings". Now, in view of the delay involved in submitting this petition to intervene until today, I think it is certainly pertinent to ask whether or not the purpose of the intervention at this point is more dilatory than substantial as to intention. Even if Mr. Bogart had submitted a petition to intervene on September 8, the problem might have been somewhat different from what it is today. He did not submit a petition to intervene at that

point. Apparently he didn't retain counsel until night before last. And he comes in with a petition to intervene this morning.

I don't see, certainly I don't see, under any circumstances, unless some very cogent reason is given to this Board, why the Board should allow this lack of respect for the Commission's orderly procedures and regulations to be unchallenged

CHAIRMAN JENSCH: Now the Board here will be guided by the form of the petition. Will you address yourself to that?

MR. UPTON: Yes. I am coming to that now, sir.

CHAIRMAN JENSCH: My point is, the Board is not seeking some supplement at this time. We are guiding ourselves by the petition as presented.

MR. UPTON: I am aware of that. I am coming to the contents of the petition now.

As Mr. Conner pointed out, the only reason given for the failure to file a petition to intervene before today was that the petitioner was not in a position to examine and consult advisors about the Safety Evaluation Report, which was issued August 25, 1966. But the development of a position with respect to a case is not the same thing as the development of a position with respect to a petition to intervene. A petition to intervene only needs to state certain formal contentions, and assertions, as to why the petitioner wants to

become a party in the case. It may well be, in view of the time that has elapsed, if a petition to intervene had been timely filed, and the petition had been granted, that a party coming in at such a late date might say to the Board, "I am sorry, I am unable to prepare my case in time for this hearing and I would like to have a recess of the hearing, in order to have an opportunity to do so". But the considerations which might militate in favor of that kind of contention are not at all the considerations that militate in favor of the petition to intervene. Section 2.714 of the Commission's regulations, in a very simple section, it tells a party how to go about filing a petition to intervene. And I can't believe, if I may say so, with the sophistication indicated in Mr. Bogart's statement about some of the issues in this case, that he would have had any difficulty in understanding that section and in filing a petition to intervene in advance of this hearing, if he had been really inclined to do so.

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Now in regard to the interests involved. Section 2.714 says the petition shall set forth the interests of the petitioner in the proceeding. All we have in this petition are some very generalized conclusions, bearing on that point. For example:

> "The outcome of the proposed proceeding and any increase in levels of radioactivity by the operation of the type of plant proposed, manifestly affects the interests of the petitioner."

That is only a generalized conclusion. That is not really a statement of what the specific interests of this organization are in this proceeding. In that regard, Mr. Chairman-- Of course, this presumably is a conservationist organization. I think it is a matter of common knowledge, and I hope it is not improper for me to refer to it in this hearing, that this particular company, in its attempt to plan for the future needs for power in this area, has met with many frustrations in the past few years and many of those frustrations have been initiated by conservationist organizations who are opposed to the pollution of air from fossil fuel plants, who are opposed to various what they call desecration of the environment by the pump storage project, at Cornwall, which is under consideration by the Federal Power Commission.

Now in that regard I have here a press release which

I want to show to Counsel for the petitioner, dated November 5th, 1965, which states the position of this group called the Conservationist Center on problems of nuclear energy in relation to other aspects of power.

(Document handed to Mr. Cabell.)

MR. CABELL: I have not read it.

(Document handed to Mr. Upton.)

MR. UPTON: I would like to read this into the record, if I may, Mr. Chairman. The heading is "From the Conservation Center, 777 United Nations Plaza, New York, New York 10017. Contact Helen Putnam, 6610232 for release afternoon Friday, November 5th, 1965. New York, New York, November 3rd.

"Rapid conversion of the city's power plants to atomic energy, to eliminate the leading source of air pollution was recommended to the Mayor Elect today by the Conservation Center. Only a comprehensive accelerated program to phase out obsolescent plants and replace them with more economical atomic energy installations, which create no pollution, will save the city from health hazards and millions of dollars of property damage a year."

CHAIRMAN JENSCH: Was this in relation to Ravenswood, did you say?

MR. UPTON: No, sir. This is dated November 5th,

1965. This is a general statement of the Conservation Center's position on that day, as to how the future power needs of Consolidated Edison should be solved.

CHAIRMAN JENSCH: Proceed.

MR. UPTON: "Ellis Island, which was proposed as a national park, when no other use could be found for it, could house one of the large-scale atomic reactors, as well as a museum and other points of interest for tourists, it was suggested. Consolidated Edison has had safe experience with an atomic plant at Indian Point, New York, since 1963 and has been considering doubling capacity there.

"The large surpluses of fissionable material should suggest to the Federal government an outright grant of enough material for the initial charges. Con-Edison operates ten plants in the city. This, and the fact that nuclear power is now considerably cheaper than the average cost of the present Con-Edison system, should make the plant palatable to the utility.

"The Oyster Creek Atomic plant of Jersey Central Power and Light produce electricity for just 4 mills per kilowatt hour. Con-Ed's average is 14 mills. Nuclear energy is now used

by 134 electric companies which have participated in one or more of 28 atomic power installations.

"A $70 million atomic plant in New London, Connecticut is currently being built by three New England utilities. The Conservation Center also recommended the prompt installation of equipment for LP gas in place of gasoline on busses operating in the city. This would reduce the amount of hydrocarbon and poisonous lead fumes.

"The rapid introduction of gas turbines for trucks was also recommended. The plain fact is that New York City has the world's dirtiest air and Con-Edison and automotive exhausts have been the biggest air pollution offenders.

"The health of millions is involved. 'Unless we tackle this problem now, it will grow into the same kind of unmanageable nightmare as mass transportation inthe metropolitan area,' Mrs. Putnam said."

Then there is a footnote --

CHAIRMAN JENSCH: It is not your suggestion that the Conservation Center couldn't change its position in that regard, or in order to deal particularly with this matter, assert a position that may be contrary to that publicly released statement to which you refer, is it?

MR. UPTON: I cannot possibly deny, Mr. Chairman, that anyone can change his mind about anything over a period of several months. But I think the question is posed for the Board, in view of the-- After reading this statement, one would expect, if one knew nothing else about the Conservation Center's activities in the meantime, one would have expected the Conservation Center to be intervening in this proceeding on the side of the applicant, rather than opposed to the applicant.

CHAIRMAN JENSCH: If you would direct yourself to this petition, rather than to a prior statement, I think it would help us more.

MR. UTPON: I'm suggesting, Mr. Chairman, that the purpose of this petition, at this time, under these circumstances, is purely for the purpose of delay in this proceeding and therefore, it should not be entertained by this Board for that reason, if for no other reason.

I want to point out something that the Board is perfectly aware of, and most other people in this room, that it is not this hearing today that will be involved if this intervention is entertained. It is a whole course of proceedings, which can continue for two or three years, and all I'm asking the Board is to consider the timeliness, the interests, intentions of this applicant in the context of what the consequences of entertaining this intervention would be at this time.

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CHAIRMAN JENSCH: Will you address yourself to comments on which the petition sets forth interests, consistent with the rule that "A person whose interests may be affected by a proceeding"?

MR. UPTON: I do not think it does, Mr. Chairman. I have stated that the statement of interest is purely general. It does not set forth the interests of the petition in the proceeding as required by the regulation.

It certainly is not timely filed under any interpretation of the documents that have been filed in this proceeding up to now.

Moreover, it is not even now filed this morning.

It does not meet the requirements of Section 2.708 of the Commission's regulations which require that any document filed in a proceeding -- it contains the following statement, "The signature of a person signing in a representative capacity is a representation that the document has been subscribed in the capacity specified, with full authority, that he has read it and knows the contents, and to the best of his knowledge, information and belief, the statements made in it are true and that it is not interposed for delay."

Now I am not trying to inquire what the composition of the Conservation Center is, but there is no indication of course that the board of directors or

the other governing bodies of that agency have authorized this petition to intervene.

CHAIRMAN JENSCH: Well, the sentence from Section 2.708 to which you referred says the signature of the person alone is a representation that it has been subscribed with full authority. And you say that the signature does not import that authority. Is that your view?

MR. UPTON: That was my statement, Mr. Chairman, and I misread this section. I apologize to the Board.

CHAIRMAN JENSCH: Does the State of New York desire to address itself to this petition?

Excuse me, sir. Have you concluded? Applicant's counsel, have you concluded?

MR. UPTON: Yes, I have, Mr. Chairman.

CHAIRMAN JENSCH: Thank you.

State of New York?

MR. SCINTO: Mr. Chairman, we do not find within this document a showing of how the proposed intervenors' interests would be affected by this proceeding. And we consider it defective under the rules.

CHAIRMAN JENSCH: Does the Conservation Center desire to speak to these several matters?

MR. CABELL: Yes, Mr. Chairman. I will briefly

address myself to the following points. Section 2.714 of course does set forth the right of the Commissioner to permit intervention by a proper applicant. And I think there ought to be some reference made to the nature of this organization.

The petition itself, I believe, could, with the permission of this Commission, be amended to set forth in some more specifics just what the purpose, what the charter recites as to the objectives of this organization. But the general statement is a factual and accurate one as to the interests that the Conservation Center has in this particular hearing.

The statement has been made that there is undue delay involved. The organization is a comparatively new one. It is not a large organization. It does not, so far as I know, retain regular counsel. It was truly spoken that counsel was first retained I believe in the last day or two. The petition was prepared under the pressure of time. In that sense it is quite possible that it does not comply in all respects with the requirements of the regulations.

But, it does seem to me that that would be a defect that could properly be corrected with the permission of this Commission.

Counsel for the AEC pointed to the Walker case,

I believe it was, and all of the reasons given there as a precedent for this particular situation, but I think they involved the individual concern, the individual interests of the applicant intervenor in that case.

In this case we are deaing with an organization, which I am told by the Director has been in touch with and has the support -- I will have to defer to him to say that -- the support of at least ten organizations who are interested in this particular hearing.

I state definitely that this attempt to intervene here is not made for the purposes of delay. It is made by the Conservation Center, Inc., as an organization which is seeking to enlist the interest of the organizations in this country which do not have public spokesmen in hearings of this sort.

I understand that there are a number --

CHAIRMAN JENSCH: Ombudsman, is that the term that should be used for this organization?

MR. CABBELL: Yes, sir. We do not think there would be any prejudice to this hearing. Mr. Bogart has told me that his intervention is only for the purpose of asking an occasional question in the event that the proceedings have not covered some of the questions that occur to him from the standpoint of representing the public.

I understand that although the State of New York

and the Atomic Energy Commission, even though they represent the public, they do it from the standpoint of representing a large sector of the public.

There is nothing wrong, it seems to me, in taking theposition that the conservationists and other organizations of that sort should be heard in a proceeding of this sort. I have not had a chance to talk with Mr. Bogart sufficiently to know exactly what all of the operations of this organization are. But I would appreciate it if this Commission could hear him for a brief instant on what the organization is attempting to do.

CHAIRMAN JENSCH: Have you concluded?

MR. CABELL: Yes, sir.

MR. CONNER: If the Board please, Mr. Cabell has just stated what may of course eliminate any problem in this case. He stated that Mr. Bogart only wishes to ask some questions that may not otherwise be covered, and that is the sole extent of his wish to intervene.

If Mr. Bogart were permitted to make a limited appearance at this point, he could identify those questions and presumably they would be answered, if they have not already been answered, as the proceeding progresses, and this would eliminate any problem of intervention, if indeed that is, as Mr. Cabell said, the only purpose in seeking intervention in this case.

So, I would once again say the staff would not object to such a limited appearance.

MR. UPTON: Mr. Chairman, the applicant would not object to such a limited appearance.

MR. SCINTO: The State of New York would not object.

CHAIRMAN JENSCH: The Board has been in consideration and has taken time, without a formal recess, in order to give further consideration to the petition to intervene by the Conservation Center.

As indicated, the petition was received at the commencement of the last recess, and during the time of the recess the Board considered the petition, and since that time has given consideration to the statements made in reference to the petition by the Conservation Center, the regulatory staff, the applicant, and the State of New York.

It is the considered opinion of the Board that the petition is and shall be hereby denied for lack of conformity with the rules of practice of the Atomic Energy Commission.

Dr. McCullough, will you return to the stand, please, for further questions?

MR. CABELL: Mr. Chairman, may I note an objection and exception to the ruling.

CHAIRMAN JENSCH: Yes, it is automatically provided by the rules. Your exception will be noted.

Whereupon,

XXXXX

C. ROGERS McCULLOUGH

was recalled as a witness and, having been previously duly sworn, was examined and testified further as follows:

CHAIRMAN JENSCH: The Board has some additional questions, and whether these are directed solely to you or to the panel, we will leave it to you.

MR. HALL: The question I would like to direct to the staff, to Mr. Case, if I may, although, Dr. McCullough, if you wish to comment on it I would be pleased to have your opinion.

I am now looking at a letter from Smith W. Brookhart, counsel for National Parks Association, to the Atomic Energy Commission. In this letter a chairman of the Advisory Committee on Reactor Safeguards, William D. Manley, is quoted. Do you have the letter there, Mr. Case?

MR. CASE: Yes.

MR. HALL: The quote is: "None of the large power reactor facilities now under construction or described in current license applications is considered suitable for location in metropolitan areas."

Would you care to comment on this?

MR. CASE: With respect to this proceeding?

MR. HALL: With respect to Indian Point No. 2, please.

MR. CASE: It is my opinion that the metropolitan site, metropolitan area to which Mr. Manley referred, this location here is not the kind of site to which Mr. Manley referred in his quotation here, in his testimony to the joint committee.

MR. HALL: What differs? What is different?

MR. CASE: The proximity of the population, large numbers of people, relatively much closer than is the situation here at Buchanan.

MR. HALL: I have seen reference to the distance from the proposed site to New York as being twenty-four miles. I am not sure that that is the correct number. But is this close in your mind?

MR. CASE: I would rather answer it in that it is not the kind of site, in my opinion it is not the proximity that Dr. Manley was concerned with in this quotation, rather than saying what is close or far or medium.

MR. HALL: You are saying, or am I to interpret your remarks as saying that the remarks attributed to Dr. Manley in this testimony before the Joint Committee really do not apply to the prsent case?

MR. CASE: Yes, sir.

MR. HALL: Thank you.

THE WITNESS: I would like to concur, that I do not consider the Indian Point 2 site a metropolitan site in the sense that I think Mr. Manley meant it in this case. I concur with what Mr. Case said.

I should also like to point out that the quotation goes on and modifies any conclusions.

MR. HALL: Yes. The letter is already in the record. I did not quote all of it.

MR. CONNER: If the Board please, may I note that the entire statement from which these two sentences were taken appears on pages 248 to 252 of the hearings before the Joint Committee on Atomic Energy, Congress of the United States, on "Proposed extension of AEC indemnity legislation," June 22, 23 and 24, 1965.

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CHAIRMAN JENSCH: That was going to be my next question. Is there something about the context of that in its entirety that would perhaps explain in some way the single quotation to which Dr. Hall referred, that would be explanatory of it? I have found that sometimes a sentence can be quoted out of context, and the whole thing might be more helpful.

MR. CONNER: If the Board please, it is difficult, in a sense it is limited in its context, because Mr. Manley's statement, of course, covers many things, including the fundamental nature of ACRS review. So the quotation in the letter certainly does not represent the entire statement that Mr. Manley made. On the other hand, for its own limited purpose, it is quoted correctly. I mean, it is not totally misleading. I merely gave the reference for the Board's consideration in the event it wished to read the entire thing, which of course is in public print.

CHAIRMAN JENSCH: Is there any objection by the participants to a reference to the matter counsel referred to?

MR. UPTON: No objection.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No objection, Mr. Chairman.

MR. HALL: I have a number of questions which, just for convenience, I will use the staff-prepared analysis as a guide to generate these, but I would also invite any comment or amplification from the applicant, should they so wish. And

particularly, Mr. Case, if I may, on page 10 of your prepared submittal, you talk about the design objectives of the containment vessel, is to have negligible outleakage under actual conditions. Can you define that word "negligible", which is a qualitative word, to make it more quantitative?

MR. CASE: In this instance, this is essentially a quotation from the application, so it is the applicant's word, and perhaps they better define it.

MR. HALL: May I ask the applicant then?

MR. CAHILL: Yes, Dr. Hall. This containment has what we call negligible leakage, because it is a containment that is designed as the containments for similar reactors are, to be leak-tight. Now, the leak-tightness has to be proved by pressure tests. These are accurate to the extent that we can be sure that the containment will not leak more than 1/10th of a percent of its contents per day.

MR. HALL: That is the specification to which this is being designed?

MR. CAHILL: For the basic integrity of the line. With that level of leakage, if the consequence of that leakage were analyzed with relation to the meteorology of the site, the safeguards that were furnished, or will be furnished, to minimize the release of fission products and to trap the fission products within the containment and such a level of leakage would result in doses to the public well below the 10 CFR 100 level. This

is not what we have reference to when we say negligible leakage. This containment has been amplified by providing pressurized zones around the containment penetrations and around the seams, the welded seams of the liner, so that those areas have double barriers, and the space between those barriers is maintained at a pressure which is in excess of the maximum design pressure of the containment. These spaces will be maintained at about 50 pounds air pressure by a system which has that pressure provided by compressors, backed up by stored gas bottles.

Now, these areas, which are the only areas which are likely to have leaks and be the source of the 1/10th percent per day leakage, in what we might call standard containers, with these areas pressurized, any leakage would not be of containment contents to the outside. Leakage would be clean air to the inside of the containment, or if the leakage were out, it would be clean air to the outside of the environment. Thus there is no leakage from the containment of its contents in this maximum credible accident. The negligible -- the significance of that term applies to the first minute or so after an accident when the containment isolation system is being affected, the valves are closing, and the isolation valve seal water system is being established.

MR. HALL: Let me jump to page 64 of the Staff Analysis, wherein the integrated thyroid dose is tabulated for various

conditions, and the conditions are specified in tabular form immediately above. The containment leakage rate, the point in question, is assumed to be one-tenth percent a day for the first day, 0.045 percent per day for the next 30 days. What is the justification for the latter figure?

MR. CAHILL: This is based on the fact that the containment pressure will be decreased rapidly after the accident and the impelling force for leakage is correspondingly reduced. The lower pressure differential between the inside of the containment and the outside atmosphere.

MR. HALL: Mr. Case, do you concur in the validity of this assumption?

MR. CASE: Yes. There is a mathematical basis for this precise number that the applicant can give.

MR. HALL: Excuse me, Mr. Cahill. Did you finish?

MR. CAHILL: Based on the assumption, and inherent in here, is no credit for the pressurized welds and penetrations.

MR. HALL: Why? Why not credit?

MR. CAHILL: I believe in the interest of conservatism, it shows that --

MR. HALL: Does it imply a lack of faith in the system working?

MR. CAHILL: I don't believe so.

MR. CASE: Perhaps I should explain this, Dr. Hall. To amplify Mr. Cahill's testimony on the specification for the

containment system, the liner, without the pressurization, penetration pressurization system, has a specification of 1/10th percent, and it will be tested that way before initial operation commences. In other words, a pressure test will be performed at the design pressure for a relatively long period of time, to determine the leakage from the containment without these extra systems in operation. And the specifications which it must meet without these is 1/10th or less. We made our calculations, therefore, on this basis, on a conservative basis, assuming giving no credit for these systems, and then assuming the 1/10th percent per day leakage rate, and calculated potential exposures, to show that even under these conservative assumptions, the containment performance was within the guidelines of Part 100, even without these extra systems in effect, or without taking credit for them.

CHAIRMAN JENSCH: May I suggest, Mr. Case, if you would move the microphone closer, we might hear you better. Thank you.

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MR. GEYER: On the same page, page 64, the table at the bottom of the page states "Filter Efficiencies." Are these the filters that are inside of the containment, which are proposed to purify the containment gases?

MR. CASE: The filters in the air recirculation, yes, sir.

MR. GEYER: And the belief is that the efficiency will in fact be better than 90 percent.

MR. CASE: At least 90, yes, sir.

MR. GEYER: If I may, I would like to go back and pick up a few questions. First with regard to the fastening of the liner plate to the concrete of the containment vessel. Are these studs shop-welded or field-welded? How is this to be put together?

MR. CAHILL: The studs are attached to the liner in the field. These are what are called Nelson studs, which are attached by means of a special tool called a stud gun, which controls the location of the stud, the gap, and automatically establishes an arc to weld this stud to the liner plate.

The stud is "L" shaped so that it hooks onto the reinforced concrete, to hold then the liner plate to the reinforcing steel.

MR. GEYER: Approximately what is the spacing of the studs?

MR. CAHILL: About two feet, two foot centers.

MR. GEYER: In this welding operation, is the plate fused all of the way through?

MR. CAHILL: It is not, sir. The penetration extends, as shown in the answer to Question 1 in the third supplement, I believe, on page 3. These are half-inch studs and the tests reported in Welding Engineering, as referred to on page 3, our third supplement, indicate the thickness of plate penetration. And these plates which we are, to which we are attaching the Nelson studs are three-eighths of an inch thick. And the penetration is approximately one-tenth of an inch.

MR. GEYER: So these welds are not considered as being in the same class as the welds that are in the joints of the plates?

MR. CAHILL: No, they are not. They are merely a mechanical attachment, they are not a strength weld to join the plates together.

MR. GEYER: And they are not pressurized, of course?

MR. CAHILL: They are not pressurized.

MR. CASE: Dr. Geyer, there is a discussion of this consideration in the report of our consultant, Dr. Newmark, in our Appendix E on page 4. Dr. Newmark states "The design of the liner and attachment to the concrete

pressure vessel discussed in the answer to the Question No. 1 of Reference 6. We consider that the plate thickness of three-eighths of an inch as indicated in Reference 6 can have adequate resistance to fatigue or repeated stresses if the welding procedures are carefully controlled. Hence, an inspection procedure is essential in which all of the stud connections to the plate and liner welds are examined. The applicant advises that 100 percent of all liner stud welds will be visually inspected and all liner seam welds will be pressure tested.

CHAIRMAN JENSCH: Thank you.

MR. GEYER: Turning to the staff evaluation on page 25, the first sentence of the first paragraph beginning on that page reads "For Criterion No. 3 above, a design criterion is that internal gas pressure within fuel rods due to the expected equilibrium burnup will be less than nominal external pressure throughout core life."

The question is: In design of the fuel rods, what pressure and temperature combinations were considered? The word "nominal," you see, I don't know what is meant there.

MR. BECKJORD: The nominal external pressure is the reactor operating pressure, which is controlled to be 2250 psia. It varies somewhat in the course of operation.

MR. GEYER: But there will be conditions under which that external pressure will be removed and yet the

rod will be quite hot, is that right?

MR. BECKJORD: No, sir. The reactor pressure -- I believe -- would you ask the question again?

MR. HALL: The question is: Do you ever take the head off?

MR. BECKJORD: Well, the fuel is cooled. The normal operating procedure is to shut the reactor down and then cool off. And during the cooling, the depresurization and cooling operation, the fuel is cooled. It is not at operating temperature.

MR. GEYER: My question was what pressure and temperature combinations were used in the design of these fuel rods?

MR. BECKJORD: The external pressure, reactor operating pressure of 2250 psia as I said, the design of the fuel is such that the gas pressure at the end of the cycle, right before the fuel is removed, at operating temperature, would not exceed this value, and if I may have a minute, I have that number here.

MR. GEYER: It seems to me like there should be another condition with no pressure on the outside and some kind of pressure inside the rods which should be looked at.

MR. BECKJORD: The temperature condition, the reference temperature condition is 725 degrees Fahrenheit for the clad and the gas temperature in the fuel clad, fuel

pellet gap --

MR. CAHILL: While you are waiting, Dr. Geyer, I will assure you this has been considered. It is a question of finding the number for you.

MR. GEYER: Yes. I understand.

MR. BECKJORD: The gas temperature for development of pressure within the rod is 900 degrees Fahrenheit.

MR. GEYER: And that is with the full pressure outside?

MR. BECKJORD: Yes, sir.

MR. GEYER: What is this condition with no pressure outside?

MR. BECKJORD: With no pressure -- you mean during a refueling operation?

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CHAIRMAN JENSCH: I don't mean to hurry your consultation in any way, but it is almost 12:30 and some of these matters might require more time than you would want to take during the hearing. It is about 12:27 and I don't think it would be taking undue advantage of our attendance schedule to recess a little early.

Mr. Scinto?

MR. SCINTO: Before the recess, Mr. Chairman, I ask the Board's indulgence in one matter and if Counsel for the parties concur, as you may know, Dr. Rossi is a rather distinguished professor of radiology and is a professor at Columbia University. He has indicated to me that a professional colleague visiting this area has requested a consultation with him on a professional matter for this afternoon. Dr. Rossi would like to accommodate this professional colleague.

I would hope he could be absent from the proceedings this afternoon, without disrupting the proceedings. He will have remaining here his associates with the New York City Department to assist Counsel and to review the discussions with the applicant and the staff this afternoon. Dr. Rossi can be available for examination prior to 3:00 p.m. this afternoon, if that is possible, or later this evening, after 7:00 p.m., or he will be available tomorrow morning.

Or if the Board indicates that it feels it would

be getting to Dr. Rossi in the latter part of this afternoon, he will stay here and make arrangements with his colleague, although this might entail some burden on his colleague.

MR. CONNER: For the assistance of the Board, I might note the Staff will have no questions of Mr. Rossi.

MR. UPTON: For the further assistance of the Board, the applicant will have no questions of Dr. Rossi.

CHAIRMAN JENSCH: I infer from the statements that have been made that it would be agreeable to the applicant and the Staff to interrupt the present examination in order to accommodate the request of the State of New York.

Upon that assumption, and hearing no disagreement therewith, may we ask you again, Dr. McCullough, to interrupt your presentation and you will be excused and Dr. Rossi may come forward now. The Board has some questions.

(Witness temporarily excused.)

Whereupon,

DR. HAROLD ROSSI

resumed the stand and, having been previously duly sworn, was examined and testified further as follows:

CHAIRMAN JENSCH: Perhaps we can conclude before we recess, Dr. Rossi, so your schedule may be carried out.

Dr. Rossi has assumed the witness stand and neither the applicant nor the staff has any questions of Dr. Rossi.

However, we do.

MR. SCINTO: If the Board please, we did not question Dr. Rossi on his qualifications when we introduced his statement but we can ask Dr. Rossi to outline his qualifications at this time.

CHAIRMAN JENSCH: Do you have it readily available?

MR. SCINTO: Dr. Rossi can outline them briefly.

CHAIRMAN JENSCH: Proceed.

MR. ROSSI: I am a trained nuclear physicist and got my training at the University of Vienna and Johns Hopkins in this country, where I received a Ph. D. degree in 1942. I have been associated with radiation problems since then.

I have been in the Manhatten District of the AEC and have worked on the various research programs relating to radiation protection, radiation measurement, biological effects of radiation.

I am now professor of radiology at Columbia University.

xzxzx CROSS-EXAMINATION

MR. HALL: Mr. Professor, one of the appearances yesterday I believe before this Board suggested the concentration of trace amounts of radiological or radioactive materials in marine life, the so-called bio-concentration process. Knowing you are familiar with this, could you make any comments on the problem as it exists, as it might exist

for Indian Point No. 2?

THE WITNESS: I don't believe so, sir. I have not studied the documents pertaining to this proposed installation in any detail. I am not familiar with the affluent levels or numbers of this type.

MR. HALL: You mean you have not studied the proposed Indian Point No. 2 in any detail?

THE WITNESS: No, sir.

MR. HALL: Then I'm sorry.

CHAIRMAN JENSCH: Let me try the question this way. What have you studied in reference to this matter, as the basis of the opinions you have expressed?

THE WITNESS: What we have addressed ourselves to quite generally is the question as to, A, whether we should advise the Mayor of New York City that he take a position in this matter, and what we thought would be the best procedure for him to follow in case this was indeed desirable.

And as our statement indicates, we believe that this matter should be taken up by experts in the area and we took the position all along that the Atomic Energy Commission review would doubtless be the most thorough and exact we could expect in the matter. It may be advisable for the Mayor, as a secondary sort of back-up, to get additional advice from another group.

We furnished this advice quite some time ago,

and finally succeeded in getting a preliminary statement from our advisors. And my comments, and the comments of our committee are merely based on the statement we got from our advisory group.

CHAIRMAN JENSCH: Who was on the advisory group?

THE WITNESS: It is a group of nuclear scientists who are Belgian, under the direction of Dr. Goens, who is manager of the MOL atomic power plant in Belgium.

CHAIRMAN JENSCH: Well, does the committee know that the construction permit proceeding is going on now, and was scheduled for this time?

THE WITNESS: Yes, sir.

CHAIRMAN JENSCH: Was it the intention or your recommendation and is it the intention of the committee that its views be made available for consideration by the Atomic Energy Commission? So if there are some suggestions they may be included in the consideration of the matter?

THE WITNESS: The only suggestions-- On the basis of the preliminary report in our hands now, we came to the conclusion that there was nothing in the application that would warrant any position of New York City of opposition at this time.

CHAIRMAN JENSCH: May we infer then that they support the application, since they don't oppose it?

THE WITNESS: Yes, that is correct.

CHAIRMAN JENSCH: And in your studies you have included a review, I take it, of some of the operations of Indian Point 1; is that correct?

THE WITNESS: Yes.

CHAIRMAN JENSCH: And you find nothing in reference to that operation to give you any concern at all as to the qualifications and ability of Consolidated Edison Company to undertake the construction and operation of a facility at Indian Point No. 2. Is that correct?

THE WITNESS: That is correct.

CHAIRMAN JENSCH: Are there any further questions?

If not, thank you, Dr. Rossi, for your appearance and for the appearance by New York City in this proceeding.

Excuse me.

MR. HALL: No, I have nothing for Dr. Rossi, but I was going to say since the question has been thrown on the floor, I wonder if Dr. Eisenbud would care to try to answer the question which I posed.

(Witness excused.)

MR. EISENBUD: The phenomenon of concentration of trace substances by aquatic life is well known and has been known for many years and the round numbers that were mentioned in yesterday's testimony are correct. In aquatic biota, concentrate trace elements, whether they be radioactive or not, are factors ranging from 10 to sometimes as much as

100,000.

In this particular instance, the amounts of radioactive substances that have been discharged into the river -- and the river is too large, if you will -- and the background of radioactivity due to nature and also nuclear weapons fallout is so high, that it has not been possible to detect radioactivity from this plant in the biota of the Hudson River. And this comes about primarily because of a relatively high background due to nature and the small amounts of radioactivity that have been introduced into the river.

MR. GEYER: Mr. Chairman, may we go back to the question with regard to control rod design?

MR. BECKJORD: Yes. We will take up where we left off.

The pressure, internal pressure of the fuel rod in the cold condition is less than half of the maximum that it would reach at the end of life.

MR. GEYER: Thank you. That covers it.

CHAIRMAN JENSCH: This is a little beyond our usual recess time. At this time we will recess to reconvene in this room this afternoon at 2:15.

(Whereupon, at 12:27 p.m., the hearing was recessed to reconvene at 2:15 the same day.)

AFTERNOON SESSION

(2:15 p.m.)

CHAIRMAN JENSCH: The hearing will come to order.

Whereupon,

C. ROGERS MC CULLOUGH

resumed the stand and, having been previously duly sworn, was examined and testified further as follows:

CHAIRMAN JENSCH: Dr. McCullough has resumed the stand. The Board has some additional questions. Before proceeding, however, let me inquire of Staff Counsel:

Has he had any further communication from -- I have forgotten the name of the lawyer who represented Conservation Center. Has that lawyer indicated any desire to make a request to make a limited appearance in this proceeding?

MR. CONNER: No, sir. Following the Board's ruling this morning, to my observation Mr. Cabell and Mr. Bogart left the hall and I have not seen them since that time.

CHAIRMAN JENSCH: There was no other communication by telephone saying they would like to make a limited appearance in this proceeding?

MR. CONNER: We received no message at all, although I would like to point out I made it clear this morning that we had no objection to the limited appearance and I am sure they were aware if their petition was not accepted, they could make a limited appearance.

CHAIRMAN JENSCH: Very well.

MR. HALL: Dr. McCullough, in the design considerations of this proposed Indian Point No. 2 it can be noted that there is a provision for a crucible immediately below the reactor vessel. I believe this is the novel feature, at least to my knowledge it is the first time such has been proposed for a reactor.

Would you give the Board the benefit of your opinion on the function of this, the desirability or necessity of such an installation?

THE WITNESS: The crucible concept came about from the consideration of what would happen in the event that there were a complete loss of coolant within the reactor vessel and reactor core, and that none of the core cooling device functioned, in which case the core would rapidly heat up. The core would then collapse and reach the bottom of the reactor vessel.

The time is, well, in minutes, maybe 40 minutes. I have forgotten the numbers at the moment.

Now there are provisions made whereby the water would be in the containment vessel and surrounding the reactor vessel so that the core falling or at least a portion of the core falling against the reactor vessel would be chilled and heat could be removed through the reactor vessel.

On the other hand, there is a possibility that if

enough of the core reached the bottom of the reactor vessel, it would melt its way through. And so the idea was that this last gasp, if you like, after all of these provisions failed, you wanted some means of catching it, to keep it off of the bottom of the containment vessel.

So this water-cooled crucible was conceived as purely a back-up device in case all of these exceedingly improbable events piled one on top of the other.

Now again in my opinion, when you look at all of the devices, the redundancy of the system, the probability of having to use such a device is extremely remote and I consider it only as a back-up device.

MR. HALL: What keeps the crucible from melting then?

THE WITNESS: It is water cooled. The crucible is completely surrounded and immersed in water.

MR. HALL: So is the vessel.

THE WITNESS: In this case the crucible has water on the top and the bottom, whereas the vessel-- In this hypothetical case, where no water got into the vessel, water is only on the outside. These are hypothetical cases.

MR. HALL: Would you then compare this to being the safety pin after the suspenders and the belt?

THE WITNESS: Excuse me, I didn't hear the question.

MR. HALL: Well, I'm not sure this microphone is

working.

Would you consider this crucible then to be the safety pin which follows the suspenders, which in turn follow the belt?

I mean, you are saying it is a last-ditch thing and may I assume that in your analysis of this plant design, prior to the deliberations of the ACRS, if you will, did you recommend such a feature to be included in the design of the plant?

THE WITNESS: Yes, sir, I did recommend having such a device there, but really from the point of view that it appeared to be a relatively easy thing to do and rather than-- It is an additional safety thing, which in further consideration-- I'm not sure if I went all over it again that I would think it is necessary.

MR. HALL: My facitious remark before was intended to ask, how does one determine when to stop piling safeties upon safeties? Is there any logical way you can determine this?

THE WITNESS: No, in pure logic, I don't see any logical way to stop. I think it has to be arbitrary. I think you have to examine each system, its reliability, its redundancy, and then finally come to a conclusion that this is far enough.

I think this water-cooled crucible is certainly

marginal as to whether it is going too far. May I reiterate the different steps that have to fail?

One, you have to have a break of the primary system. Then you must be sure that none of these many pumps that are set up to pump water into that vessel, that these all fail. Then you must assume that enough of the core melts down so it will reach the reactor vessel. Only then do you use this.

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MR. HALL: Is there a size break of the primary system which would prevent water from being injected into the core? I am thinking now of a break which allows the water to drain from the vessel and uncover the core, but does not allow the pressure to drop. This is again a hypothetical situation, and a very closely bounded one on both sides. And under such conditions only the high pressure injection pumps can operate, the low pressure can not overcome the head. Is such a situation possible?

THE WITNESS: According to my understanding of the system and its characteristics, this cannot -- and the core would have to be uncovered. If the core is covered with water, there is no problem. But you are assuming the core is dry?

MR. HALL: I assume that the leakage of the primary system is such as to drain the water from the core, so it is indeed dry, but at such a rate that the pressure does not fall.

THE WITNESS: I am not aware that this is possible. I would prefer to have Westinghouse back me up on this, or contradict me, if they wish.

MR. HALL: Would the Westinghouse members of the panel or Con-Ed, either one, care to answer this question?

MR. BECKJORD: We know of no situation where what you have described would occur. If there is a small break, the high head pumps would get water into the vessel. We know --

we don't conceive of a way that the vessel could fail --

MR. HALL: I don't say vessel, I say any part of the primary system.

MR. BECKJORD: Oh, excuse me. My answer would be that a failure in the primary system for small breaks up to a certain area -- and I don't want to quote an exact number, but it is in the neighborhood of a 4-inch pipe -- the high head safety injection system would get adequate cooling water into the vessel to prevent a melt-down. For larger breaks, the low head system.

MR. HALL: In the event the pressure does indeed fall?

MR. BECKJORD: Yes.

MR. HALL: Do you understand the situation I am searching for?

THE WITNESS: Let me remind you that even a quite small break will reduce the pressure, saturation pressure, very rapidly. And that pressure is -- I have forgotten the number.

MR. BECKJORD: It is about 1,250 weighted average.

THE WITNESS: And the high head pumps have a head of what? See, all you are doing is expanding the water, the compression of the water.

MR. BECKJORD: The shutoff head of the high head safety injection pumps is about 3,500 feet of water.

MR. HALL: Does the staff concur with this answer to the question I posed?

MR. CASE: Yes. We know of no conditions of primary rupture where the proposed safety injection system, consisting of both high head and low head pumps, cannot deliver sufficient water to prevent a significant core melt-down.

MR. GEYER: Is there any credible way that unborated water could get into the containment vessel and be pumped into the reactor vessel during an accident?

MR. BECKJORD: No, sir.

MR. GEYER: You have unborated water circulating in the cooling equipment, however, inside of the containment, do you not?

MR. BECKJORD: The possible dilution from component cooling water, which is nonborated, inside of the containment with the liquid from the primary system and with the borated water from the refueling water storage tank, which would be pumped into the containment in such an accident, that dilution is negligible.

MR. GEYER: Thank you.

MR. HALL: I am not sure, I think this is probably directed towards the panel, although certainly Dr. McCullough, if you want to, we would appreciate any answer you might want to give. In the ACRS letter, and again in the staff Evaluation, there is a statement about in-service inspection being required or desirable, I am not sure what phraseology is used. Could you make any comments as to the nature of this? Is it proposed

to walk around the vessel and beat it with a hammer, or what is the nature of your inspection? In-service inspection?

MR. BECKJORD: I will answer that question, Dr. Hall. In-service inspection to us means, and we will act upon this course, that the inspections will be made during reactor shut-down periods such as a refueling period, after the reactor has operated. We are reviewing and investigating possible modes of in-service inspection. These include, but are not necessarily limited to, visual inspection of the complete inside of the reactor vessel, which is, of course, the highly stressed area in the reactor vessel. Furthermore, it is possible that an ultrasonic transducer will be developed which will enable ultrasonic inspection of the inside of the vessel through the vessel wall.

MR. HALL: This is during refueling times?

End #20 MR. BECKJORD: Yes.

MR. HALL: When the core would be completely emptied.

Mr. Beckjord: It would require removal of the core and the barrel. The barrel is removable.

MR. HALL: It would be planned to remove the barrel every time of a refueling operation?

Mr. Beckjord: Yes.

MR. HALL: So again this in-service inspection is not a routine thing done at a refueling time, it would be a specially scheduled event?

MR. BECKJORD: I said it could be done during the refueling period.

MR. HALL: It is not proposed at this time that it be done.

MR. CAHILL: Not at every refueling, but after the first refueling it would occur at approximately yearly intervals.

MR. HALL: Would the refueling consist of the removal of all of the fuel assemblies?

MR. CAHILL: No. Refueling consists of removal of one of the three regions, approximately one-third of the total core would be removed, the other regions would be shifted and a new region would be located. So the normal refueling would not involve the complete removal of the core. The point here is that the whole core can be

removed and the reactor internals can be removed to make the interior of the vessel accessible for inspection.

MR. HALL: I am aware of the possibility of this, but what I was looking for was what is the planned operation in terms of in-service inspection? If you tell me that you are planning to have in-service inspection, I would like to know what can be done during your proposed method of operation.

MR. UPTON: Dr. Hall, may I say one thing? I am not objecting to the question, but I would like to point out that the difference between what can be done and what will be done essentially in this situation is the difference perhaps between a construction permit type question and an operating license type question. It does seem to me the kind of question you are now asking as to what will be done in the nature of in-service inspection is more properly an operating license consideration than a construction permit consideration.

MR. HALL: Except as it is part of this letter and if the information has been developed, I would appreciate hearing it. I am not asking you to invent or be bound by anything you say here.

THE WITNESS: I should point out, Dr. Hall, that provision has been made in the shielding of this plant, so that plugs of the shielding can be rather easily removed,

so one can get at some of the critical areas like nozzles and other locations of the primary system.

As far as I am aware, this is the first time that this provision has been incorporated in the design of a plant.

Now the details of inspection are something which as far as I know have not yet been thoroughly worked out.

I should also like to comment that the history and experience with pressure systems is that if any failure develops at all, it occurs as a crack, which then grows to a size which eventually begins to leak and generally the leak is a small amount, relatively speaking. And at the time of refueling, it would be relatively easy to go and search out and see where a leak had occurred. There are telltales and so forth, water spots, that kind of thing. So I feel that this, although the details are not yet available, I think this plant and this system is susceptible to following the recommendations made by the Committee.

MR. HALL: You are citing experience. Can you give some examples of experience of leakages and failures or incipient failures of this type?

THE WITNESS: In nuclear plants?

MR. HALL: Any plants.

THE WITNESS: There is a compilation of pressure vessel failures covering the petroleum and chemical industry, with which I am quite familiar. In those cases there were many cracks discovered that were not leaking at all, and a few cracks which did break through and leak. It has been customary to go and find these things at periodic intervals, repair them, and go on and use the plant.

There is a case of a steam plant that I am aware of, where one of the high pressure steam lines from the plant, the man was inspecting his plant, he discovered the crack, they shut the plant down, welded it up, and started the plant up again.

In the nuclear system there have been a few leakages, but these were not high pressure systems. There was a pipe at Valecitos which did rupture. That was a fault of design and operation. But there were no serious consequences from it. I can't recall any other pertinent ones.

MR. HALL: It is your statement, though, that faults of this type are easily found by a detailed inspection of the component in question?

THE WITNESS: This is the experience. This is my statement based upon experience.

CHAIRMAN JENSCH: Here is a question that is

perhaps directed to the panel of applicant.

As I understand it, the number of coolant loops in the projected Indian Point 2 facility is the same as that for Connecticut Yankee. But on the Connecticut Yankee coolant loops, there are check valves that assist in isolating a rupture if one would occur. Is that correct?

MR. BECKJORD: They are stop valves.

CHAIRMAN JENSCH: You do not have those for the projected Indian Point facility; is that correct?

MR. BECKJORD: That is correct.

CHAIRMAN JENSCH: Why not?

MR. BECKJORD: We don't believe they are necessary for the safe operation of the plant.

CHAIRMAN JENSCH: Why were they necessary in the Connecticut Yankee?

MR. BECKJORD: It was not our decision to place the valves in the Connecticut Yankee plant.

CHAIRMAN JENSCH: That is not quite the answer to the question, whether it is your decision or somebody else's. If they were considered necessary for safety in Connecticut Yankee, why are they not considered necessary for the Indian Point No. 2?

MR. BECKJORD: The valves were included in the Connecticut Yankee plant not as a matter of safety, but as a matter of assisting in maintenance of the plant.

CHAIRMAN JENSCH: They would permit you to isolate a rupture if one would occur. And I understood that was the purpose of their inclusion. Is that correct?

MR. BECKJORD: My understanding is maintenance. They were included to isolate for maintenance purposes.

CHAIRMAN JENSCH: What maintenance would there be if there weren't a rupture?

MR. CAHILL: The maintenance would be the repair --

CHAIRMAN JENSCH: Painting?

MR. CAHILL: No. The repair.

CHAIRMAN JENSCH: Repairing what? A rupture, wouldn't it be? What would you repair if there were not a rupture?

MR. CAHILL: A boiler tube leak.

CHAIRMAN JENSCH: I am talking about the coolant pipes having the stop valves, and if you want to do some maintaining on it, aren't you going to have to do the same maintaining on the projected Indian Point facility?

MR. BECKJORD: Mr. Chairman, one of the significant advancements that was made in the Connecticut Yankee plant was to include a shaft sealed pump as the primary circulator in those loops. This was a departure from past practice, which had canned rotor pumps. The shaft sealed pump does indeed have a seal and equipment, auxilliary equipment, to remove the leakage through that seal, which occurs under

normal operation.

The possibility was envisaged that that seal might not perform properly and would leak excessively, and a major contributing factor in the decision of those valves was to incorporate a means of isolating a loop, should a large leakage develop.

CHAIRMAN JENSCH: And you do not have the same type of pump for the projected Indian Point facility; is that correct?

MR. BECKJORD: The Indian Point 2 facility does include that type of pump, a shaft sealed pump. It is a pump similar to the Connecticut Yankee pump, but larger.

CHAIRMAN JENSCH: Well, won't you have the same contemplation that you might have to isolate that loop, in view of that pump, and therefore you need the same type of stop valve that you have for Connecticut Yankee?

MR. BECKJORD: It is our opinion that the development of that pump will have proceeded to the point where we will not face the failure of that seal, that is to say, excessive leakage in that seal.

CHAIRMAN JENSCH: Well, you haven't put the pumps in the Connecticut Yankee facility yet, have you?

MR. BECKJORD: Yes, sir.

CHAIRMAN JENSCH: You have? What additional experimentation or data are available to indicate that you

won't have the type of problem you envisage for Connecticut Yankee?

MR. BECKJORD: These seals have been tested extensively in both mockup setups of the shaft sealed pump and also in actual, in the actual pump itself, in a test loop. Extensive test experience has been obtained on these pumps already, and we will shortly have these pumps in actual service conditions at the San Onofre plant.

MR. CAHILL: I think I can also amplify on this question, Mr. Examiner.

CHAIRMAN JENSCH: Proceed.

MR. CAHILL: The isolation valve in the case of Yankee and as considered for this plant would be for the purpose of, in case there were a defect in the seal or a boiler tube leak, or some other, are not being considered for this plant. Or some other difficulty in one of the loops, the loop might be isolated while the remainder of the plant would run. And the maintenance of the particular defect could then be postponed.

This is a question of operating convenience and economics. Our decision was that the isolation of a loop on this plant, ponstponing the maintenance which of course would involve a reduction in the power output, was not justified in the face of the additional complexity and cost of these valves. It would be better to shut down and

repair the defect and get the plant back on the line as soon as possible, from the point of view of economic operation.

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CHAIRMAN JENSCH: Rather than isolating the coolant loop, is that correct?

MR. CAHILL: Right.

MR. BECKJORD: May I add, sir, that the loop stop valves at Connecticut Yankee are not engineered safeguards.

CHAIRMAN JENSCH: Not so classified?

MR. BECKJORD: They are not so classified as engineered safeguards.

CHAIRMAN JENSCH: What is the label you put on them?

MR. BECKJORD: As I indicated previously, it is for purposes of isolating the loop for maintenance.

CHAIRMAN JENSCH: Has there been any additional experimentation concerning this type of pump since the installation of the pumps at Connecticut Yankee?

MR. BECKJORD: The pumps, both a mock-up of the pump seal and a full operating service test of the pump, but not in a reactor, is underway at Westinghouse, and has been for some time. The tests on the full scale, the actual pump, one of the actual pumps that is installed in San Onofre, underwent tests beginning about a year and a half ago.

CHAIRMAN JENSCH: Let me turn to a different subject. Would you turn, please, to page 64 of the staff Evaluation? I am on to a different subject, in reference to the containment leakage rate. The staff, in its evaluation, indicated that there would be a ground release of 0.1 percent per day

for the first day, and 0.045 percent for the next thirty days. There has been reference to that second figure, but I understood that the testing would be to the level of only 0.1 percent. I wondered what experimental data confirmed the 0.045 percent?

MR. CAHILL: The tests would be at design pressure at which, under which conditions the leakage would be measured to be 0.1 percent per day or less. If the containments were leaking at that rate, at the test pressure, at some lower pressure, and after the first day the containment pressure will be substantially lower, in the order of 1 to 2 or 3 pounds, the leak rate would be accordingly lower and --

MR. HALL: May I interrupt and ask what pressure law you used in the extrapolation?

MR. CAHILL: I am not sure.

MR. HALL: Linear, square root, what kind of pressure dependents?

MR. BECKJORD: Sir, the law is the critical flow pressure ratio. That is to say, the critical pressure in this case would be -- excuse me. The critical flow pressure is 15 psig, and the leakage rate is assumed to be constant at 15 percent until the pressure drops to 15 psig, and thereafter it would follow the square root relationship, the final pressure, 3 psig. So the 0.045 is 1/10th divided by the square root of 15 divided by 3.

MR. HALL: If I may continue the interruption for a moment and ask the staff if this is consistent with their analysis?

MR. CASE: Yes.

MR. HALL: Thank you.

CHAIRMAN JENSCH: Let me go back to my question. Do you have any experimental data in support of this figure 0.045? I infer from the several responses that it is negative. Is that correct? It is a calculation, rather than an experimental confirmation?

MR. BECKJORD: It is a calculation.

CHAIRMAN BECKJORD: There are no experimental data in support of it, is that correct?

MR. BECKJORD: Well, I think my answer would be that this is a very conservative way of calculating the leakage rate, by assuming it is undiminished as pressure falls down to 15 psig. We can certainly demonstrate that. That is based on a wealth of experimental information.

CHAIRMAN JENSCH: Well, it is a pretty vital figure for your containment leakage rate, and --

MR. HALL: Excuse me. What is supported by a wealth of experimental data?

MR. BECKJORD: The assumption is the leakage rate does not decrease below 1/10th of 1 percent as pressure falls.

MR. HALL: And that assumption is supported by data?

MR. BECKJORD: No, sir, what I say is supported by data is that actual leakage rate will decrease slightly below that.

MR. CASE: In fact, it is a conservative assumption that is supported by a wealth of data.

MR. HALL: Thank you.

CHAIRMAN JENSCH: Between the assumptions and the calculations, I am trying to find out if there is any experimentation. I infer that is negative, is that correct, for this projected facility?

MR. BECKJORD: Sir, I would say that the leak in this case will be somewhere between an orifice law and a capillary law. And we assume that it is an orifice law for leakage. And that is the worst case.

CHAIRMAN JENSCH: That is your best answer for the worst case?

MR. BECKJORD: There is extensive information which will establish what the leakage rates are through an orifice.

MR. HALL: Would you also say for the record what pressure you are assuming to prevail for this 30-day period? What internal pressure?

MR. BECKJORD: Less than 3 psig.

CHAIRMAN JENSCH: In view of those answers, would you turn to the calculations at the bottom of page 64? Are you in agreement with those calculations shown by the staff on

page 64 of its Evaluation?

MR. UPTON: Dr. Elsenbud will respond to that.

CHAIRMAN JENSCH: Very well.

MR. ELSENBUD: We are in agreement, taking into consideration the fact that there are certain differences in the assumptions.

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CHAIRMAN JENSCH: What are the differences in the assumptions?

MR. ELSENBUD: There is a difference in the method of correcting for building weight. It is a minor difference, but it is there. And there is also a difference due to the fact that in the PSAR it was assumed that 70 percent of the organic iodine will be removed, whereas the Staff took no credit for organic iodine removal.

CHAIRMAN JENSCH: What is your assumption for organic iodine removal? You are assuming what percent efficiency of your filters?

MR. ELSENBUD: It was assumed 70 percent of the organic iodine was removed.

CHAIRMAN JENSCH: With the filter operating at what efficiency?

MR. ELSENBUD: Ninety percent for the inorganic.

CHAIRMAN JENSCH: For the organic?

MR. ELSENBUD: Seventy percent.

MR. HALL: Is this efficiency appropriate for the condition which would probably previal in the containment vessel, namely, full fog, 100 percent humidity?

MR. ELSENBUD: I believe this is a conservative assumption, in view of the steps that are being taken to keep the filter dry, and in view of information that has been developed.

CHAIRMAN JENSCH: I don't think that was quite the question. He wants to know if this is a realistic assumption for the conditions that probably will be prevailing.

You say you assume it is dry. But if the conditions prevailing are 100 percent humidity is that figure realistic?

MR. ELSENBUD: I think so, yes, sir.

CHAIRMAN JENSCH: So you don't need to make it dry. It will be 70 percent efficient with the foggy high humidity conditions; is that correct?

MR. CAHILL: There are demisters ahead of the filters.

MR. HALL: What you use is really another question. The building is full of fog, and under those conditions, the conditions you assume, 90 percent for the elemental iodine, 70 percent for the organic form, and these are the efficiencies you assume in this. You say those are reasonable assumptions?

MR. ELSENBUD: I haven't seen the data for the water-logged filters.

CHAIRMAN JENSCH: Will you try a Yes or No?

MR. ELSENBUD: No, it is not reasonable.

MR. HALL: What is not reasonable? I'm sorry. The question may have been lost. Shall I ask it be read back or shall I try it again?

MR. UPTON: I wonder if the Reporter could read back the question. As I recall the question, it was addressed to Dr. Elsenbud, and it was whether certain assumptions were

reasonable and the Chiarman asked him to answer that question Yes or No.

MR. HALL: I think the answer came back No.

MR. UPTON: I thought it was qualified. Perhaps I misunderstood.

MR. ELSENBUD: I would personally have no basis for saying they were reasonable if the filters were water-logged.

CHAIRMAN JENSCH: I think that answers it.

There is a gentleman raising his hand. Do you have something you desire to add in reference to these filters? I thought Mr. Cahill started to say something.

MR. CAHILL: Well, on the question of water logging, the containment atmosphere will be saturated with water. This will not cause water logging of the filters unless there is entrained moisture brought along with the containment atmosphere as it is blown through the filters. There are di-misters to prevent this entrained water from reaching the filters and water logging them.

CHAIRMAN JENSCH: How efficient are the de-misters?

MR. CAHILL: They are relatively high in efficiency, running up into the high 90 percent level.

MR. HALL: What is the form of the dimister? Is it a chilled water or --

MR. CAHILL: No, these are centrifugal type, mechanical

separating devices.

MR. BECKJORD: Mr. Chairman, if you please, relative to the efficiency of the demisters, filters similar to the ones for Indian Point 2 have been tested for the Connecticut Yankee plant in service conditions and they have operated in excess of 99 percent efficiency.

CHAIRMAN JENSCH: Are the service conditions for Connecticut Yankee similar to that projected for Indian Point 2?

MR. BECKJORD: Excuse me. Let me correct something. I said "filter". I meant demister.

CHAIRMAN JENSCH: I think you did say demister. Are the operating conditions for Connecticut Yankee sufficiently similar to be used in consideration of Indian Point No. 2?

MR. BECKJORD: Yes, they are.

CHAIRMAN JENSCH: The difference in size is of no importance as to the efficiency of the demisters? Is that correct?

MR. BECKJORD: The conditions are close relative to temperature and pressure.

MR. GEYER: Have the entire systems been tested under conditions that could be expected to prevail at the time of an accident in the containment?

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MR. UPTON: Mr. Chairman, we have some backup witnesses here. Mr. Beckjord would like Mr. Don McAdoo of Westinghouse to answer this question. Mr. McAdoo has not been sworn, and his qualifications will be presented to the Board and to the reporter, and he will answer the question.

CHAIRMAN JENSCH: Will you stand and be sworn, Mr. McAdoo.

Whereupon,

JOHN D. McADOO, JR.

was called as a witness and, having been first duly sworn, was examined and testified as follows:

XXXXX CHAIRMAN JENSCH: Mr. Larson has his qualifications. They may be incorporated as if read. Any objection to that procedure?

MR. CONNER: No objection.

MR. SCINTO: No objection.

CHAIRMAN JENSCH: The qualifications of Mr. McAdoo may be incorporated in the transcript as if read.

(Qualifications of Mr. McAdoo follow.)

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS
JOHN D. McADOO, JR.
MANAGER
ENGINEERED SAFEGUARDS SYSTEMS
ATOMIC POWER DIVISION
WESTINGHOUSE ELECTRIC CORPORATION

1. My name is John D. McAdoo, Jr. My residence address is 153 Crescent Hills Road, Pittsburgh, Pennsylvania 15235. I am employed by the Westinghouse Atomic Power Divisions in the System Engineering activity as Manager of Engineered Safeguards Systems.

2. I graduated from Carnegie Institute of Technology in 1951 with a Bachelor of Science degree in Chemical Engineering.

3. From 1951 until 1956 I was employed by the Kellex Corporation, later renamed the Vitro Corporation of America, in their Jersey City and West Orange, New Jersey, laboratories where I participated in a variety of research and development projects related to the study of the chemical and physical behavior of uranium and fission products. During that period I held lead responsibility for development work on homogeneous reactor fuel reprocessing under sub-contract to the Oak Ridge National Laboratory.

4. Since coming to Westinghouse in 1956, I have held engineering assignments related to systems design for a large homogeneous power reactor, technical coordination of reactor plant engineering, and hazards evaluation. For

the past six years I have been engaged in the evaluation of safeguards and potential hazards for the following projects: Yankee Atomic Electric Company Reactor, Carolinas Virginia Tube Reactor, Saxton Reactor, San Onofre Nuclear Steam Generating Station, Connecticut Yankee Nuclear Plant, Malibu Nuclear Plant, Brookwood Nuclear Station, and Indian Point Unit No. 2. In my present position I am responsible for design of shielding, waste disposal and engineered safeguards systems, and for analysis of loss-of-coolant accidents.

5. During my employment at Vitro and Westinghouse I have completed post-graduate courses in nuclear engineering at New York University, and in advanced heat and mass transfer and fluid dynamics at Carnegia Institute of Technology.

6. I am a member of the Committee on Radioactive Air Pollution of the Air Pollution Control Association.

CHAIRMAN JENSCH: Will you proceed with the answer, Mr. McAdoo?

MR. MC ADOO: There were several questions.

CHAIRMAN JENSCH: Pick one out for a start.

MR. MC ADOO: Let me discuss first -- I think one distinction that has to be made here and that perhaps was not clear in the discussions, is that liquid water being entrained into the charcoal filter has a different effect on the efficiency of the filter than does the presence of steam or water vapor in the air passing through the filter. From the experimental information which is available to us the charcoal will continue to be efficient with respect to removal of methyliodide from the air, even though it is in equilibrium with the water vapor passing through.

MR. HALL: Would you care to cite the experimental evidence you are referring to?

MR. MC ADOO: The source of this information is experimentation that is being done at Oak Ridge National Laboratory and additional experiments which have not been published, which are being done in connection with the Connecticut Yankee filter test program.

The evidence that we have examined suggests that the moisture loading that the charcoal attains as a result of exposure to water vapor under the conditions of the containment during the accident, under those conditions

the assumption of 70 percent removal efficiency are justified. One then faces the problem of disposing of the entrained liquid water which Dr. Hall I believe has referred to as fog, and of course water droplets originating from the containment spray as well are to be considered. And for this purpose the demister and absolute filter are located such that the air passing through the charcoal filter will have already been protected or divested of those water droplets before the air enters the filter.

On that basis, and on the basis of the efficiency of those demister units, demonstrated by test, we don't expect that the entrained water entering the charcoal will cause waterlogging or deterioration of the charcoal.

MR. HALL: I would like to have somebody, perhaps Dr. Elsenbud would prefer to answer, have somebody state what is the difference between organic iodine or iodide in the elemental form.

MR. ELSENBUD: There are chemical differences that make the elemental form more susceptible to absorption of charcoal and make it more reactive chamically generally.

MR. HALL: Is there a physiological difference? Is there a difference from the standpoint of radiological hazard?

MR. ELSENBUD: Once the methyliodide is inhaled, it remains about the same as elemental iodide.

MR. HALL: So one does not greatly enhance the danger there. It is just the matter of ease with which, or efficiency with which they can be removed from the atmosphere.

MR. ELSENBUD: That is correct, sir.

MR. CASE: I might add, Mr. Chairman, that we are aware of the experimental data to which Mr. McAdoo referred. We have used it in this area of the efficiency of charcoal filters for organic iodide on the basis of our assumption given on this page of our Safety Evaluation and Dr. Parker's advice.

MR. MC ADOO: I think the Board posed the question regarding testing of these units in an integrated system. I think this bears on the remarks just made by Mr. Case. I think the record shows that a testing program is planned and will proceed, in which full scale components such as those which will be used in the Indian Point plant will be tested as an integrated system under the conditions of the accident. This program will address itself to just these problems.

CHAIRMAN JENSCH: Out of consideration to the length of time we asked Dr. McCullough to remain available, we think it is only proper that we indicate we do not have any further questions of Dr. McCullough.

Do any of the parties desire to propound questions to Dr. McCullough based upon the Board's questions?

Applicant?

MR. UPTON: No, sir.

CHAIRMAN JENSCH: Regulatory staff?

MR. CONNER: No, sir.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No, sir.

CHAIRMAN JENSCH: Thank you, Dr. McCullough. You are excused as a witness, without further call for cross-examination.

(Witness excused.)

CHAIRMAN JENSCH: The Board has additional questions of the panel.

MR. HALL: I have a relatively minor question.

In the analysis, as I understand it at least, there is a very high degree of dependence placed on the operation of emergency generating equipment should it be needed. I would like to inquire about experience that might be appropriate, or what experience has been observed on the reliability of diesel stand-by?

MR. CAHILL: Yes, sir. We have extensive experience in our own system on the starting of diesel engines.

MR. HALL: Excuse me. Are these lighter diesels, or are they gas-fired or oil?

MR. CAHILL: These are diesel engines which we have installed in our conventional plants to protect equipment in case of loss of power.

MR. HALL: And they are normally in a shut-down condition?

MR. CAHILL: They are normally in a shut-down condition.

MR. HALL: Cold?

MR. CAHILL: Cold. Cold in the sense that they have not been running. There are heating elements provided in the water jackets and in the oil reservoirs to keep that oil warm and make them ready to start at all times.

Now we have extensive experience in starting these and they do start well within the times that are needed to provide emergency power for this plant.

MR. HALL: What kind of experience have you had on failures? I guess I have had my own experience in which somebody forgot toopen the cooling valve and the motor froze and what-not. Have you had any experience of this type, equipment mal-function?

MR. CAHILL: We have 28 diesel installations.

Normally they start within six to eight seconds. We have one case at our Ravenswood plant where we have started a 600-kilowatt diesel engine 180 times and have had, except for one or two when we first put this engine into service, all of the subsequent starts, I would say 140 starts in succession have all been successful and under 10 seconds.

That is our own experience.

MR. HALL: That is a similar type of equipment which would be concerned here?

MR. CAHILL: Yes.

MR. HALL: Let me jump to Mr. Case.

In the summary statement which you prepared for the Board, on page 7 thereof, I will read the following sentence:

"In any event, if it should prove to be undesirable to operate with positive reactivity coefficients, minor design changes such as burnable poison rods can be made to reduce the coefficient."

My question is, one, what is objectionable about putting burnable poison rods in now or at any time? Why are they held out?

And point two, who is the one who will decide whether or not such core changes will indeed be required?

MR. CASE: The asnwer to point one, as far as I know, there is nothing undesirable from a safety standpoint. For operating convenience, the applicant would rather not

install the burnable poison rods.

MR. HALL: Is it a matter of convenience or economics? Maybe I should ask them.

MR. CASE: Yes.

MR. CAHILL: It is economics, sir. The burnable poison will increase the fuel cycle cost. It will be used if the analysis during the detailed design shows that it is necessary. If it is not necessary for safety, there is no need to burden the fuel cycle with the additional cost.

MR. HALL: I guess I'm still talking to both of you, but I would ask then, in my understanding of the analysis, you are prepared, and the Staff is prepared to accept operation of Indian Point 2 with the positive moderator coefficient? And at what point do you decide you must have burnable poisons?

I am looking for the criteria at which you will modify this design. And I don't believe this is an operating question.

MR. CAHILL: Mr. French will answer that.

MR. FRENCH: Sir, the purpose of the shim, of course, is to permit the reduction in the boron concentration. With a reduction in concentration, one can in turn reduce the moderator temperature coefficient.

Now the decision then of whether or not to employ the burnable shims will be based upon the effect of the

MR. HALL: This is very qualitative --

MR. FRENCH: Now, I am sorry, I have one more statement. There are several -- I am sorry. There are at least six of the design criterion specified by the staff that are specifically affected by the magnitude and size of the moderator coefficient. So the basis for making the decision will be the ability to be in conformance with these criteria.

MR. CASE: Principally, from an accident consideration, the rod ejection accident, the consequences of which are affected by a positive moderator coefficient, and also the consequences of various losses of coolant accidents are affected by a positive moderator coefficient. And both of these accidents, among the other things Mr. French mentioned, will have to be evaluated when the design parameters of the core are available -- these accidents will be reviewed both by the staff and ACRS, and as indicated on page 3, ACRS has indicated a desire to review this, the use of solid burnable poisons, as soon as the core design is set.

MR. HALL: ACRS considers this to be of sufficient importance to ask that it be brought back to their attention, rather than leaving it to be resolved between the applicant and the staff. Is this correct?

MR. CASE: That would be my interpretation of their letter, sir.

MR. HALL: At what point in the core cycle would

the evaluation be made? Inasmuch as the composition of the fuel changes with burn-up, plutonium is burning in, and 235 burning out, and the fission products, the evaluation of the positive moderator coefficient would be evaluated --

MR. CASE: There is only a problem during the first part of the first cycle.

MR. HALL: First part of the first cycle. And this bothers me, I guess. Why does it become better than?

MR. FRENCH: The reason for the positive coefficient is the fact that we have a chemical poison in the water. Hence, as the water is expelled, poison is expelled. Therefore, as you reduce the concentration with burn-up, the coefficient is steadily becoming more negative. And it comes to an end, it is typical of a core control rod that is strongly negative.

MR. HALL: At the end of you fuel life?

MR. FRENCH: That is correct.

MR. HALL: In refueling?

MR. FRENCH: At that time of refueling, we replace the fuel with fresh fuel, the reactivity is increased, the boron concentration is brought up. However, the characteristics of a cycle core core are such that the first cycle is 50 percent longer than any following cycle. Under these circumstances, the coefficient will never again be positive, following an early portion of the first cycle.

MR. HALL: This is in spite of the fact that

plutonium now has been fed into the core and the well known resonance absorption at 3/10ths volt does, or can, provide a positive effect?

MR. FRENCH: In the type of spectrum that we see in a pressurized water reactor, plutonium actually is a negative contribution. With burn-up, the uncontrolled coefficient becomes more negative, and we have verification of this fact, as well as analysis.

MR. HALL: Plutonium is a poison in the reactivity sense?

MR. FRENCH: That is correct.

MR. HALL: Is that relative to U-234 or an absolute scale?

MR. FRENCH: It is only within the specific circumstances that you have in a U-234 fuel reactor that we have any verification of this fact.

MR. HALL: So the positive coefficient which is flagged in the review in several places exists only for a short time of the first cycle, during which time the fission product in the reactor is really at a low level -- is this correct?

MR. FRENCH: This is correct. We would submit it is no longer than full-powered moments of operation.

MR. HALL: So this is not the hazard, in your contention, not the hazard that it might be thought, just on a casual reading of these several documents. Is this correct?

The fact that this is -- I realize it is a matter of some concern to you, and you are taking proper consideration of it. I am not denying that. But it is not something that will exist for the lifetime of this reactor installation?

MR. FRENCH: That is correct. It is a very short portion of the plant life.

MR. HALL: In some of the communications that have been sent or delivered to the Board, the phrase "experimental information" and "experimental data" recurs and is picked up as being a source of concern, that this Indian Point 2 is indeed an experimental reactor. I would appreciate some discussion on those features, if any, if Indian Point 2, which are regarded as being experimental in the sense of truly unknown.

CHAIRMAN JENSCH: If I may suggest, while there is a pause, is this the kind of question that maybe you would like to give to Dr. McCullough, as an elder statesman in this field of reactor technology?

MR. HALL: Yes, although we agreed not to call Dr. McCullough back, but if he is willing, yes.

CHAIRMAN JENSCH: Are you willing to come back, Dr. McCullough?

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CHAIRMAN JENSCH: Will you take a try at that question? You have additional backup behind you, I see.

MR. MC CULLOUGH: Let me be sure I clearly understand the question.

MR. HALL: Shall I rephrase it?

MR. MC CULLOUGH: Please.

MR. HALL: In the letter which has been sent to the Board by Larry Bogart, Director of the Conservation Center, the phrase "experimental information to be derived from other reactors, San Onofre, Connecticut Yankee," et cetera, is picked up with some concern that the Indian Point 2 reactor is truly an experimental installation.

I would like some comments or some discussion, if you could, on what features of the Indian Point 2 you regard as being experimental in nature.

MR. MC CULLOUGH: You have already been discussing one of these points which could be categorized as experimental, namely this coefficient and its effect on stability, and so forth. These are small extensions, and as Mr. French has laid it out before you, these are matters which are subject to rather accurate calculations and estimation. And there are ways of correcting for this.

Let me see if I can think of some others.

MR. HALL: Would you call this experimental in the sense of let me say a popular conception, where somebody

pours two liquids together and wonders what will happen, or is it experimental in a sense of trying to refine a number and obtain a higher degree of accuracy than that which you already have?

MR. MC CULLOUGH: It is definitely the latter case. It is a verification of a calculation, in effect. It is refining the numbers.

Now, the other cases -- frankly, again we are in semantics. This word "experimental," as you pointed out, has a tremendous gamut of meanings. Any time you are extending your technology in this meaning of the word which we have here, it is called experimental. A little higher power density of the fuel rods discussed this morning is another extension and experimental feature by this kind of definition.

I am groping for other cases, other items. One other case which could be called experimental, but I don't call it so, is this electric seal system which is being proposed for the containment. To me this is an engineering design feature which will be verified of course in its use. I really don't call it an experiment, but in the general jargon of this business it would be called experimental. Again it is a legalistic thing. This is a 104B reactor, which by law is defined as experimental.

Can somebody else help me with other cases?

end

MR. CAHILL: I think I can add to this. As you said, Dr. McCullough, it is experimental only in the definition as given in our written testimony on page 34 of what research and development means under the AEC regulations. The actual nature of these items is it is not experimental if you consider a conventional steam plant, the coal-burning plant.

We recently installed a 1000 megawatt unit at Ravenswood. It was more than twice the size of our previous largest unit, which was about the largest unit ever built. We did not, and the industry did not, consider this an experimental plant. It did involve developments that followed the orderly course of engineering development making use of known engineering principals. The pressurized penetration application is not experimental in the sense that this is an unknown feature. This principal has been used in many applications, much more difficult than this. The steam from a turbine is kept from leaking out with a similar type of seal. Many applications of this principal are used in industry. It is only a new application of an old principal. In that sense the reactor is not experimental.

MR. MC CULLOUGH: I guess another way of putting it is that in the meaning that is being used here, anything is experimental that has not been used before in this exact design, which is really stretching the word, the meaning of

the word experiment in my view.

Now, the thiosulphate is another case which was discussed yesterday. It is well known that thiosulphate will absorb iodine. The engineering application of this is the first. So how well it works is a verification of an engineering technique rather than experimental in the sense of probing the unknown.

I don't think of any other cases where this reactor is experimental in a sense.

MR. BECKJORD: The record of our testimony and also of the staff analysis includes a listing of research and developmental items. I think I would stand on what Mr. Cahill and Dr. McCullough have said, and I would emphasize that if anything is termed experimental in this plant, it is only in the sense of an orderly step-by-step development of the pressurized water reactor, based, soundly based on past experience and technology.

MR. CONNER: If the Board please, I think I might make a legal observation at this point. I think it is implicit in everyone's mind, but it might be well to lay it out, that despite the semantical distinctions which may revolve around the use of the word experimental by the various witnesses and in the letter which you referred to, Dr. Hall, the fact that even if the plant were "experimental" in someone's mind, still that would be no

bar to it receiving a construction permit or an operating license, and so long as it met the statutory and regulatory requirements laid down by the Commission -- this is an obvious point, but I think it might be well to have it in the record at this point.

CHAIRMAN JENSCH: I am glad you pointed that out. But I think what Dr. Hall had in mind is this projected facility is not similar to the illustration he gave Dr. McCullough of mixing two liquids together and having no idea what the effect will be.

As I understand the answers from the panel and Dr. McCullough, these may be extensions and refinements, and if the stage is reached where some further device should be relaid to it, it is something that can be arranged at that time. But you are going in a known directly, the limit of which may be subject to verification. Is that correct?

MR. MC CULLOUGH: That is correct. It appears in all cases that there is ample room to provide whatever may be necessary on further analysis. It is a matter of degree, rather than kind.

CHAIRMAN JENSCH: The Board has exhausted its questions of these several witnesses. If there are no further questions of the witnesses, we would await the presentation of the responses to the specific questions

that were set forth at the prehearing conference, if that is agreeable. If that be the next order of business, we might take a recess prior thereto.

Mr. Scinto?

MR. SCINTO: Mr. Chairman, we do have some questions. It may be appropriate to take the recess before that, however.

CHAIRMAN JENSCH: Very well.

Mr. Conner, did you have a statement?

MR. CONNER: No, sir. We have a couple of questions that I don't think have been covered yet.

CHAIRMAN JENSCH: Very well. Let us take a recess at this time to reconvene in this room at 3:40.

(Recess.)

CHAIRMAN JENSCH: Please come to order.

Dr. McCullough has resumed the stand. I understand the staff and the State of New York have some questions.

Will the staff proceed, please?

MR. CONNER: If the Board please, our questions were not so much of Dr. McCullough, as probably for Westinghouse and Consolidated Edison.

So in very simple terms, reference has been made earlier to the crucible and the fact that it will be worked out. In line with the question raised in the ACRS letter, we would like to know what are your plans for developing the theoretical and experimental bases for this device?

MR. BECKJORD: We intend to design the reactor crucible on the basis of conservative analysis of the conditions attending the accident and the available experimental data available now and available as the design work gets under way.

MR. CONNER: I have one general question.

On page 7, lines 18 to 24 of your summary, you refer to the continuous monitoring of the environment at Indian Point 1. And you refer to it as providing persuasive background references to checking on radioactivity to be discharged from unit 2.

Would you summarize the results of this site monitoring program which leads you to this conclusion?

MR. ELSENBUD: The program initiated in connection

with plant 1 began in 1958, some four years prior to the start-up and has continued up to the present time. Up to the present time there has been essentially no detectable effect of this plant on the radioactive environment.

I say "essentially," because there is an exception in that, if you go to the edge of the discharge canal, within a matter of some feet, you can find traces of radioactive nucleids in the sediments. But in the river itself, in the soils around the plant, as respects the gamma radiation levels around the plant and as respects the atmospheric radioactivity, there has been no detectable change.

This is an observation that has been confirmed in studies of the New York State Health Department and published by them.

MR. CONNER: Based on this experience, would you expect any substantial change in the release of radioactivity resulting from the operation of Indian Point Plant 2 as proposed? Would the total discharges from both plants be within the limits established by the Commission?

MR. ELSENBUD: Yes.

MR. CONNER: No further questions.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: We have a few questions. Our questions likewise are not particularly directed to Dr. McCullough.

In answer to question 15 in the first supplement

it is indicated that the concentrations at the Chelsea intake would not exceed MPC's, even if as much as 120,000 curies of liquid waste were instantaneously released into the river at the plant. As we understand it, no liquid waste storage tank will contain anywhere near this amount of activity.

We would like to know what the anticipated maximum amount of radioactivity that would be contained in the large liquid waste storage tanks is?

MR. CAHILL: About 1600 curies.

MR. SCINTO: Would you amplify on the likelihood of such liquid wastes being accidentally discharged into the river?

MR. CAHILL: It is extremely improbable. The tanks of course are designed in accordance with ASME pressure vessel codes. They are tested for leak-tightness and they are maintained in a leak-tight condition. The tanks are monitored, the area is monitored for leakage. The area in which the tanks are located is in a water-tight sump area so if the tanks did leak, it would be collected and confined within the building and this leak water could be pumped back into sound tanks, as well as the material remaining in the leaking tank, to prevent any escape to the environment.

MR. SCINTO: In the application there is an indication of the effect of rain-out under accident conditions on

the surface water reservoirs in the area. Could you give us an indication of how the deposition of radioactivity released by an accident, either resulting from rain-out or drive-out would affect the pastureland in the area, and through the pastures, how it would affect the milk produced?

MR. ELSENBUD: The effect on pastureland will depend on the meteorological assumptions you make. Using the same assumptions that were made for rain-out, we have not done detailed calculations, but from rough calculations it would take about a dose reduction factor of somewhere between 5 and 10, at least by the calculations I made, to stay within the Federal Radiation Council's report No. 5 guidelines. And at a distance of five miles and there are very few pasturelands inside of five miles. There are only two small dairies.

MR. SCINTO: In connection with the response to this, we have another question.

On page 12-37 of Exhibit B, Vol. 2, Part B, there are a number of different dose reduction factors for each engineered safeguard in the event of a loss of coolant accident. Could you indicate the combined dose reduction factor that can be reasonably anticipated to occur as a result of the engineered safeguards that would be uperating under accident conditions?

MR. ELSENBUD: I would say it would be, for the two-hour exposure, 1,000 plus the product of all of the others.

In the case of the accident duration, it would be 5900 plus the product of the other dose reduction factors, --

MR. SCINTO: Thank you.

MR. ELSENBUD: -- which is a very large number. I haven't worked it out.

MR. SCINTO: In the event of a loss of coolant accident, how will the dose reduction factors actually being contributed by the combined engineered safeguards operating at that time -- how will this be known or detected?

MR. ELSENBUD: Most probably the quickest way would be simply to -- from the radiation measurements that are available. I mean, there will be presumably controlled information on what is operating and what isn't. There will be instant information about radiation levels both within and outside of containment.

MR. SCINTO: We were wondering if there would be some other means that might supplement radiation monitoring in determining the effectiveness of the engineered safeguards operating under accident conditions?

MR. CAHILL: In these dilution factors used in the accident analysis, they are based on conservative meteorological conditions which would not be expected to occur at the specific time of such an accident. So the dilution factors would, in most probability, be greater than we have used in the analysis. These could be re-established on the basis of meterological information that could be obtained after the accident. The actual effects of such a radiation release would be determined by environmental monitoring which we would initiate not on a maximum credible accident, but even relatively minor releases. And, of course, the authorities such as the New York State

Department of Health, AEC, and other people, would have been notified, and would be available to aid us in this determination.

MR. SCINTO: Mr. Chairman, we would like to direct a question to the staff at this time.

CHAIRMAN JENSCH: Proceed.

MR. SCINTO: Would the staff give its indication of what it might reasonably expect to be the effect of the engineered safeguards operating at the time of a loss of coolant accident in terms of perhaps the types of factors mentioned by the applicant, the dose reduction factor, or combine them?

MR. CASE: As a minimum, they would be as given in the accident evaluation section of our Safety Analysis, wherein assumptions are made for either filter effectiveness, containment leakage, various factors like that. They are not exactly in the same order as listed in the application, but as a minimum effectiveness of safeguards under accident conditions, it would be as given in our Safety Evaluation.

MR. SCINTO: Is the rupture of the secondary coolant system in containment at the time of loss of coolant accident considered credible, and if not, could you give us some of your reasons?

MR. BECKJORD: We don't consider a rupture of the secondary system consequential to a loss of coolant accident credible, because, first of all -- there are two factors.

First of all, support design -- the steam generator supports are designed to withstand the full reaction loads of the double-ended rupture of the main coolant pipes, so that they will stay in place, and the steam pipes will remain intact and will not leak.

Secondly, the forces of blowdown. The resulting forces of blowdown on the steam generator internals are such that the tube sheet, which is the main base structure holding the tubes, to which the tubes are welded, will remain intact, the tubes will go into compression in this accident, and there is a wide margin over a factor of 2 to buckling of the tubes, and they will not buckle, and they will not leak. Therefore, the secondary system will not develop a leak as a result of a loss of coolant accident.

MR. SCINTO: Just one other matter. On page 13 of the Metcalf-Eddy Report, which is Section 1.5 of Exhibit B, Volume I, it is indicated that "in case of contamination of Queensboro Lake, Bear Mountain Inn would be deprived of its water supply". The quote continues to indicate that installation of an emergency well supply to Bear Mountain would be feasible. In the rain-out analysis, on page 12-45 through 12-47 of Exhibit B, Volume II, Part B, it is indicated that even in rain-out, after the loss of coolant accident, the concentrations in Queensborough Lake and the doses therefrom would be less than MPC's and FRC preventive measure guidelines.

The question is simply: Does the statement in the Metcalf-Eddy Report contemplate some other mechanism for contamination of Queensboro Lake, since the rain-out analysis indicates the levels are quite low?

MR. CAHILL: The Metcalf and Eddy Report, as is the case for these other reports from our site consultants -- we went to these consultants to seek information as to the environment around the site, and to establish where there were problem areas. Based on the Metcalf-Eddy statement about Queensboro Lake, we made the rain-out analysis, which is made on very conservative meteorogical compilations and assumptions, and found that after the worst accident the water is not above Part 20, the tolerance for drinking water, and therefore, the point about an emergency supply does not apply.

MR. SCINTO: Thank you. That clarifies that matter. We have no further questions.

CHAIRMAN JENSCH: Has the staff any further questions?

MR. CONNER: No, sir.

CHAIRMAN JENSCH: Are we ready to proceed with the presentation of responses to the interrogations made at the prehearing conference?

MR. UPTON: Yes, sir. We are ready. By agreement with staff counsel, and if the Board also agrees, I would propose to go right through the list sequentially, in the

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order in which they were asked at the prehearing conference, and not try to group them by topic or anything. It is possible that some of the questions the Board will feel have already been answered, but I won't make a judgment about that. That is for the Board to say. So the first question I have appears on page 55 and 56, in which the statement is made, "In the application, I believe there is a report by Consultant Page, and in there he shows a description of the Hudson River, and there is a fault, an earthquake fault, in the center of the river. Just as zircaloy alerted some people years ago, maybe faults alerted people today, and I wonder if it is within the range of contemplation or possibility to have some elucidation about the intimation of the fault."

Now, I would like to call Father Lynch, who has not been sworn in. We have his qualifications here, Mr. Chairman.

CHAIRMAN JENSCH: Very well.

Whereupon,

REV. J. JOSEPH LYNCH,

having been called as a witness, and being duly sworn, upon examination testified as follows:

30

CHAIRMAN JENSCH: The qualification of the witness having been distributed, is there any request that they be orally read?

(No response.)

CHAIRMAN JENSCH: If there is no such request they may be incorporated into the transcript as if read. Hearing no such request, the reporter will incorporate the qualifications into the transcript as if read.

(Qualifications of Rev. J. Joseph Lynch follow.)

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS
REV. J. JOSEPH LYNCH
DIRECTOR, SEISMIC LABORATORY
FORDHAM UNIVERSITY
CONSULTANT ON SEISMOLOGY TO
CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

My name is J. Joseph Lynch. I received my A.B. and M.A. degrees from Woodstock College in Maryland in 1920 and my Ph.D. from New York University in 1939. I became an ordained priest in 1926 and a member of the Society of Jesus. I have been an associate professor of physics and director of the observatory of Fordham University since 1928. I am a member of the Board of Trustees of Fordham University. I am a Fellow in the Royal Astronomical Society, the American Geological Society, the American Physics Society and the American Geophysics Union. I am a member of Phi Betta Kappa and Sigma Xi. I am the author of several texts including "General Physics," "Our Trembling Earth" and "The Effect of Occluded Hydrogen on the Rigidity of Palladium". I have also been a contributor to numerous professional journals.

CHAIRMAN JENSCH: Will you proceed, please?

DIRECT EXAMINATION

XXXX BY MR. UPTON:

Q I will ask Father Lynch to address himself to that question.

A Mr. Chairman, a fault is a fracture in a rock which indicates that at some time past there has been a release of strain. You can liken a fault to a gun, both are potential weapons, but they only become actual weapons if they are loaded. The fault becomes loaded when there is indication of strain developing in the region of the fault.

Now, the faults that were referred to -- I read that some time ago -- were the faults under the Hudson. I might add there is one under the Triborough Bridge, but don't think of that when you are riding over that.

These faults are inactive, and for two reasons we claim they are inactive. Geologically they are pre-glacial faults. That means that they have not been active for at least 10,000 years. I understand that that time of 10,000 years was taken up in conjunction with longer periods in California. The reasonable estimate of the Ice Age is 10,000 at a minimum, which means, therefore, that these faults have not been active since then. How long prior to that they were active we don't know.

The second ground for the statement of inactivity

is on the basis of our short period seismic instruments. We pick up any vibrations within 250 miles of New York. Of course we pick up everything on the longer period instruments. There has been no activity -- may I perhaps go one step further by way of background.

There are two types of quakes that occur in the United States and may presume to continue to occur. There are the tectonic quakes, from Tecton the Builder, which are connected with mountain building. These all occur on the Pacific Coast from the Rockies out to the Pacific. The second type is a resettlement type of quake, unimportant in the sense that it is never serious, and it is a recovery from a released strain rather than the indication of new strain developing.

Perhaps an illustration might be helpful, to give us a clear picture. I think almost everybody has been in a frame house and at night, especially if you are alone, you hear wierd noises and you may swear somebody is on the stairs. These noises are physical and they are to be expected. When a heavy person steps on a wooden stair, that stair is strained and the stair will not immediately recover from the strain. It may recover in the middle of the night and it would sound as if somebody is on the stair then.

Now, most of North America was covered with a couple of miles of ice some 10,000 years ago. That is like

a heavy person on the stair, and the crust is gradually recovering from that strain and there is no State in the Union which is exempt from this second type of what we might call creaking stair type of quakes. That is the only type of quake you need fear in this area. The periodicity is about every five to ten years.

Now, if strain should develop, then it would be shown up on the seismographs, and we have many networks of them, and therefore there would be an indication of any new developing strain.

If that satisfies the Chair, I will be glad to entertain any further questions.

CHAIRMAN JENSCH: Well, you will understand that I am not doubting your veracity, but I would like to ask a further question.

(Laughter.)

CHAIRMAN JENSCH: Father Lynch, in any event, the activity, the seismic activity in the eastern half of the United States as you say, is similar to the creaking stair. The intensity of that activity is low on the Richter Scale, is it not?

THE WITNESS: (Nodding yes.)

CHAIRMAN JENSCH: You did give a figure in the report that Consolidated Edison filed a figure I believe below 6.5.

THE WITNESS: Much below that.

CHAIRMAN JENSCH: You really don't anticipate any damage below that figure; is that correct?

THE WITNESS: I wouldn't anticipate a quake as high as that, first, and I certainly anticipate no damage whatever from any quake that would occur in this area.

CHAIRMAN JENSCH: Thank you very much. It has been very helpful to me to have your statement.

If any Board member has a question, or any party -- the staff?

MR. CONNER: No.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No.

CHAIRMAN JENSCH: Thank you. You are excused, Father Lynch.

(Witness excused.)

CHAIRMAN JENSCH: Proceed.

MR. UPTON: The next question appears on page 60 of the transcript. "The meteorological data I noticed were largely further presentations of that data which had been submitted for Indian Point 1, and although I think you have some restraints by some meteorologists since that time, I don't think there is much data on what has been going on in Indian Point 1 by way of measurements which may or may not affect at all your earlier conclusions, but

I just wondered whether or not you wanted to bring that data up to date."

In this instance I would like to call Dr. Ben Davidson, who has not been sworn. We have his qualifications also.

CHAIRMAN JENSCH: If there is no specific request, the qualifications may be incorporated in the transcript as if read.

(Qualifications of Ben Davidson follow.)

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

BEN DAVIDSON
PROFESSOR OF METEOROLOGY
AND DIRECTOR
GEOPHYSICAL SCIENCES LABORATORY
NEW YORK UNIVERSITY

1. My name is Ben Davidson. My business address is New York University, Washington Square, New York, New York. I am presently a professor of meteorology and director of the Geophysical Sciences Laboratory at New York University, a position which I have held since 1965. Before that I was an associate professor of meteorology at New York University, a position which I held from 1960 through 1965.

2. I am a graduate of New York University having received my A. B. degree there in Statistics in 1947. I received an M. S. degree from that University in 1949 in Meteorology and my Ph. D. in the same field from that University in 1959.

3. From 1940 to 1945 I was a weather observer and forecaster for the U. S. Army Air Force and from 1949 to 1955, I was a meteorologist to Supervisory Meteorologist, Chief, Small Scale Section, Atmospheric Analysis Laboratory, Air Force Cambridge Research Center, Massachusetts.

4. I was a co-organizer with H. Lettau of the Great Plans Turbulence Field Program (1953) which was an effort by some ten universities to observe the details of atmospheric turbulence in the planetary boundary layer.

I was also Director of the Micrometeorological survey of the Consolidated Edison Nuclear Power Plant at Indian Point for Unit #1 (1955-57) and since then I have been active in experimental and theoretical studies of valley winds. Recent relevant work topics include the Dynamics of Small Scale Circulation, the diffusion of polydisperse particulate clouds, and numerical integration on a global scale of a two dimensional diffusion-general-circulation-settling velocity-rainout model.

5. At the present time I am the principal investigator of a Public Health Service Research Grant on Mathematical Models of Urban Air Pollution Dynamics. This is essentially an experimental and theoretical study of urban meteorology as it affects the dispersal of multi-source complex.

6. I have contributed to many technical publications in the field of meteorology and have participated in many research reports on micrometeorology, turbulent diffusion, siting of nuclear plants and local wind observation and theory.

Whereupon,

BEN DAVIDSON

was called as a witness and, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

XXXXX THE WITNESS: Meteorological data which was collected here in connection with Indian Point Unit 1 covers an extensive series of -- complete micrometeorological observations over a period of two years.

In the original submission, we compared the chronological results of the first year with that of the second year and found no significant differences. I think the reason for this is that those climatic elements which are important in compiling diffusion climatology have a strong diurnal dependence. They depend really on the time of sunrise and sunset. The strong diurnal components appears to swamp any year-to-year variation of meteorological elements. So from this point of view, I regard the two years of data which have been taken as complete enough to specify the diffusion climatology at the new plant.

I would like to bring this data up to date, but the data does not exist which would bring it up to date. But I have no hesitation in saying that the dominant features of diffusion climatology at this site are known, they have been well studied, the characteristics appear in the scientific literature.

CHAIRMAN JENSCH: Any further questions?

Regulatory staff?

MR. CONNER: No.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No.

CHAIRMAN JENSCH: Do you have anything further of this witness?

MR. UPTON: Well, there may be something further on. I am taking these questions as they come.

CHAIRMAN JENSCH: Yes. He may be recalled if you desire.

You are temporarily excused.

(Witness tempcrarily excused.)

MR. UPTON: At pages 61 and 62 there is another item:

"In Indian Point 1,it is my understanding that there is a letter of April 19, 1966, that refers to some transaction about January 25th at Indian Point 1 and the letter of April 1966 indicated some difficulty in making computation of the level of radiation involved. It wasn't any great amount if I understand it. Under any circumstances it was below the guidelines of Part 20, but the thing that gave me concern was that the application in this letter said it didn't understand the regulation and

they didn't know how to make the computation so they were suggesting a revision.

"There was no response by the Commission to the inquiry, and I thought it difficult to see how well a program can be carried out if the regulation itself is not clear to the parties, and perhaps that might be expanded, and what should be done about it."

Dr. Elsenbud will respond to that.

MR. ELSENBUD: The incident to which you refer, as you say, took place in January 1966 and involved a low-level exposure to three men working inside the plant. The dose they received was about 1 percent of the dose permitted under Part 20.

CHAIRMAN JENSCH: What was the figure?

MR. ELSENBUD: .14 rem. This involved a dose from inhalation of dust. And the inconsistency to which the applicant referred in their letter of April 19th had to do with the fact that in administering the maximum permissible concentrations of dust in air for off-site populations, you are permitted to average over a one-year period. And in the case of administering occupational exposure to external radiation, you average over a 13-week period.

In the case of dust inhalation, Part 20 isn't quite clear in just this one respect. And as read, probably it requires that the dose be computed over a 40-hour week. In

view of the fact that the maximum permissible concentrations are designed to protect a person from 50 years of continuous exposure, this seemed unnecessarily severe and inconsistent with the manner in which the maximum permissible concentrations were calculated in the first place.

The purpose of this letter was simply to point this out. Coincidentally, I understand the ICRP has recently revised its language and is recommending that the doses be averaged over a 13-week period.

MR. UPTON: I believe the ICRP referred to is the International Committee on Radiation Protection.

MR. ELSENBUD: Yes.

CHAIRMAN JENSCH: So far that hasn't reflected itself in any of the Commission's regulations?

MR. ELSENBUD: No.

As I say, it is a minor point that doesn't affect the dose to which people are exposed. It does affect the point at which you have to turn in a routine report to the Commission, the 30-day notice required by one of the paragraphs in Part 20.

CHAIRMAN JENSCH: When was your first report made after the incident?

MR. ELSENBUD: Well, this was-- This report was made verbally to the Commission immediately after the incident, as a matter of general information, I believe within a day or

two. And the nature of the incident was that it would take several weeks to fully evaluate it, because the men were put into a whole body counter to measure the dose to the lung, or the lung burden of these various nuclides and in order to compute the dose, you would have to follow them for several weeks.

So in this respect, too, it would have been impractical to have turned in a complete written report within the 30-day period.

CHAIRMAN JENSCH: Well, what clarification has been received respecting this matter?

MR. ELSENBUD: None.

CHAIRMAN JENSCH: Have you had any oral discussions with the staff of the Commission respecting the matter?

MR. ELSENBUD: The oral conversations I have had would indicate that in order to comply with the formalities, one would probably turn in a preliminary incomplete report as soon as possible, rather than wait until all of the evidence is available.

CHAIRMAN JENSCH: Will you undertake that procedure for the future?

MR. ELSENBUD: I would so recommend in the future.

MR. CAHILL: We intend to do so.

CHAIRMAN JENSCH: Very well.

MR. CONNER: If the Chairman please, it is our

understanding that part of the regulatory staff is considering this whole matter and discussing with the Safety Standards Division this general problem in keeping with our continuing review of the adequacy of Part 20. We certainly wouldn't consider this a matter of any particular significance.

CHAIRMAN JENSCH: My inquiry would stem from the fact that the licensee had difficulty understanding the regulations and I thought the record should show fully whatthe difficulty was so the Commission staff could give thorough consideration to it, because I think it is improper procedure if the regulations are unclear to the licensees who are expected to follow them.

I take it the record is now fully complete from the licensee's point of view and he will await action by the Commission staff or the Commission respecting this matter.

Will you proceed?

MR. UPTON: The next questions appear on page 62 and 63 and are again for Dr. Davidson.

I realize there is some confusion, Mr. Chairman, perhaps inherent in this calling and recalling, but the other confusion of trying to skip around in the transcript I thought would be greater.

CHAIRMAN JENSCH: Whatever suits your convenience.

Would Dr. Davidson return to the stand?

Whereupon,

BEN DAVIDSON

resumed the stand and, having been previously duly sworn, was examined and testified further as follows:

FURTHER DIRECT EXAMINATION

BY MR. UPTON:

Q "A problem that also bothered me in meteorology is the references or the computations made by the dispersive qualities of the atmosphere. What confusion there is."

That maybe should be "diffusion." The transcript says "confusion."

"I wondered are any of those calculations affected at all by the purity of the air in the atmosphere. How do you figure this? I think the factor is generally a thousand."

A Well, I'm not quite sure what the exact question is.

CHAIRMAN JENSCH: Let me try to state it. Perhaps the transcript doesn't reflect my inquiry as I might have expressed it.

How do you know how well things will be dispersed in the air? Does it vary according to the quality of the air? Or are you always going to get as good dispersion from one time to the other?

For instance, we know smog does affect it. Take that as one end of the consideration and absolutely pure air

at the other. When do you know what you are going to get, if there were something released in the air?

THE WITNESS: Well, the dispersive capacity of the atmosphere does vary by orders of magnitude, depending on the specific turbulence and temperature conditions which happens to exist at the moment of the release.

Now as a result, say, of two years of observations we have had here, where we have observed the turbulent components of the wind, the primary diffusion is done by the turbulence in the natural wind. Now on a day like this, with strong winds blowing over rough terrain, you are getting fairly good turbulence and therefore things will disperse more rapidly than they would at night, say, when the winds die down and the turbulence inherent in the winds is not as great as it is in the daytime.

So there is a large diurnal variation in the dispersive capacity of the atmosphere. When you see the air full of impurities, it is probably because the dispersive quality of the atmosphere is very low and these are generally conditions which go with inversions in the atmosphere.

But in the calculations which have been presented in the safety analysis, we have assumed what I consider to be, in quotation marks, the worst possible set of realizable sequences of meteorological conditions. And we have incorporated in the calculations the vast range of diffusion coefficients

that one may find in the atmosphere. So that although it is true that the dispersive capacity of the atmosphere varies by orders of magnitude, we have tried to take this into account in making the computations, in computing the dilution factors.

#31 I don't know if this answers your question.

CHAIRMAN JENSCH: I don't think it does. I am trying to find out how you arrive at a dilution factor. I understand the turbulence effects the dispersive qualities of the air, and that sort of thing.

THE WITNESS: Let me tell you how we went about it experimentally, which is a good word.

CHAIRMAN JENSCH: Tell us what you did in the actual conditions in the river.

THE WITNESS: We had a smoke generator which we transported to the top of a tower, and released smoke for a period of an hour, meanwhile measuring all of the turbulent components of the wind and photographing the smoke from a mile away at 10-second intervals. We were able to establish through a sequence of such investigations, from photographing the dimensions of the plumeand noting the time the smoke was on the ground, we were able to reconstruct the concentration of our effluent, let us say, and from there we were able to go back and derive diffusion coefficients for this set of meteorological conditions. An alternate approach was to measure the turbulence of the atmosphere under a variety of conditions from these tower instruments, and then compare these with measurements made at Brookhaven, under identical meteorological conditions, where they have a large body of numerical diffusion data. And it is theoretically at least known how the rates of diffusion companion on the turbulence

which is in the atmosphere.

In this manner, we were able to go from the known Brookhaven coefficients, known in the sense that there is a vast body of experimental data to support these coefficients, we were able to estimate what these coefficients would be for the Buchanan site.

CHAIRMAN JENSCH: What was the dilution factor you used for the Buchanan site?

THE WITNESS: Well, I don't know it as a dilution factor. I know it only in terms of diffusion coefficients.

CHAIRMAN JENSCH: What is the diffusion coefficient you used, then?

THE WITNESS: Well, this depended on the wind speed and the temperature gradient conditions. Do you mind if I am off in the second decimal place?

CHAIRMAN JENSCH: I couldn't hear you.

THE WITNESS: Do you mind if I am off in the second decimal place, or shall I refresh my memory?

CHAIRMAN JENSCH: Whatever suits your accuracy is all right with me.

THE WITNESS: There are three parameters in a diffusion equation, this is C_z, C_y, and n. We found that "n" varied between .2 and .5, depending on whether you had unstable temperature gradients or stable temperature gradients in the atmosphere. We found that C_y varied from about .6 to about .4,

and we found that C_z varied from perhaps about .05 to about .40, depending again on the vertical stability of the atmosphere. These numbers were used in the computation of the dilution factor.

CHAIRMAN JENSCH: Have you ever heard of a dilution factor sometimes considered from a reactor plant of, say, a thousand? Have you ever heard that terminology?

THE WITNESS: Well, I have heard the terminology, but it is loose terminology. You have to specify the distance at which you are computing it before it means anything.

CHAIRMAN JENSCH: Yes. You have heard it. How would you apply it to the Buchanan site?

THE WITNESS: Well, I don't use that term. I think that is loose talk. Are you asking me how I would compare the dispersive characteristics of Buchanan with other sites?

CHAIRMAN JENSCH: No. I am interested in the procedure for determining a dilution factor which is sometimes used. I have seen it for some reactor proceeding of one thousand. I wondered if you can always use this one thousand like a postage stamp, or do you have to know something about the purity of the air and come back to these coefficients?

THE WITNESS: Yes, you have to know something about the wind speed and temperature structure. A thousand, by itself, really means nothing.

CHAIRMAN JENSCH: I am very happy to hear you say

that. I will use that as a quotation.

THE WITNESS: One might be willing to say if one had an elevated stack that the minimum dilution might be, by the time the spoon struck the ground, might be on the order of 10^3. But you have to specify distance, because the farther out you go, the greater the dilution.

CHAIRMAN JENSCH: You mentioned the Brookhaven Report on meteorology. Are you familiar with the Brookhaven study that shows plumes from a stack of 250 feet in height and -- about that -- and its smoke is going three different directions from the same stack at the same time, at the same hour. Where do you pick out the coefficient for the meterological conditions from such data?

THE WITNESS: Well, I think they were very fortunate to have a camera available at the time this happened.

(Laughter.)

CHAIRMAN JENSCH: Or unfortunate for the meterologists, perhaps.

THE WITNESS: Well, fortunate to teach people how tricky the atmosphere may be. But at this site, we ourselves have found, for example, that the frequency of north-northeast winds decreases markedly with height, so that although you may find in certain seasons a frequency of 20 percent at 70 feet above the river, you will find this frequency has decreased to perhaps 5 percent at the top of the tower. This

is because there is a local wind system in this area, and this local wind system is essentially a valley wind system, where at night you will have down-valley flow, and in the daytime up-valley flow.

Now, the height of this system depends on the heights of the ridge lines, which in this case is about 800 meters -- 800 feet, excuse me -- to the west of us. And it also depends on the strength of the prevailing flow, that is, the flow above the mountains. So you will find on some nights, when the valley wind is blowing, it is only 100 feet high, and on other nights it is 400 feet high. Above the valley wind you can have, well, whatever wind direction you have prevailing, the largest scale wind flow. And so that if we had wanted to, I am sure we could have found many instances at Buchanan where you can get differences of perhaps 90 degrees in the flow below 200 feet, say, and above 200 feet. But these are things which you get.

CHAIRMAN JENSCH: This is a very interesting report on weather conditions as you have observed them. I am trying to find out how you find a factor for dilution that you can use in the consideration of the operations of the Buchanan plants? Do you know how to figure a dilution factor of one thousand which I mentioned? How do you do that?

THE WITNESS: Well, you would go into Sutton's Formula.

CHAIRMAN JENSCH: You mean even in a high valley situation like Buchanan? I thought Sutton's Formula was applicable solely to flat terrain, or more applicable to flat terrain.

THE WITNESS: Well, but if you adjust the coefficients so that they reflect the amount of turbulence in the air due to the valley itself, then I think it is safe to use Sutton. And this is why we devoted two years to finding out what C_y and C_z and "n" were in this region. But knowing these coefficients, it is simply 2 over the wind speed times "pi", times U-bar -- all of that is in the denominator, times "e" to the minus -- also in the denominator, "x" to the 2 minus "n" power, and this is multiplied by an exponential factor which along the center line of the cloud is zero, is one. So we don't have to worry about that.

CHAIRMAN JENSCH: You mean all you have said, we don't pay any attention to it? What is it you say we don't pay any attention to? What is it you want to exclude?

THE WITNESS: The exponential. Let us just take the dilution is equal to one over "pi" times C_y times C_z, all of that being in the denominator, times "x" to the "x" minus 2 power.

CHAIRMAN JENSCH: Will you get 1,000 if you go through all of that?

THE WITNESS: It depends on the value of "x".

If you made "x" 10 kilometers, you would get 10,000.

CHAIRMAN JENSCH: Well, the reason I am bothering you, Dr. Davidson, I appreciate your help, really, because in many of these reactor cases, I have seen this dilution factor of 1,000. It seemingly applied like a postage stamp for any kind of a consideration. As I understand your statement, you wouldn't get a thousand unless you had variable weather conditions, which can't be really forecast with any certainty. Is that correct?

THE WITNESS: I say it is an incomplete statement. The dilution factor, if I was sitting on top of the source, would not be 1,000. It would be one. If I were some distance downwind, it might be 1,000.

CHAIRMAN JENSCH: And it might not?

THE WITNESS: It might not, depending on how far downwind I am.

MR. HALL: Do you want to take it to at least the low population zone or the boundary zone, or something of that type?

THE WITNESS: For this area, yes, that is in the report.

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MR. CONNER: If the Board please, while they are looking up this data, would it be of assistance to you to hear from Mr. Spickler, our witness in this area, as to just what the staff looks at when it determines whether or not a certain dilution factor can be employed at a given reactor site?

CHAIRMAN JENSCH: Yes, after Dr. Davidson has finished. I am afraid we are in the middle of a formula and I don't want to lose it.

MR. UPTON: This subject, if that is what one calls it, is discussed, Mr. Chairman, on page 12-42 of Exhibit B, Volume 2, Part B.

CHAIRMAN JENSCH: Thank you.

THE WITNESS: The two-hour dose, which I think is really the worst meteorological, which assumes the worst diffusion and meteorological conditions which are reasonable to expect, the dilution is 9.5 times N^{-4}, at 400 meters distance. And at 10,000 meters, it is 2.1 times N^{-5}.

MR. UPTON: Mr. Chairman, may I ask a clarifying question? Is what the Chairman is trying to find out from Dr. Davidson the dilution factor of Indian Point?

CHAIRMAN JENSCH: Yes.

MR. UPTON: Is Dr. Davidson saying that that is not a correct phrase to use about the meteorological conditions?

MR. HALL: It is an incomplete sentence.

THE WITNESS: Yes. the dilution factors will vary from hour to hour. In the thirty-day dose, the dilution factor was approximately one-ninth, at 400 meters, as the one assumed for the two-hour incident, because we assumed a different set of meteorological conditions to exist for the thirty days after the accident than existed for the first two hours or the first 22 hours after the accident. So these things are highly variable.

But in an accident like this, which depends really on the integration of two or three days of weather which is continually changing, we get some mean factors. But again the dilution factor should always specify the meteorological conditions, the wind wpeed, and the distance from the source.

CHAIRMAN JENSCH: I have no further questions.

Have you completed your presentation of this witness?

MR. UPTON: On this particular question in the transcript, yes, sir.

CHAIRMAN JENSCH: Does anyone have any questions of the witness on this?

MR. CONNER: If the Board please, I think it might be well at this point if we were permitted to, due to your question and the fact that you indicated you might

quote Professor Davidson in later cases, I feel it would be highly desirable for us to clarify this point now.

CHAIRMAN JENSCH: Is there any objection?

(No response.)

CHAIRMAN JENSCH: Hearing no objection, will you proceed?

MR. SPICKLER: I am afraid the 1000 dilution factor you mentioned is largely our fault. We come up with a term in developing a routine release limit for a nuclear plant based on average meteorological considerations and coming up with an average dilution factor between the plant stack and the site boundary. And we generally in specifications for nuclear plants specify some dilution factor and in some cases it has been 1000. Generally it is a good deal higher than that.

Would this explain what your thought is on this, Mr. Chairman?

CHAIRMAN JENSCH: I think I understand what you have done. I wonder if Dr. Davidson's comment isn't applicable?

Do you have anything further to add?

MR. SPICKLER: On another point that you mentioned earlier in the questioning of Dr. Davidson, concerning the effect of air quality on the dispersive qualities of the air, it is our feeling that the quality of the air does not

affect the dispersive capabilities of the air.

Iodine, which may be released from a containment building in an accident may absorb airborne particulate matter, for example, but the material that would be airborne would act essentially as a gas, and you would have no change in the diffusion that you ultimately get.

CHAIRMAN JENSCH: Wouldn't it affect the extent of the exposure?

MR. SPICKLER: No, it would not.

CHAIRMAN JENSCH: The distance of the exposure from the site?

MR. SPICKLER: No, it would not, because the particular matter would essentially act as a gaswould, so there would be no change in the relative concentration, for example, as you moved away from the source.

CHAIRMAN JENSCH: Let me ask you this: Is your statement consistent with Gifford's view from Oak Ridge?

MR. SPICKLER: Yes, it is. We have talked with Dr. Gifford concerning this. Perhaps Dr. Davidson would like to comment on this.

THE WITNESS: Well, I couldn't tell whether your question came from the ultimate scientific sophisticate or whether you meant something else.

CHAIRMAN JENSCH: Try it either way.

THE WITNESS: It is possible when you have a

polluted layer in the atmosphere, that because the top of this layer would act as a radiating surface, so you get cooling above and development of some sort of elevated inversion, due to this polluted layer, it is possible you are dealing here with an unlinear process, namely air pollution, diffusing conditions are poor, you get a simulation of aerosols at some level, which act as radiators, with change in temperature structure of the atmosphere, which would be a cyclical process.

Now actually this is a good scientific problem to work on. Some of my students are working on it in New York, where we unfortunately do have smoke palls and tops of air flow layers. But that is a very sophisticated question.

CHAIRMAN JENSCH: Well, it was intended to be.

(Laughter.)

CHAIRMAN JENSCH: And you think it is still in the process of being resolved?

THE WITNESS: Yes, I do.

MR. SPICKLER: Might I add that the conditions that might result from the process that Dr. Davidson just described, the meteorology would be no worse than the meteorological paramaters that we used in the accident calculations.

THE WITNESS: I believe that to be so, yes.

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CHAIRMAN JENSCH: Have both of you gentlemen finished?

If so, will you proceed, please?

(Witness Davidson excused)

MR. UPTON: Mr. Chairman, that question on page 62 and page 63 actually consists of four paragraphs and I didn't read the other three paragraphs. They seem to me all to relate to the same basic question about meteorology.

CHAIRMAN JENSCH: That is correct.

MR. UPTON: So I think I will proceed from that. On pages 63 and 64 there is another question I believe which is similar to the one the Chairman asked earlier. "As I say, some of these -- I don't say jumpy phrases, but there is a statement in the submittal by the applicant to this effect. It is on page 6 of I think Section 1.7 of the application to this effect: 'There are no geologic faults of magnitude extending through the site or close to it.' It is that old word magnitude. Are the faults insignificant, immaterial? What measures the magnitude? Are there faults that are something that aren't of magnitude but still are problems? I don't know."

I believe in essence Father Lynch answered that question.

DB2

CHAIRMAN JENSCH: I believe so, yes.

MR. UPTON: The same may be true of the next paragraph, which asks how long is a small fault and so forth.

CHAIRMAN JENSCH: Correct.

MR. UPTON: "There is also a statement: 'The fact that there are now intensely jointed rocks show that any such stresses that may have been in the area have been dissipated. Additional stresses can't accumulate in a rock formation as jointed as this one.'"

That is a quotation of one of our statements.

"What is the supporting data for that condlusion?"

CHAIRMAN JENSCH: What are the supporting data I think may have escaped reproduction in the transcript.

MR. UPTON: Thank you. I was sure that was the case.

I think Father Lynch can probably respond to this question.

CHAIRMAN JENSCH: As far as I am concerned, he has answered that question to my satisfaction unless somebody else desires to press it further.

Hearing on such request, will you proceed?

MR. UPTON: I am on my way to boric acid poison now.

CHAIRMAN JENSCH: Very good.

MR. UPTON: On page 64: "As I recall the application, you are planning to use boric acid poison as part of the shutdown equipment. Will the absorbing material depend on the fuel elements in any respect? Do you know? So that they would be later removed rapidly as the result of the changes in the acidity or any of the characteristics of the coolant?"

Mr. Beckjord will respond to that question.

MR. BECKJORD: Mr. Chairman, would you phrase that question again?

CHAIRMAN JENSCH: Yes. If I may suggest, perhaps if you gentlemen who are going to respond to the several inquiries set forth in the two transcripts in reference to the pre-hearing conferences, that will be sufficient perhaps for the answers to be given rather than being re-read at this time.

What I had in mind was this boric acid situation comes up again and I really wanted to know whether the boric acid is going to have a plate-out problem, as, as boric acid alone, or, b, with thiosulphate in it.

Can you discuss it from that point of view?

MR. BECKJORD: First of all, Mr. Chairman, in normal operation there is no mixture of boric acid and thiosulphate.

CHAIRMAN JENSCH: That is correct.

MR. BECKJORD: This could only occur in an accident situation.

CHAIRMAN JENSCH: That is correct.

MR. BECKJORD: The thiosulphate would have no effect on the strength of the boric acid in regard to shitdown after the accident occurred.

CHAIRMAN JENSCH: What data do you have in that regard? Have you experimented with a mixture of thiosulphate and boric acid?

MR. BECKJORD: I will ask Mr. McAdoo to answer that.

MR. MC ADOO: We considered the possibility of interaction between boric acid and sodium thiosulphate under this post-accident condition. We referred the question to our chemical development group for their consideration and in addition I had some of my own people do some investigation of the literature.

Both groups or both parties came back with the same response, namely, that there is nothing inherent in the chemistry of these solutions such that either would affect the chemical property of the other were they mixed.

We have done no specific experiments to verify this, but in their opinion there was no need for such experiments.

CHAIRMAN JENSCH: That is, the effects of the radiation under MCA conditions wouldn't be a factor?

MR. MC ADOO: No, sir.

CHAIRMAN JENSCH: Thank you very much.

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MR. UPTON: In Volume II of the transcript, page 88, is a question which I believe has been already answered by Mr. Crawford, on what the ACRS letter and the applicant and the staff meant about operation not being planned above 960 megawatts electric.

CHAIRMAN JENSCH: I believe, unless Dr. Hall has something further on that, it has been answered.

MR. HALL: Yes.

MR. UPTON: The next question is on page 90, which I think may also have been answered, which talks about the moderator temperature and void coefficients --

CHAIRMAN JENSCH: Dr. Hall indicates to me that question has been answered.

MR. UPTON: All right. On the same page, there is a discussion of in-service inspection, which I believe has also been answered.

CHAIRMAN JENSCH: Dr. Hall indicates it has been answered.

MR. UPTON: The next reference is to getting the ACRS letter of November 1965, which has now been furnished.

CHAIRMAN JENSCH: Yes.

MR. UPTON: I believe the next question which was asked by Dr. Geyer, and which appears on page 96, in which Dr. Geyer wanted a description of anchor bolts or whether the welds would be considered welds in the sense that they would be

pressurized. We did give him a reference. Is that sufficient?

MR. GEYER: Yes, and we discussed it this morning, also.

MR. UPTON: All right. Also, the next part about which you are not clear, as to just how the angles are put on and so forth. Is that all right?

CHAIRMAN JENSCH: For the record, the answer is yes.

MR. UPTON: The next again deals with positive temperature coefficients of reactivity, in which the question is: Is there any new thinking on this, any additional information, which I presume has also been answered.

CHAIRMAN JENSCH: I so understand.

MR. UPTON: The next one appears not to have been answered. The bottom of page 97. You would prefer I not read it, right?

CHAIRMAN JENSCH: Well, except insofar as you need to, to state the question.

MR. UPTON: All right. The question is -- I suppose this is really a question for the AEC staff.

CHAIRMAN JENSCH: Propound it to the staff then.

MR. UPTON: In the Staff Analysis, you say the design criteria for the fuel tubes is that the internal gas pressure will be less than the nominal external pressure. What do you mean by the word "nominal" in that connection?

MR. GEYER: We discussed that this morning.

MR. CONNER: Does the Board wish any additional information from the staff on that point?

MR. GEYER: In the case of the maximum credible accident, what happens to the fuel tubes?

MR. CASE: Well, depending on what assumption one makes --

MR. GEYER: Some assumption must have been made.

MR. CASE: Yes, in the course of a maximum credible accident, in some cases parts of the fuel elements are uncovered, and in these cases, it is reasonable to presume that there may be cracks in the cladding due to the pressurization, and some gases in the cladding gaps may be released. However, the assumptions that we have made in assessing the potential consequences of this accident are a release of the fission products from 100 percent of the core, namely, 100 percent of the noble gas, 50 percent of the iodines, and 1 percent of the solids. So our assumptions are much more conservative in assessing the potential consequences than one could reasonable expect if the safety system does function under these conditions.

MR. HALL: May I suggest that, in essence, is it not a part of your assumptions that the fuel elements do fail and you are not really concerned with the detailed mechanism by which they may fail?

MR. CASE: That is correct.

CHAIRMAN JENSCH: Will you proceed, applicant?

MR. UPTON: The next question is -- there is a reference to a number of manually operated valves or connections to the containment vessel. Just how many valves are there in that category, and how many are normally standing in safety position, and how many must be operated in case of an accident? I will ask Mr. McAdoo to answer that question.

MR. McADOO: I would call the Board's attention to Table 19-E in the first supplement, which summarizes the various categories of penetrations and identifies those in each group, giving the type of isolation valving employed. To give a specific answer to the question from that table, it can be derived that there are six manual valves in the Class 3 penetrations, 12 manual valves in the Class 4 penetrations, and one manual valve in the Class 6 penetrations. Where manual valves are identified as fulfilling in part the isolation function attributed to that penetration, there is no urgent requirement to close the manual valve. Generally, this applies where an automatic valve is tripped, which would perform the isolation function itself, or where that pipe connects to a closed system, or where that line is normally filled with water and is therefore not regarded as an immediate potential leakage source. Among those 19 valves which I listed, only one normally exists in the safety position, that is, exists in a closed position during plant operation, that being the one in the fuel transfer tube.

MR. GEYER: Do I understand your answer to imply that the plant can be put in a safe condition in case of accident without someone actually going to these valves to operate them?

MR. McADOO: That is correct. The function of the manual valves is one of surveillance, and the operator would, in due course, proceed to check the status of these valves at some later time, there being ample time available to take care of this before a potential leakage source could develop.

End 35 MR. GEYER: Thank you.

MR. UPTON: Mr. Chairman, there are three other questions on page 98 which I believe have been answered.

CHAIRMAN JENSCH: That appears to be the case. You may proceed.

MR. UPTON: That also seems to be true of the three questions on page 99, the phrase "negligible out-leakage," which has been discussed, in-service inspection. That also seems to be true of the question on page 100 about the function of the United States Testing Service.

CHAIRMAN JENSCH: That is correct. That has been answered.

MR. UPTON: On page 101, I believe the effect of sodium thiosulphate has also been discussed.

CHAIRMAN JENSCH: That is correct. It has been answered.

MR. UPTON: Water logging on the same page has been answered.

CHAIRMAN JENSCH: Correct.

MR. UPTON: Page 102, the efficiency of the filters, that has been answered.

CHAIRMAN JENSCH: Correct.

MR. UPTON: The question on solid burnable poisons on the same page I believe has been answered.

CHAIRMAN JENSCH: Dr. Hall indicates that is correct.

MR. UPTON: I'm not sure, Mr. Chairman, about the

next question at the bottom of page 105 and the top of page 106. I believe in a general way it has been answered by some of the general discussion, but I would like to know what the Board thinks about that.

CHAIRMAN JENSCH: That has been answered for the Board.

MR. UPTON: I believe that was in response to a State of New York question that that answer was given.

CHAIRMAN JENSCH: Very well.

MR. UPTON: That is the last question I have on the list, Mr. Chairman.

CHAIRMAN JENSCH: All right.

Does any party have any additional evidence to adduce?

MR. CONNER: No, sir.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: Mr. Chairman, we have some witnesses who have not yet been examined by the Board or the Staff.

CHAIRMAN JENSCH: Will the parties indicate their wishes--

Will you identify the witnesses for the record?

MR. SCINTO: Mr. Jon D. Anderson, Deputy Director of the New York State Office of Atomic and Space Development, and Mr. Sherwood Davies, New York State Health Department.

CHAIRMAN JENSCH: Applicant?

MR. UPTON: I have no cross-examination of the

State of New York witnesses.

CHAIRMAN JENSCH: Regulatory staff?

MR. CONNER: That position is the same with us.

CHAIRMAN JENSCH: The presentations that have been made by the parties so far in the proceeding have obviated questions that might otherwise have been directed to these two witnesses and we thank you for their availability, but the Board does not have any questions of those witnesses.

MR. SCINTO: Thank you, Mr. Chairman.

CHAIRMAN JENSCH: Does that conclude the presentation of evidence in this proceeding?

By the applicant?

MR. UPTON: Yes, it does.

CHAIRMAN JENSCH: Regulatory staff?

MR. CONNER: Yes, sir.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: Yes, sir.

CHAIRMAN JENSCH: Are we ready to proceed to a consideration of closing matters, first transcript corrections, second, the submission of proposed findings and conclusions?

MR. UPTON: Speaking for the applicant, we will be ready to submit transcript corrections next Wednesday, whic I believe is the 21st.

CHAIRMAN JENSCH: Staff?

MR. CONNER: That date would be agreeable with us.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: We would be agreeable.

CHAIRMAN JENSCH: September 21st is the date on or before which the parties may submit proposals for corrections of the transcript. If no objections are received by the Board from the parties objecting to the proposed transcript corrections by the other parties, it will be assumed on September 23rd that no party has any objections to the proposals for corrections by respectively the other party and it will be considered closed for consideration of proposed corrections of the transcript by September 23rd, 1966.

The Board may have some proposals for correction of the transcript and if so they will endeavor to submit them by September 23rd, in which event the parties may comment or object to the proposals by the Board by September 24th, 1966. And if no proposals for correction are submitted by the Board, the Board will proceed to a consideration of those proposals submitted by the parties.

That I believe disposes of the consideration of proposals for correction of the transcript.

I think the Staff at the outset indicated that proposed findings might be considered at this time, at the close of the presentation of evidence. Is there any further report from the Staff in that regard?

MR. CONNER: If your Honor please, the Staff has

proposed findings which I expect I will be able to file by mailing them tomorrow. We have also examined proposed findings by the applicant which vary from ours in only relatively unimportant detail. And we believe we can have our proposed findings in the mail to the Board tomorrow. It is really a question of reproduction.

CHAIRMAN JENSCH: May I inquire if this is a feasible procedure, that the applicant and the Staff confer and resolve the various answers between the two proposals for findings and conclusions, so that the Board will receive something that does reflect possibly a joint presentation? Is that likely to be feasible?

MR. UPTON: Mr. Chairman, we have our proposed findings and conclusions ready to submit now and we would really like to do that. May I explain a little more?

We are basing our proposed findings and conclusions on the findings and conclusions that were adopted by the regulatory board in the Rochester Gas and Electriccase. We have had a somewhat academic but nonetheless slight difference of opinion with the Staff from time to time as to just how long our proposed findings and conclusions ought to be. And while the differences between our positions is not -- does not by any means address to one of substance, we would prefer to submit our proposed findings and conclusions in the form which we feel is preferable.

CHAIRMAN JENSCH: Will you proceed to do so.

MR. UPTON: Thank you, sir.

I have them in 3 originals, as required by the Commission's rules and they have already been distributed to the parties.

CHAIRMAN JENSCH: Very well.

We are receiving from you then these three copies of proposed findings and conclusions.

MR. UPTON: Mr. Chairman, if I may say so, the proposed findings and conclusions are up-to-date in the sense that they do include references to the events of today.

CHAIRMAN JENSCH: I complement you on your prediction of meteorological conditions for the case.

(Laughter.)

CHAIRMAN JENSCH: The Board had contemplated staying here in this area for a period of time at least to give consideration to the proposals for findings and fact and conclusions of law. We wonder if there is any way of receiving a copy of the Staff proposals by tomorrow morning?

MR. CONNER: If the Board please, I believe we can probably work this out. We got the name of a public stenographer, at a business college in Peekskill, but unfortunately we were unable to contact them. However, Mr. Weiskopf has to stay in town tomorrow on other business, so I believe we can arrange for reproduction and Mr. Weiskopf could deliver

these to the Board wherever the Board is staying tomorrow, and we would serve copies on the other parties by mail, if that is agreeable to the State of New York and to the applicant.

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CHAIRMAN JENSCH: Is that agreeable to the applicant?

MR. UPTON: Yes, it is.

MR. SCINTO: That is agreeable.

CHAIRMAN JENSCH: Would you put a figure on that time tomorrow for delivery?

MR. CONNER: Well, if I knew that I could obtain the services of the public stenographer, I think I could tell you. But not having been able to contact them on the telephone, I have a little nervousness about a definite commitment. However, we will make every effort to have them available by noon.

CHAIRMAN JENSCH: Can you indicate generally at this time, wherein is there some difference between the staff and the applicant?

MR. CONNER: As Mr. Upton pointed out, there are no differences of substance whatsoever. However, the regulatory staff continues to seek the most expeditious way of making proposed findings of fact and there are certain things we feel are unnecessary and one paragraph in particular we feel should be put in, which is wholly procedural.

CHAIRMAN JENSCH: Can you state what that is? Can you read that to the reporter?

MR. CONNER: We feel that the proposed findings

should contain the following language: "The application and the procedures thereon comply with the requirements of the Act and the Commission's regulations. There are no unresolved safety questions pertinent to the issuance of a provisional construction permit. There are no controverted matters of fact or law between the parties to the proceeding."

The essense of that is contained in the applicant's proposed findings. Nevertheless, we feel that that specific provision should be incorporated in line with the Commission's statement of policies for the conduct of these proceedings.

CHAIRMAN JENSCH: The applicant proposed "The applicant has proposed and there will be conducted a research and development program to resolve the safety questions, if any, with respect to those features which require research and development."

I take it your expression is not contrary?

MR. CONNER: No, sir. We made the same ultimate findings in our proposed findings on that point as the applicant. Ours are only related to the procedural status of the case at this point. Specifically, there are no differences between the staff and the applicant as to the approach to that particular R& D program, or of anything that has been said thus far. So I do not relate the paragraph you read to the one I read.

CHAIRMAN JENSCH: Does the paragraph you read express the thought you have just indicated?

MR. CONNER: Yes, sir. Read in conjunction with our other findings, which of course include the one you just referred to,namely that they will conduct the necessary developmental program to provide the necessary information.

CHAIRMAN JENSCH: Would you indicate what other differences you have, if they are not too extensive?

MR. CONNER: The other differences are only ones of degree and relatively minor points. We, too, of course, followed the format the Commission approved, namely the Board's decision in the Rochester case, which the Commission adopted of course by under the Commission's rules not taking specific action. So there is almost no differences.

CHAIRMAN JENSCH: Well, let us accept your presentation in part by virtue of your statement here for the reporter and we will receive the transcript from the reporter the first thing in the morning. That is, 8:00 o'clock.

MR. CONNER: If the Board please, a simple solution occurs to me. I can correct our proposed findings and give them to the reporter to reproduce at the end of the transcript, so they will be available to you in the transcript tomorrow morning.

CHAIRMAN JENSCH: Is there any objection by the

applicant to the addition to the transcript by this proposal?

MR. UPTON: NOt at all, sir.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No, sir.

CHAIRMAN JENSCH: Let us proceed on that basis.

MR. CONNER: This solves my problem about a public stenographer.

CHAIRMAN JENSCH: Knowing the contract rates for the reporting services, I know there will be no objection by the reporter. Let us proceed on that basis, then.

Is there any other matter that can be considered at this hearing?

MR. UPTON: Mr. Chairman, I would like to file, in accordance with the Commission's rules, a motion for expedited effectiveness of the initial decision, which I have here in three signed originals, as required.

CHAIRMAN JENSCH: The Board will receive your submittal for that purpose.

Do your proposed findings reflect the motion that you are now serving?

MR. UPTON: They do, yes, sir.

CHAIR MAN JENSCH: Very well. We are now receiving the motion to which you made reference, and it will be considered in connection with your proposed findings

and conclusions.

In addition, such a motion will be filed with the Secretary of the Commission, so the formal record will reflect your motion in that regard.

Is that correct?

MR. UPTON: And I assume there is no objection by either of the other two parties to the entertaining of this motion.

CHAIRMAN JENSCH: I was going to get to that. But you will supplement the formal record of the Commission with additional copies for the Secretary's files, will you?

MR. UPTON: Yes, sir.

CHAIRMAN JENSCH: Is there objection to this motion?

MR. CONNER: Staff consents to the motion.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: The State has no objection.

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CHAIRMAN JENSCH: Is there any other matter that can be considered at this hearing?

Does the Applicant have anything further, either by way of motions, submittals or evidence in this proceeding?

MR. UPTON: No, sir.

CHAIRMAN JENSCH: The Regulatory Staff?

MR. CONNER: Nothing.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: I would like to add that if we have any changes to the proposed findings submitted by the other parties to submit, we will endeavor to do that by September 21, the date for submission of changes to the transcript.

CHAIRMAN JENSCH: That will be satisfactory, because it is only an initial consideration we will give to these findings tomorrow and we are planning a session for later consideration, at a time when it will accommodate your submittal as well.

There being nothing further, this hearing is now concluded.

(Thereupon, at 5:10 p.m. the hearing was concluded.)

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UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

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

PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW BY THE AEC REGULATORY STAFF IN THE FORM OF A PROPOSED INITIAL DECISION

1. This proceeding involves the application of Consolidated Edison Company of New York, Inc., (Consolidated Edison), dated December 6, 1965, and amendments thereto dated March 29, 1966, May 24, 1966, June 17, 1966, July 21, 1966, and July 25, 1966 (the "application") for a construction permit for a pressurized water reactor designed to operate at 2758 megawatts (thermal) to be located at its Indian Point site in the Town of Buchanan, Westchester County, New York. The facility will be constructed for Consolidated Edison by Westinghouse Electric Corporation. The application contains a description of the site and the proposed facility, the financial qualifications of the applicant, and the technical qualifications of the applicant, including those of its principal contractor, to design and construct the facility.

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2. The application was reviewed by the Regulatory Staff of the Atomic Energy Commission which concluded that the facility can be constructed and operated at the proposed site without endangering the health and safety of the public. The application was also reviewed by the Advisory Committee on Reactor Safeguards which concluded that the proposed reactor can be built at the proposed site with reasonable assurance that it can be operated without undue risk to the health and safety of the public. (Staff Hazards Analysis, App.A).

3. In accordance with the requirements of the Atomic Energy Act of 1954, as amended, a hearing was held before an atomic safety and licensing board on September 14-15, 1966, to consider whether the provisional construction permit should be issued. The State of New York, through its Office of Atomic and Space Development, intervened in the proceeding. In addition, several persons made limited appearances, some on behalf of the project and some in opposition. The Conservation Center, Inc. of New York City petitioned to intervene during the course of the hearing. The petition was denied by the Board.

4. The proposed site of the Indian Point facility is in the Village of Buchanan, Westchester County,

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New York, on the eastern shore of the Hudson River, about 2.5 miles from the center of Peekskill, New York, and approximately 24 miles north of New York City. The proposed facility is similar to a number of pressurized water reactor facilities which are now in operation or under construction, particularly the Connecticut Yankee facility at Haddam Neck, Connecticut, the Southern California Edison facility at Camp Pendleton, California, and the Rochester Gas & Electric Brookwood facility.

5. The location of the proposed reactor is on a 250-acre site and will be located on limestone which has a bearing capability of up to 50 tons per square foot, more than enough for any load superimposed by the plant. Ground water flow is toward the river since the ground water table in the hills surrounding the site is at a high elevation. There are no identifiable geologic structures which could be expected to localize faulting in the immediate vicinity of the site and the area is seismologically quiet. Meteorologically the proposed facility is situated in an area which provides adequate diffusion and distribution for the gases released from the facility.

6. The applicant is soundly financed and has plentiful resources at its command. It plans to

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finance the cost of construction of its proposed nuclear plant in the same manner as it finances the construction of its conventional plants, namely, in the ordinary course of business through the internal generation of funds and the sale and issuance of securities, if required.

7. The reactor will be fueled with uranium dioxide (UO_2) sintered pellets sealed in 12-foot long zircaloy fuel rods. The active core will be about 12 feet in diameter and 12 feet long. The core will be contained within a pressure vessel designed for a pressure of 2485 psig. The cooling water will be circulated through the core and the four steam generators by four primary coolant pumps.

8. The containment, within which the reactor vessel, steam generators, primary coolant pumps, and other primary system equipment will be located, will be a reinforced concrete structure which is similar in concept to the containment vessel being built for the Connecticut Yankee facility. The containment is designed to withstand the pressures and temperatures that would occur in the unlikely event of a failure of the largest primary coolant line and to retain radioactive fission products which might be releases as a consequence of this and lesser accidents. Although the basic design of the containment vessel is similar, the Indian Point containment system is designed with the added objective of preventing outleakage under accident conditions. To achieve this goal, the containment system includes a penetration pressurization system and an isolation valve seal water system. The penetration pressurization system provides a zone maintained at a pressure of at least 50 psig at the potential leakage paths at or near the various containment penetrations. In addition, welded joints of the containment liner are also covered with a channel which is pressurized to at least 50 psig. The isolation valve seal water system will be designed to provide under accident conditions either a water seal at isolation valves or a water leg in fluid lines which penetrate the containment barrier. The water

pressure at the valves or in the fluid line would be maintained at a pressure of at least 50 psig. The value of 50 psig has been selected because it is greater than the maximum pressure calculated to occur in the containment during the course of a major loss of coolant accident.

9. A safety injection system will cool the core with borated water in case of a major loss of coolant accident. In addition, two other emergency cooling systems (containment spray and air recirculation system) within the containment vessel will depressurize the containment by cooling the containment atmosphere and will remove radioactive fission products which might be released as a consequence of an accident. Either of these containment cooling systems acting independently can maintain internal containment pressure within acceptable limits with no reliance on the safety injection system. The systems function in accordance with different principles and are provided with redundant components (pumps, valves, heat exchangers, etc.) within each system for maximum reliability. The service water system which transfers the heat from the containment cooling systems to the river is also provided with duplicate equipment so that no single failure would preclude continued operation of these important engineered safeguards.

10. While the Indian Point Unit No. 2 plant is similar in most respects to the other pressurized water

reactor facilities previously approved by the Commission, there are several differences. The length of the core in the Brookwood and Indian Point Unit No. 2 reactors is 12 feet as compared to 10 feet in both Connecticut Yankee and San Onofre reactors. The Brookwood and Indian Point Unit No. 2 fuel rods will be clad with zirconium, whereas both San Onofre and Connecticut Yankee will employ stainless steel cladding in the first core. The Indian Point Unit No. 2 core will operate at somewhat higher linear heat generation rate (up to 20.7 kw/ft at the maximum overpower condition), and higher central fuel temperature (up to 4250°F at the maximum overpower condition) than Brookwood, San Onofre or Connecticut Yankee. Some of the post-accident reactor core and containment cooling system components will be installed inside the containment structure to minimize potential leakage sources, and complete back-up system located in the primary auxiliary building will also be installed. The capacity of the post-accident core cooling system has been improved by the addition of pumping capacity and piping. Most of these items are within the range of established technology and engineering practice. Others will be the subject of a development program proposed by the applicant. The development of the final design of the containment will be carefully followed by the AEC staff as recommended by the ACRS

11. At the conclusion of the hearing, applicant filed with the Board, in accordance with § 2.764(a) of the Commission's Rules of Practice, a motion for expedited effectiveness of the initial decision.

12. The application and the proceeding thereon comply with the requirements of the Act and the Commission's regulations. There are no unresolved safety questions pertinent to the issuance of a provisional construction permit. There are no controverted matters of fact or law between the parties to the proceeding.

13. The Board has given careful consideration to all of the documentary and oral evidence produced by the parties and to the report of the Advisory Committee on Reactor Safeguards in this proceeding. Based on our review of the entire record in this proceeding and the foregoing findings of fact and conclusions we conclude that:

(1) The applicant has described the proposed design of the facility, including, but not limited to, the principal architectural and engineering criteria for the design, and has identified the major features or components on which further technical information is supplied;

(2) The omitted technical information will be supplied;

(3) The applicant has proposed, and there will be

conducted, a research and development program reasonably designed to resolve the safety questions with respect to those features or components which require research and development; and

(4) On the basis of the foregoing, there is reasonable assurance that (i) such safety questions will be satisfactorily resolved at or before the latest date stated in the application for completion of construction of the proposed facility and (ii) taking into consideration the site criteria contained in Part 100, the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public;

The applicant is technically qualified to design and construct the proposed facility;

The applicant is financially qualified to design and construct the proposed facility;

The issuance of a permit for the construction of the facility will not be inimical to the common defense and security or to the health and safety of the public.

14. Pursuant to the Act and the Commission's regulations, subject to review by the Commission upon its own motion or upon the filing of exceptions in accordance with the "Rules of Practice," 10 CFR Part 2, Con Edison is authorized to construct the facility in accordance with the

application and with the evidence and representations entered in the record at the hearing; and the Director of the Division of Reactor Licensing is directed to issue a provisional construction permit pursuant to § 104(b) of the Act substantially in the form of Attachment A hereto. IT IS FURTHER ORDERED THAT, in accordance with § 2.764, this Initial Decision shall become effective on (ten days after issuance) and, in the absence of any further order from the Commission, shall constitute the final decision of the Commission on (forty-five days after issuance), subject to the filing of exceptions and to any order by the Commission upon such petition or upon its own motion.

ATOMIC SAFETY AND LICENSING BOARD

_____
Dr. David B. Hall

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Dr. John C. Geyer

_____
Samuel W. Jensch, Chairman

Dated at Germantown, Maryland
this day of 1966.

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