UNITED STATES ATOMIC ENERGY COMMISSION

IN THE MATTER OF:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

(Indian Point Station, Union No. 2)

Docket No. 50-247

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

Date - November 17, 1971 Pages 3920 - 4157

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UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

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In the Matter of: :

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

- -

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

Wednesday, November 17, 1971

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

BEFORE:

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

DR. JOHN C. GEYER, Member.

MR. R. B. BRIGGS, Member.

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

CHAIRMAN JENSCH: Please come to order.

What is the desire of the Applicant, to proceed with the pressure vessel integrity matter now or in reference to emergency core cooling concerning that the Board would like to discuss?

MR. TROSTEN: I think it would be preferable, Mr. Chairman, if we were to proceed first with the pressure vessel panel and then go on with emergency core cooling.

CHAIRMAN JENSCH: Very well. Has all of your panel been sworn?

MR. TROSTEN: Yes, they have, Mr. Chairman.

CHAIRMAN JENSCH: Very well.

MR. TROSTEN: Mr. Chairman, before we proceed, I wish to make a statement relative to our discussion yesterday on scheduling of the hearing.

Pursuant to the Board's directive to us last Friday, Applicant was prepared to proceed in all respects on ECCS matters yesterday, including interrogation by the Board. All of the Applicant's redirect testimony was offered. In Mr. Briggs' absence we understand the Board was unable to go forward with interrogation of Applicant's witnesses. Witnesses Moore and Roll are here again today and we continue to stand ready to respond to all questions by the

Board on the ECCS and to conclude fully the inquiry into this matter this week. Applicant's basic evidence concerning satisfaction on the AEC's interim acceptance criteria has been before the Board for four months. Of course, additional time is available to the Board to study the record yesterday in view of the short hearing session.

In view of the fact that this session of evidentiary hearings was scheduled by the Board on September 17th to conclude the hearing and this proceeding in all respects possible, and the fact that the proposed issues and documents to be considered this week have been known for some time, we urge the Board to continue this hearing in session until outstanding ECCS matters have been resolved.

The fact that a fire has occurred at Indian Point 2 is no reason for changing the hearing schedule previously established. None of the questions scheduled to be considered by the Board this week, whether dealing with radiological safety or environmental matters, is affected by the fire, and all of the Applicant's testimony on these matters should be received and considered by the Board now rather than being deferred to a future date. If the Board has questions on the evidence adduced, Applicant should be afforded an opportunity to respond to them now. There are always problems associated with deferring hearings including conflicts with the commitments of Board members and parties.

Unless the Staff, the Board, and the parties proceed with this proceeding as expeditiously as possible, notwithstanding unforeseen contingencies, the result is bound to be serious delays in the processing of this license application since problems invariably occur when bringing a new plant on the line.

With regard to cross-examination by Mr. Roisman, Applicant sees no reason why it should not be completed this week. Mr. Roisman is desirous of doing so, but he has said he cannot be ready with any cross-examination until Friday. If the Board believes that it cannot wait until then for any such cross-examination to be conducted, we move the Board to direct Mr. Roisman to conduct his cross-examination before then. As an alternative to Mr. Roisman's cross-examination before Friday, we ask the Board to utilize the time this week exclusive of hearings on radiological safety matters, including night sessions asrequired, to consider fully Applicant's environmental testimony on a 50 per cent testing license. The Applicant originally filed a motion for a limited operation license on September 24, 1971. We supplemented this motion on October 19, at which time we moved the Board, pursuant to 10 CFR-50, Appendix D, for a hearing on environmental matters not to exceed three days in length and to commence after the radiological safety hearings commencing November 1st.

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EDF and HRFA, Intervenors in this proceeding, are in agreement with the schedule. Our proposed testimony was also filed with the Board and the parties on October 19, almost four weeks ago, at which time we said we wish to have introduced in evidence at the present session of hearings.

At the outset of these hearings on November 1st I reiterated Applicant's hope that the Staff would be able to respond with any environmental impact well in advance of November 15, and that the Board would consider the environmental matters at that time. Yesterday we learned that the Staff was definitely not going to be ready with such memorandum this week. Applicant is most concerned and disappointed by this information and we can see no reason why the Staff should not have completed its work on the impact memorandum before yesterday.

Moreover, we believe this position by the Staff is inconsistent with the Staff's answer filed in this proceeding on October 30, 1971.

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MR. TROSTEN: Applicant's panel of witnesses on environmental matters is here today and ready to proceed. We ask the Staff to complete its work on the environmental impact memorandum forthwith and ask the Board's assistance in achieving this result consistent with out motion of October 19.

In summary, Mr. Chairman, the hearing on the Indian Point 2 operating license has been going on for almost a year now. We have an opportunity this week to conclude the hearing in all respects possible, in the words of the Board's order of September 17. The Applicant is prepared to stay here as long as necessary to accomplish this objective, and we ask the co-operation of the Board and the parties toward the same end.

CHAIRMAN JENSCH: Very well. We appreciate the statement by Applicant's counsel. We wish to come to some schedule to accomodate the Applicant in all respects. We will endeavor to do so.

As we indicated yesterday, the Board was somewhat dismayed. There are several matters awaiting presentation that could not have gone forward, especially in view of the fact that discussions had been had between Applicant's counsel and Environmental Defense Fund counsel respecting the intended recross-examination by Environmental Defense Fund counsel on Friday. But there were other matters that could have gone forward. These proceedings have schedule difficulties in the sense that when adjustments are made in order to accommodate the needs

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of the parties, such as indicated by the Environmental Defense Fund or, rather, I should say, the Citizen's Fund for the Protection of the Environment, then the Board expects the parties to have their other witnesses ready to go forward and to be ready to keep in continuous presentation evidence of one kind or another.

It is not quite possible to compartmentalize the presentations and limit the presentation of evidence to one subject and pick up another subject and finish that. Sometimes we have to work one subject as well as the parties are able to proceed at a particular time, and then we turn to completion of any unfinished matters. Certainly that is the general procedure. I think if the Applicant understands the difficulties that the parties have with the presentation of evidence, the Applicant will better understand why schedule arrangements are made as this Board has provided.

The Board is ready to sit and receive all evidence from the parties as soon as it can be prepared. As to the Staff, it is the recollection of the Board that the Staff indicated that it was working on the Environmental Defense matter, Environmental statement, but that it indicated it felt the fire is going to delay the matter to some extent, at least. I think it must be apparent to Applicant's counsel that the Compliance Section of the Atomic Energy Commission could not present evidence in this proceeding; that the facility is ready for any

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near operation. The Board intends to be kept informed concerning the readiness of this plant to proceed. We are mindful of the fact that the Board was encouraged to get out and order last July very promptly because there was a great need for the order, and that there would be a serious delay, if delay ensued, and there would be disasterous results of many kinds if the order wasn't immediately issued. So the Board recessed in July to permit its consideration and issuance of an order to permit subcritical testing.

We later learned that the plant wasn't ready for any such subcritical testing until approximately September or October. But in the meantime there were many reports that the Board was holding up something about this plant, and the planning was not ready for the subcritical testing that was sought in July.

We have perhaps some similar situation right now. This plant, unfortunately, has suffered a fire. It will be some time before it is repaired and ready for any further steps that the Applicant contemplates. The Board will complete the necessities of the schedule that has been, in a sense, forced upon the Applicant bythe fire.

The Board will make itself available for the receipt of all evidence as promptly as the parties are ready to proceed and as the plant permits the consideration of its readiness.

I am sure that the Board feels that the Staff is not to be criticized by not having an environmental statement ready. Applicant's counsel has referred to schedules that were set up some time ago, and sometimes, as Applicant knows about his own plant, the schedules can't always be carried out. There is no criticism about it. It is sort of a fact of life that all parties to the proceedings should keep in mind.

The Board does not feel that the Staff is derelict in its duty at all respecting the environmental statement as indicated by Applicant's counsel.

MR. KARMAN: Mr. Chairman, the only things I have to say is, certainly the Board is aware, as all the parties of the Staff have been prepared, to carry out the schedule with respect to the radiological hearings. We have had all our witnesses present. As a matter of fact, just fortuitously, our ECCS witness remained overnight because we were under the impression that there would be no ECCS questions today and received no official notification to the contrary.

CHAIRMAN JENSCH: You were intended to have notice from Applicant's counsel whom the Chairman of the Board requested Applicant's ECCS witness Moore be here, and also requested that word be sent to you to request Mr. Novak to be here.

MR. TROSTEN: I requested that word be conveyed to Mr. Novak or to you, Mr. Karman, that Mr. Jensch had requested that Mr. Novak be present for cross-examination.

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MR. KARMAN: I didn't learn about it until late yesterday evening. But be that as it may, Mr. Novak is here. With respect to the environmental statement, the only comment I can make at this time is that it is not ready and I cannot give any date on which the environmental statement will be prepared.

CHAIRMAN JENSCH: The Board is mindful of the fact that the Staff witness in the Compliance Section, the Witness Madsen has estimated three months from the date of his statement before the plant would be ready to proceed with the further steps contemplated by the Applicant. It is understood that the Applicant disagrees with that estimate but until there are some more convincing showings about it, the Board will be inclined to be kept informed of the matter from the Staff's Compliance Section.

Are you ready to proceed?

MR. TROSTEN: Mr. Chairman, I don't want to belabor the points we were discussing, but the statement I made addresses itself to several of the matters which the Chairman raised. But there are several points I feel I should comment on.

First, with regard to my conversations with Mr. Roisman yesterday, this really had nothing to do with the delay in the hearing, Mr. Chairman. All I did was to receive a message from Mr. Roisman indicating that he would not be ready until Friday and pursuant to the Chairman's direction, contact Mr. Roisman in an effort to try to expedite his presentation of cross-examination. Mr. Roisman informed me he would not be available, notwithstanding my strong urging to him to have his cross-examination before Friday.

With regard to our presentation of evidence yesterday, we were prepared with ECCS matters rather than the pressure vessel matters because of my understanding of the instructions which were received from the Chairman at the close of Friday's session.

With regard to the matter of the facility being ready for operation in light of the matter of the fire, Mr. Chairman, it is Applicant's position, sir, that the fact that there may be repairs required with the fact that there may be some time involved in doing this is no reason why the schedule for the hearing has to be delayed or any reason why the hearing record has to be held open with regard to matters that are not directly related to that point. Mr. Cahill has testified in response to examination by Mr. Roisman as to what his belief is as to the effect of the fire on the schedule and that is the Applicant's stated position, notwithstanding what Mr. Madsen may have said.

Finally, with regard to the matter of the fuel loading and the amount of time that it took for the fuel loading to be completed, I believe the record speaks for itself, Mr.

Chairman. You have referred to that on one or two occasions during the last day or two. I do not believe that that instance which has no relationship to this fire situation, sir, that I can see needs to be considered as any basis for a delay in the hearing schedule and as I say, I don't really feel that it's relevant to the consideration of the matter of the hearing schedule at the present time.

CHAIRMAN JENSCH: Very well. I think that you are under some misconception of the discussion. There is not any delay in the hearing. We are proceeding as expeditiously as the parties are ready to proceed and that set schedule will be subject to adjustment as the parties' accommodations need to be considered. As I understand the Environmental Defense Fund position, the matter of further cross-examination by the Environmental Defense Fund is guided considerably by the availability of the technical assistance received by the Environmental Defense Fund. We can proceed with other matters and we were ready to proceed with other matters yesterday.

But the Environmental Defense Fund was not here and that necessarily meant that we would shift to the next presentation, if the evidence were available. We were ready to meet last night but your witnesses were scheduled to arrive. But we understood you had some preparations to undertake with them them before you were ready to proceed and we understand you have now completed that.

Let us proceed to the interrogation of your panel on the pressure vessel matters.

MR. TROSTEN: Yes, Mr. Chairman. My intention this morning, Mr. Chairman, is to refer to the transcript on which Mr. Briggs asked several questions on November 8 and to ask members of the pressure vessel panel to respond to the questions asked by Mr. Briggs.

First, on page 2914, lines 12 through 18, Mr. Briggs asked a question concerning the scope of ultrasonic coverage of the Indian Point 2 pressure vessel. Mr. Dressel, will you please respond to Mr. Briggs' question?

MR. DRESSEL: Yes. The scope of ultrasonic coverage on the Indian Point 2 vessel was not done as specified on a grid pattern normally associated with the code. The search unit for the instrument is about one and one-eighth inch in diameter. Total compliance would normally require that this be done over nine-inch grade patterns. In the case of the Indian Point vessel, the Westinghouse requirements were such that the search unit literally overlapped on each scan tap. Therefore, 100 per cent of the surface area of the plates were inspected, which is considerably greater than the nine-inch grid pattern referred to it.

MR. TROSTEN: Also on page 2914, beginning on line 19, Mr. Briggs inquired about flaws in the vessel and in service inspection. I ask Mr. Grob and Mr. Dressel to respond to the question.

MR. DRESSEL: In the service inspection, the post hydromapping of the Indian Point reactor vessel ultrasonic test mapping was reviewed both longitudinal wave inspection and shear wave inspection was done, as discussed in previous testimony. The results are that in the shell sections, there were 15 randomly disposed indications shown by the longitudinal method of inspection. The largest of these were a lamina type indication measured about one inch in diameter. All of the other indications were less than this. The other technique of testing used was the shear mode. Of these there were three indications that showed that were less than the accepted or the standard utilized for the test and the standard utilized for this test was a notch three hundred thousandths deep by one inch long. The three indications were all less than this magnitude.

CHAIRMAN JENSCH: Excuse me. May I interrupt. You used the term "indications" for both your longitudinal and vertical inspections and also the shear mode. What do you mean by "inspections," indications, flaws?

MR. DRESSEL: There were indications that there were reflections back from a lamina type inclusion. I guess I cannot define "flaw." There were, apparently, a nonmetallic inclusion within the plate material. Flaws we normally define as something unacceptable. These are acceptable.

CHAIRMAN JENSCH: Acceptable according to the code?

MR. DRESSEL: Acceptable much -- oh, yes, definitely.

CHAIRMAN JENSCH: Thank you. Proceed.

MR. DRESSEL: That is the extent of the indications that were mapped as a result of the post hydroinspection.

MR. BRIGGS: Just a moment. There were on the post hydro inspection. The amount of vessel that was examined in the post hydro inspection was only a small fraction of the vessel. Is that right?

MR. DRESSEL: It was essentially the shell sections in the nozzle areas from the core support blocks up to the top of the vessel.

MR. BRIGGS: And this was in the area of the wells, only?

MR. DRESSEL: No, sir. This was the entire surface on the inside of the vessel.

MR. BRIGGS: From the inspection that was conducted before the hydro test, was the number of flaws essentially the same as you indicate here?

MR. DRESSEL: Well, no. The inspections that were performed prior to the hydrostatic tests were performed essentially the same way, 100 per cent coverage, both methods of inspection. There were indications in the plate meeting the accepted standards of the code.

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There were no indications that fell outside of that range. However, a great deal of these indications were removed during fabrication, removing plate edges and cutting penetrations or nozzles, and so forth. So it is difficult to correlate the indications prior to fabrication and after fabrication.

MR. BRIGGS: All right. Then the vessel, as it was completed but before the hydro testing was not inspected ultrasonically, plates and sections of the vessel were inspected ultrasonically during fabrication?

MR. DRESSEL: That's correct. All plates, all notches, all sections of the vessel.

MR. BRIGGS: And then, after the ultrasonic tests, there was a complete ultrasonic inspection of the vessel?

MR. DRESSEL: Yes.

MR. BRIGGS: You indicated the code required about a nine-inch grid but the method that was used on the Indian Point vessel involved having the probes, I will say, move around the vessel and move up and down the vessel. About how far apart were these scan paths?

MR. DRESSEL: The crystal, the search unit is about an inch and an eighth in diameter and the one path slightly overlapped the other path.

MR. BRIGGS: You mean you made scans on paths that were like one-inch apart?

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MR. DRESSEL: If we have a one-inch crystal that stands in this path, the next path would have been slightly overlapped onto the previously scanned path.

MR. BRIGGS: But you make one scan path and, let's say, the center line is along the vertical center line that is roughly an inch away.

MR. DRESSEL: Yes.

MR. BRIGGS: All right. And this was done after the hydro test and what you indicate here is that--what was the first type of mode that was used in the inspection?

MR. DRESSEL: The first was longitudinal.

MR. BRIGGS: And this mode of inspection determines flaws that are in the plane of the metal?

MR. DRESSEL: Yes, sir. The lamina in nature and parallel with the surface, essentially.

MR. BRIGGS: And you found fifteen indications, the largest one of which was roughly an inch in diameter in this?

MR. DRESSEL: Yes.

MR. BRIGGS: The shear mode, then, is supposed to find flaws that are in the plane of the thickness, I guess I would say, of the material?

MR. DRESSEL: Yes, off parallel to the surface.

MR. BRIGGS: Off parallel to the surface. And only three indications were found, the largest of which was three-thousandths of an inch deep?

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MR. DRESSEL: No, sir. The acceptance standard was three-hundred-thousandths by one inch of the standard on which the instrument was calibrated, of course.

MR. BRIGGS: The acceptance standard was three-hundred-thousandths or three-tenths of an inch?

MR. DRESSEL: Three-tenths of an inch by one inch long notch.

MR. BRIGGS: The acceptance standard was three-tenths of an inch by one inch and there were three indications found that were less than this?

MR. DRESSEL: Less than that.

MR. BRIGGS: Any idea of how much less?

MR. DRESSEL: No. That's difficult to examine. They were probably ten per cent, as near as I can read the results of the scope. They were less than the indication that was shown as a result of the three per cent notch.

MR. BRIGGS: Is there any basis for deciding whether these indications were surface indications or whether they were in the metal?

MR. DRESSEL: They were both. One that was shown in the shell section was as the result of surface. The two that we noted in the nozzle areas were some four inches from the surface.

MR. BRIGGS: Did you get anything from the indications that indicate or suggest whether these were--well, the ones that were in the thickness of the metal, whether these were cracked, or whether there was porosity or anything like that?

MR. DRESSEL: No. The results would indicate that they would be, at indication, there. But not what it would be.

MR. BRIGGS: I don't have any questions right now.

MR. GROB: With regard to Con Ed's in-service inspection plans, these are based on the requirements of Section 11 of the code, which requires inspection of a certain percentage of the welds and to one thickness on each side of the welds.

MR. BRIGGS: Are these indications that had been seen during the post hydro testing in places that will be examined during the in-service inspection?

MR. GROB: Some of them. The ones in the nozzles and in the plate section, there is one of these indications there. It is also in this area required by the code.

MR. BRIGGS: There are three indications found in the shear mode. Are those three indications in places where they will be examined?

MR. GROB: Yes.

MR. BRIGGS: Is the largest indication that was found in the longitudinal mode in a place that will be examined during the in-service inspection?

MR. GROB: No.

MR. BRIGGS: Are there others that were found in the shear mode that will be examined during the in-service inspection and what is their size relative to this largest one?

MR. GROB: Excuse me, do you mean longitudinal? I said the ones in the shear mode were being covered.

MR. BRIGGS: Yes, I'm sorry. You indicated the ones in the shear mode would be examined. The question now is in the longitudinal mode there were fifteen indications found, the largest being one-inch in diameter. I believe you indicated that the one-inch diameter lamina indication would not be looked at in the in-service inspection.

Do you know which one of the fifteen will be examined by the in-service inspection?

MR. GROB: Not offhand. Could I consult for a moment?

CHAIRMAN JENSCH: Yes, certainly.

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MR. GROB: One of the indications in the longitudinal mode, which is roughly half of the one-inch indications referred to previously, will be inspected.

MR. BRIGGS: In considering the likelihood of these indications increasing in size with time, is there any difference in importance of finding the two indications that are found by the longitudinal inspection, the longitudinal mode inspection and the shear mode inspection, is one type or the other type more likely to produce a failure?

MR. GROB: I think I would like to refer this question to Warren Hazleton.

MR. HAZLETON: Yes. The indications furnished by the longitudinal mode are parallel to the surface, and therefore are parallel to the direction of the stress in the pressure vessel, and just are no problem as far as causing failure to the vessel is concerned. So the more important type of indications or flaws that could conceivably lead to failure of the vessel are, of course, those found by the shear mode. These indications that we are seeing were very much smaller than the indications that would be assumed to be completely acceptable and would not be expected to lead to any failure of the vessel.

MR. BRIGGS: Is the number of indications found in the Indian Point 2 vessel, the amount that one would normally expect to find in a vessel of that size, or is it unusually large in number or unusually small in number?

MR. DRESSEL: It is typical of material of that class.

CHAIRMAN JENSCH: I think the question was the number. Is it larger or smaller?

MR. DRESSEL: It is average.

CHAIRMAN JENSCH: Very well. Proceed.

MR. TROSTEN: On page 2915, lines 2 through 12, Mr. Briggs asked about the propagation of flaws in the base metal to the vessel cladding. I would like to ask Mr. Hazleton to comment on this.

MR. HAZLETON: Yes. As I understand it, the question here relates to whether a crack that formed in the vessel is large enough to fail the vessel without causing a leak because the crack might not penetrate the stainless steel cladding.

MR. BRIGGS: That's a good place to start.

MR. HAZLETON: I would like first to emphasize that we do not depend on the detection of leaks to assure integrity of the vessel. Also, that the stresses that occur to the vessel are so low that cracks will not grow to a critical size.

But to answer your specific question, if a similar vessel were to be stressed in a cyclic manner and stress levels that would cause cracks to grow to critical size, the cracks would grow through the cladding. This is because even though the cladding and the base metal are of significantly different over-all properties and types, the crack growth rates of the two materials are about the same. So there is no reason to assume that any crack would not go through the cladding just as well as to the base metal.

MR. TROSTEN: I ask Mr. Von Osinski now to discuss Mr. Briggs' question on page 2915, beginning on line 19, concerning an experimental stress analysis of a reactor vessel during hydrostatic testing.

VON OSINSKI: The report that I referred to in my previous testimony is the proprietary combustion engineer report number CENC 1152. It is entitled, "Experimental Evaluation of Stresses in Ligaments and Flange to Head Junction Region of Closure Head for 173 inches R.D. Reactor Vessel."

I have reviewed this report and conclude that it does not provide a comparison between test and analytical results. However, I would like to mention another proprietary report that was, "Summary Report on Strain Gauge Testing on the NBK Reactor Vessel." It is a proprietary report that was prepared on a reactor vessel somewhat similar but smaller than IPB. This was done on 131-inch tube reactor vessel constructed in France through ASME Code Section 3 requirements. The test results of this report did confirm the analysis.

MR. BRIGGS: Do you have the title of the report, the number of the report?

MR. VON OSINSKI: Yes, I do. The title of the report is, "Summary Report on Strain Gauge Testing on the NBK Reactor Vessel." The report number is DC-5112. This report was prepared by the Crewsot Loire.

MR. BRIGGS: Did I understand you to say that you conclude that the results described in the report confirm the analysis of these stresses?

MR. VON OSINSKI: Yes, sir.

MR. BRIGGS: Is there a description of the analysis of the stresses in that report, also, and does the author of the report arrive at the same conclusion?

MR. VON OSINSKI: The author arrived at the same conclusion that Westinghouse did.

MR. BRIGGS: Proceed.

MR. TROSTEN: Mr. Chairman, I do not have any further answers to comment on at this time. The Staff is going to respond to certain of these questions.

CHAIRMAN JENSCH: Very well. Will the Staff proceed please.

MR. KARMAN: Mr. Chairman, I would like at this time to have an additional Staff witness sworn in, Mr. Raymond Maccary, who has not been sworn in.

(Raymond R. Maccary, sworn.)

CHAIRMAN JENSCH: Will you proceed, please.

MR. KARMAN: Did you prepare a statement of your professional qualifications for this hearing?

MR. MACCARY: Yes, I did.

MR. KARMAN: Do you have any notations or corrections to such statement?

MR. MACCARY: None whatsoever.

MR. KARMAN: Is this statement of your professional qualifications true to the best of your knowledge?

MR. MACCARY: Correct.

MR. KARMAN: Do you adopt it as part of your testimony in this proceeding?

MR. MACCARY: I do.

MR. KARMAN: Mr. Chairman, at this time I offer in evidence the statement of professional qualifications of Mr. Raymond R. Maccary, and request it be incorporated in the transcript as if read. This statement has previously been distributed to the Board and parties.

CHAIRMAN JENSCH: Is there any objection?

MR. TROSTEN: None.

CHAIRMAN JENSCH: Any on the part of the Hudson River Fishermen's Association?

MR. MARTIN: None.

CHAIRMAN JENSCH: The request of Staff counsel is granted, and the statement of professional qualifications may be incorporated in the transcript as if read.

MR. KARMAN: Thank you, Mr. Chairman.

(Document follows.)

RAYMOND R. MACCARY

PROFESSIONAL QUALIFICATIONS

DIVISION OF REACTOR STANDARDS

U. S. ATOMIC ENERGY COMMISSION

Biography and Qualifications

As Assistant Director for Engineering of the Division of Reactor Standards of the Atomic Energy Commission, I have the responsibility of (a) directing the development of safety standards, criteria, and guides for the engineering and design of nuclear power plant components, as they relate to the protection of public health and safety in the operation of licensed reactors, and (b) supervising the review and evaluation activities related to applications as performed by the Mechanical Engineering Branch and the Structural Engineering Branch under my direction.

Acceptance of the appointment with the Atomic Energy Commission early in 1962 followed a period of over 25 years of broad and diversified experiences in the development, engineering design, and project management of complete processing facilities and plants, including nuclear processing facilities required in handling radioactive materials.

As a consulting engineer, I have had the opportunity to render design, engineering, and construction supervision services to the nuclear, chemical, and process industries, including such companies as the Westinghous Electric Corporation, Pittsburgh, Pennsylvania.

In the capacity of director of engineering of the various manufacturing divisions of the H. K. Porter Company of Pittsburgh, Pennsylvania, engaged in the fabrication of pressure vessels, heat exchangers, piping components and pumps and valves intended for the chemical, petroleum, power, and heavy industries, my major responsibilities included the development of fabrication practices, welding procedures, inspection standards and non-destructive testing specifications employed in the manufacturing of pressurized equipment.

During the years 1943 to 1945 my association with the Kellex Corporation of New York, in the position of mechanical project engineer, I was responsible for the development of the major processing equipment for the Oak Ridge gaseous diffusion plant of the Manhattan project. In recognition of my services, I was included in the technical roster of engineers who were recipients of the Manhattan Project Gold Key Award.

Prior to my appointment at Kellex Corporation, I served as mechanical design engineer with the M. W. Kellogg Company of New York where I assumed the duties of design and engineering of a wide range of pressure containing components intended for petroleum refinery plants and petro-chemical facilities. My responsibilities included the performance of stress analyses for pressurized equipment and components, as well as the application of the rules of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code rules, in the designing of equipment covering a broad range of operating temperatures and pressures, and loading conditions.

As a design engineer with the Griscom-Russell Company of New York during the period 1935 to 1940, my duties included engineering design and drafting of detailed fabrication drawings for the manufacture of heat transfer apparatus and high pressure equipment used in power plants, process industries, and maritime and naval applications.

With a continuity of over 25 years experience in the application of the principles of design, fabrication, welding, nondestructive testing, and inspection practices, in accord with ASME Boiler and Pressure Vessel Code Rules, I have been afforded numerous opportunities to evaluate performance reliability, serviceability, and operational safety of many designs of plant equipment and components in fulfillment of their service and safety requirements.

During the past seven years, I have been an active member of the ASME Subcommittee on Nuclear Power and numerous Task Groups which are entrusted with the responsibility of developing the rules of the ASME Boiler and Pressure Vessel Codes - Section III - Nuclear Vessels, Section XI - Inservice Inspection of Nuclear Power Plant Components.

I received a Bachelor of Mechanical Engineering degree from the Cooper Union Institute of Technology of New York in 1940 where I majored in power plant technology. Graduate studies at New York University included courses in Structural Engineering and Design Analysis.

NUCLEAR PRESSURE VESSELS - OPERATIONAL SERVICE, STATISTICS

Reactor	Type	Types of Vessels*	Design Press	Initial Critical	Hours in Operation
SM-1	PWR	1RV, 1P, 1SG	1600	4/08/57	78,000
Shippingport	PWR	1RV, 1P, 4SG	2500	12/02/57	92,464
Dresden 1	BWR	1RV, 1D, 4SG	1250	10/15/59	76,426
Yankee Rowe	PWR	1RV, 1P, 4SG	2500	8/19/60	78,312
PM-2A	PWR	1RV, 1P, 1SG	2000	10/02/60	21,000
NS "Savannah"	PWR	1RV, 1P, 2SG	2000	12/21/61	30,000
Saxton	PWR	1RV, 1P, 1SG	2485	1/13/62	31,362
PM-1	PWR	1RV, 1P, 1SG	1485	2/25/62	27,000
HWCTR	PHWR	1RV, 2SG	1500	3/03/62	9,262
PM-3A	PWR	1RV, 1P, 1SG	1500	3/03/62	60,200
SM-1A	PWR	1RV, 1P, 1SG	1600	3/13/62	63,200
Indian Point	PWR	1RV, 1P, 4SG	1800	8/02/62	54,833
Big Rock Point	BWR	1RV, 1D	1700	9/27/62	53,441
Elk River	BWR	1RV, 2SG	1250	11/19/62	24,296
Humboldt Bay	BWR	1RV	1250	2/16/63	63,150
CVTR	PHWTR	1P, 1SG	1750	3/30/63	19,228
Pathfinder	BWR	1RV	700	3/24/64	3,631
Bonus	BWR	1RV	1150	4/13/64	5,827
"Sturgis"	PWR	1RV, 1P, 1SG	1600	1/25/67	16,671
San Onofre	PWR	1RV, 1P, 3SG	2485	6/14/67	26,704
LaCrosse	BWR	1RV	1400	7/11/67	11,982
Conn. Yankee	PWR	1RV, 1P, 4SG	2485	7/24/67	31,648
Oyster Creek	BWR	1RV	1250	5/03/69	12,582
Nine Mile Pt.	BWR	1RV	1235	9/05/69	9,353
Ginna 1	PWR	1RV, 1P, 2SG	2485	11/09/69	12,137
Dresden 2	BWR	1RV	1250	1/07/70	8,674
Point Beach 1	PWR	1RV, 1P, 2SG	2485	5/10/70	6,975
Robinson 2	PWR	1RV, 1P, 3SG	2485	9/20/70	8,389
Millstone 1	BWR	1RV	1250	10/26/70	5,296
Palisades	PWR	1RV, 1P, 2SG	2485	11/02/70	1,000
Monticello	BWR	1RV	1250	12/10/70	5,487
Dresden 3	BWR	1RV	1250	1/31/71	3,500

Total Plant Operating Time, hrs., 952,030
Total Number of Vessels - 97
Total Vessel Operating Time, hrs., 3,524,078
or approximately 400 vessel-years

*RV - Reactor Vessel
P - Pressurizer
SG - Steam Generator
D - Steam Drum

MR. KARMAN: Mr. Maccary, Mr. Briggs requested some information dealing with a response previously given by the Staff dealing with the number of nuclear pressure vessels and in-service inspection. Do you care to respond to this additional question?

MR. MACCARY: Yes. I would like to principally indicate the bases for the preparation of this chart.

MR. KARMAN: This chart has previously been distributed to the Board and the parties.

CHAIRMAN JENSCH: Do you desire to have this incorporated in the transcript?

MR. KARMAN: I do, Mr. Chairman.

CHAIRMAN JENSCH: Do you have copies sufficient for the reporter and counsel?

MR. KARMAN: We have distributed it to the reporter, Mr. Chairman.

CHAIRMAN JENSCH: Very well. Any objection to the Staff's request?

MR. TROSTEN: No.

MR. MARTIN: No objection.

CHAIRMAN JENSCH: The so-called chart or the one-page statement entitled NUCLEAR PRESSURE VESSELS - OPERATIONAL SERVICE STATISTICS, 10/26/71, may be incorporated within the transcript as if read. Will you proceed, please.

(Document follows.)

MR. MACCARY: Yes, sir. I would like to state that the basis for the pressure tabulation is the summation of the operating service reported to the Atomic Energy Commission for water cooled reactors that have been in-service or have been used to generate power. We have attempted in this tabulation to present those vessels which in effect are subjected to conditions not unlike the pressurized water systems and the boiling water systems that are currently being applied in nuclear power plants.

We have indicated that the bases for our summation is nuclear vessels. The one point I would like to emphasize is that we have included reactor vessels, pressurizers, steam generators. The part I am trying to clear is that all of these vessels are designed and constructed in accordance with the rules of the Code for nuclear vessels. Therefore, each of these vessels is exposed to the same operating conditions as reactor vessels. We consider these not unlike a reactor vessel in quality and in construction.

There was an additional item in the question which related to the degree of superficial volumetric in-service inspection that some of these vessels may have received to date. In reviewing our records, I can state at least four of these plants have been subjected to in-service examinations as generally required by Section XI of the ASME Boiling Water Pressure Vessel Code. Namely, these vessels are the Yankee Rowe, the Humboldt Bay, San Onofre, and Connecticut Yankee. These plants have already received the initial inspections required by the Code in accordance with a program developed to comply with the requirements of the Code.

MR. GEYER: In talking about these parts on the primary system, what is the situation with regard to the piping? Is the piping fabricated and installed in accordance with a code, and, if so, what codes?

MR. MACCARY: The practice at the time -- I am relating this to the Indian Point. --was to build the piping to another code and not the ASME code in view of the fact that there was not in existence at the time an appropriate code covering piping, nuclear piping. But there was an acceptable code which was a piping code, and the components of these plants have been built to these earlier codes.

We might mention that the current edition of the ASME Section 3, Boil and Pressure Vessel Code, incorporates the same standards, the same requirements for piping as normally applied to pressure vessels.

end

C3wt1

DR. GEYER: Do you know the name or number of the code which was followed in Indian Point No. 2?

MR. MACCARY: I do not have that with me. I think perhaps Westinghouse can answer that question.

CHAIRMAN JENSCH: Can Westinghouse give us that data?

MR. WIESEMANN: I'd like to just check with the safety analysis report and we will give you the answer shortly.

DR. GEYER: A further question. Have you made any tabulation with regard to piping difficulties in these plants, if any?

MR. MACCARY: No, we haven't made a tabluation but we are aware of the fact that some plants that encountered difficulties in the piping.

DR. GEYER: Thank you.

MR. MACCARY: I think I might be able to add to my earlier response to your question.

I note that in one of the reports here, the piping was built in accordance with the ANSI, B-311 Code for power piping including the requirements of the nuclear code cases N-7 and N-10.

CHAIRMAN JENSCH: Are code requirements adequate?

MR. MACCARY: In my opinion, yes.

CHAIRMAN JENSCH: The reason I asked, I recall Admiral Rickover, he said the codes are the lowest common denominator that can be agreed upon. Do you agree?

C3Wt2

MR. MACCARY: We have examined the code criteria with respect to the design conservatisms. It is the opinion of the Division of Reactor Standards that the code requirement as presently applied is adequate. We have also recognized that in order to maintain the quality and also to have the assurance that this quality is maintained during service, that reliance must be placed upon in-service examinations in accordance with the ASME, Section 11 code. The AEC has adopted most of these codes as its regulations.

CHAIRMAN JENSCH: Especially with in-service inspection you feel more confident about the quality of it?

MR. MACCARY: We feel that one must not be omitted in order to have the assurance that the initial quality is retained during its service life.

CHAIRMAN JENSCH: Excuse me. Go ahead.

MR. MACCARY: We have, for the information of the Board, participated directly in the development of the in-service requirement for nuclear components.

CHAIRMAN JENSCH: You gave an answer to Dr. Geyer about some problems with piping. Did you just mention a few minutes ago that while the piping has been installed, you have some problem with the piping? Do you have that?

MR. MACCARY: I don't have the details here, but I do recall that the piping has indeed been subjected to some degrees of degradation. These are distinct and separate from

Wt3

the vessel.

CHAIRMAN JENSCH: What was the degradation, leaks?

MR. MACCARY: Leaks in the piping.

CHAIRMAN JENSCH: How large?

MR. MACCARY: Sufficiently to provide means of detection and requiring shutdown for repairs.

CHAIRMAN JENSCH: Large enough to permit detection? I suppose if you have a twenty-a-gallon-a-second flush, you can detect that pretty well. Is that the kind of a leak you are talking about?

MR. MACCARY: I'd like to make a correction. It is to permit detection, not to prevent detection.

CHAIRMAN JENSCH: I say, how large the leak is. If you have twenty gallons a second flushing out of your piping, you can detect that. Is it that kind?

MR. MACCARY: I would respond that the leaks are much smaller than that magnitude. They are generally sufficiently small that it takes a considerable period of time before there is sufficient escape of reactor coolant to permit it.

DR. GEYER: Mr. Maccary, is there any reference that you can give us that reports your experience with piping?

MR. MACCARY: We can if we review our records.

DR. GEYER: It might be helpful to have that information. Thank you.

CHAIRMAN JENSCH: All this in-service inspection of

3Wt4

both the vessel and the piping, in case there is any doubt about the codes for construction and installation of the vessel or the piping, you have the assurance you get from in-service inspection during operation; is that right?

MR. MACCARY: That's correct.

CHAIRMAN JENSCH: And you insist on in-service inspection; is that right?

MR. MACCARY: Yes, we require it.

CHAIRMAN JENSCH: Do we infer from that, you are not too satisfied with the codes for construction and insulation, but you want the in-service inspection to give you the assurance you need?

MR. MACCARY: No. I think I'd like to restate my earlier position, that we feel that the initial quality as o: obtained by the applicant of the current practices and code requirements is indeed satisfactory and acceptable.

But we also like to advise that the components are subjected to a rather wide spectrum of conditions, particularly during transients. It is under these conditions that we feel that it is essential to monitor this initial quality on a timely basis.

end

MR. BRIGGS: Mr. Maccary, is my recollection right that there is a statement in Section 11 of the Code that this code represents the minimum requirement for inspection and that it is not intended to -- and these words aren't quite in the Code. It would not discourage the operator from engaging in further inspection?

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MR. MACCARY: That is correct.

CHAIRMAN JENSCH: Is it also right that in general the codes indicate that they consider these to be minimum requirements, and that there is no discouragement of raising the standards on the part of manufacturers?

MR. MACCARY: Yes, that is correct, also.

MR. BRIGGS: In looking at this list of vessels and the times, it is certainly impressive that the total vessel operating time has been over 3.5 million hours, or approximately 400 vessel years. How should we assign significance to these numbers? In other words, what assurance does this total give us that any one of these vessels would operate for thirty years without failure?

MR. MACCARY: In responding to the Board's question, it was our intent here to indicate principally that we do have some operating experience with nuclear vessels. I must agree that the extent of the statistics perhaps is not of sufficient influence to draw any further conclusions. But we do have some operating experience which allows us to at least draw some confidence in the adequacy of the construction and a design of vessels to serve their intended functions.

MR. BRIGGS: And there is not many of these vessels that have operated over periods of one to, I suppose, five years. Could one conclude, then, that the probability of a nuclear vessel operating for as long as five years without failure is high?

MR. MACCARY: Are you referring to high with respect to similar vessels under similar conditions? I didn't clearly understand your question.

MR. BRIGGS: Many of these vessels have operated for five years or more without failure. Is this a reasonable statistical indication that one can expect vessels designed as these have been and operated as they have been, manufactured as they have been manufactured, would operate for five years without much concern for failure?

MR. MACCARY: My answer would be yes.

MR. BRIGGS: You mentioned that four of these vessels had received inspection. As I understood it, the inspection that is required by Section 11 of the Code, that is. The Yankee Rowe reactor vessel is shown to have operated 78,000 hours. This comes during the end of the ten-year inspection.

Are you acquainted with the in-service inspection that was performed on the Yankee Rowe vessel?

MR. MACCARY: Yes. We do have knowledge of the inspection since it has been reported to the Atomic Energy Commission.

MR. BRIGGS: Is it your understanding that it satisfied all requirements of Section 11 of the Code?

MR. MACCARY: It satisfied the requirements to the extent of the degree of examinations which were conducted in accordance with the requirements of the Code. We recognized that the plants, earlier plants, were not necessarily designed with the intent of providing the degree of accessibility normally applied to current design plants.

Therefore, we are aware that certain areas of these components are not accessible to the examinations required by the Code.

MR. BRIGGS: This was my impression, also. I believe the Southwest Research Institutes' report on the inspection of the Yankee Rowe vessel indicated that the only inspection of the reactor vessel that had taken place was of the flange to vessel weld, and that this was conducted from the surface of the flange. The top head was inspected but, as I believe the report indicated, essentially no volumetric inspection of the bulk of the reactor vessel.

MR. MACCARY: I believe the report you reference is correct. I also have some additional data which I just compiled prior to my leaving the office. I have some indications here that in 1970, twenty were ultrasonically examined at the

Yankee Rowe plant.

MR. BRIGGS: On the reactor vessel or other piping and the vessel?

MR. MACCARY: I do not have the details exactly of that inspection.

MR. BRIGGS: The Shipping Port reactor has been in operation for the longest time. Do you have any idea of inspections that might have been made of that reactor vessel?

MR. MACCARY: No, I do not.

MR. BRIGGS: Has any attempt been made in any of these inspections to follow the progress of known indications of flaws in the vessel that were obtained during manufacturing?

MR. MACCARY: To my knowledge, we have no such information as yet.

MR. BRIGGS: And out of this list of 32, I believe it is, plants with 31 reactor vessels, a large number of steam generators are pressurizers. Is it right that you do not know of any programs that have been undertaken to follow the behavior of flaws in the vessel by in-service inspection?

MR. MACCARY: Other than those which have received some degree of in-service examination, since this initial examination is currently performed in conformance with the procedures of the Code would provide a base line for the subsequent examination results.

CHAIRMAN JENSCH: Is there any program in this regard?

MR. MACCARY: It is our intent to review the results of subsequent examinations and compare them with those that have been performed. This is a function that we, indeed, carry on for all plants.

MR. BRIGGS: But I see many vessels here that have operated for periods of two years to more than ten years and in the Shipping Port vessel, more than ten years where there seems to be noinformation at all on what the status of the vessel is, whether they have flaws that have grown in them or just what the situation is. Some of them seem to have been in vessels that may no longer be in operation, reactors that are no longer in operation. Has any attempt been made to do tests on those vessels that will no longer be used in order to find out how they survive their life as reactor vessels?

MR. MACCARY: I can cite one example. I have some data available -- and that is the PM-2A. This vessel was retired from service and was subjected to extensive testing in order to evaluate not only the structural integrity and the conditions but also the influence and effects of irradiation of brittlement.

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MR. BRIGGS: Are the results of that study reported?

MR. MACCARY: Yes, they are.

MR. BRIGGS: Could you cite the report number, please.

MR. MACCARY: WAPD-TM-640.

MR. BRIGGS: While we are talking about inspection, the Board has expressed concern about the words that were used in the technical specifications concerning the inspection of the Indian Point 2 reactor. The words, at least one interpretation of the words being that the inspections of the reactor vessel will be carried out provided somebody develops the equipment to do it. We have received assurances from the Applicant and the Staff that work is going on towards development of the inspection equipment and as I understand it, that the inspection of Indian Point 2 reactor vessel will be made to conform to the Code. In most cases -- let's put it in some cases the Code permits the inspection to be made at the end of the inspection period, which is ten years , but there are two or three places in the technical specification and these are, I believe, code requirements where some of the inspection will be done at the end of about three years of operation. The Staff says it will review the inspection program at the end of five years.

Are we to have complete assurance that the inspections that are proposed for the end of three years will actually be done and will be done thoroughly?

MR. MACCARY: This is a requirement of the Division of Reactor Standards technical specification and we, indeed, understand that to be the case, that we will have a report of the initial examinations that will be completed at the three and a third year interval, which will provide a basis for the development of the remaining program for the inspection interval.

MR. BRIGGS: And the words that these inspections are predicated on the development of equipment, this just means to Staff that equipment is going to have to be developed in order to do these inspections, that the equipment will be developed and the inspections will be performed or that the Indian Point 2 plant will have problems with the Staff. Is that right?

DGm4

MR. MACCARY: That is correct.

CHAIRMAN JENSCH: Let me just ask Mr. Maccary a further question. You have been here and heard Mr. Dressel, is that correct, testify about some three indications or flaws that they found. In line with the inquiry from Mr. Briggs, will you develop some sort of a procedure to see what happens to those three indications or flaws as time goes on, if this plant is operated?

MR. MACCARY: Yes. The practice that the Division of Reactor Standards has currently adopted is to compile what we refer to as the base line examinations and these will be the basis upon which we will evaluate the results of subsequent examinations.

CHAIRMAN JENSCH: Maybe my terms aren't correct, but will you go over to that vessel and mark it with a red X or tie a string to it where the flaws are and follow it every time someone makes an inspection of it from then on?

end

MR. MACCARY: Yes, we will do it to this extent. We were advised of the locations of the flaws in the vessel. We will evaluate the significance of these flaws as they affect safety. We will request that where these are examined that they be reported to the extent to which they appear to have been subjected to changes in their indications. We will again require an evaluation at that time and the basis, of course, is to provide a comparison and to detect if there are any changes occurring during that interval between inspections.

CHAIRMAN JENSCH: On this tabulation of nuclear pressure vessels operation service statistics, do you have any ready statistics on what percentage of time these plants were in operation and what percentage of time they were out of operation? Maybe I can calculate it, but --

MR. MACCARY: No, I don't think this chart will provide that information. We principally sum the actual operating hours in order to get the service experience rather than the age of the vessel.

CHAIRMAN JENSCH: Yes, I understand. But I was wondering some of these indicate, offhand, less than 50 per cent of the time were these plants in operation. Is that approximately correctly?

MR. MACCARY: There may be some. It could be as high as that. We have not compiled that information.

CHAIRMAN JENSCH: And most of them are lower than

50 per cent. Is that correct?

MR. MACCARY: I really do not have that information.

CHAIRMAN JENSCH: That can be calculated, I guess, 8,000 hours a year, 8800 hours a year.

Just one further item. The Staff counsel, Dr. Geyer, asked for a report on pipe failure records. At your convenience, will you be able to supply that record to the Board?

MR. KARMAN: I made a note of that, Mr. Chairman.

CHAIRMAN JENSCH: Very well.

Let me ask Mr. Dressel just a question, if I may.

You heard the inquiry by Mr. Briggs about the code, did you? And that codes aren't intended to discourage improvement over the standards set by the codes, for instance, as to flaws or metallic quality. Did you hear those?

MR. DRESSEL: Yes, sir.

CHAIRMAN JENSCH: What has Westinghouse done over and above the standards of the codes to reflect better quality than the codes would provide?

MR. DRESSEL: In the instance of the ultrasonic inspection, a much greater degree of flow of coverage was provided on the materials than it was required by the code. A 100 per cent of the materials were investigated ultrasonically.

In addition to this, we know that the indications that are present in the material are well below code acceptance standards. We know this.

CHAIRMAN JENSCH: What does the code permit as to ultrasonic testing? What percentage of vessel need be covered?

MR. DRESSEL: At that particular time, I think that the 9-inch grid pattern was used, which meant -- I can't give you a percentage of the area that it would involve, but conservatively, it was somewhat less than 100 per cent of the volume to be inspected.

CHAIRMAN JENSCH: And you weren't satisfied with that limited coverage as provided by the code and you did more. Is that correct?

MR. DRESSEL: The designing engineering group wasn't satisfied with it. That's correct.

CHAIRMAN JENSCH: Were there any other instances where you weren't satisfied with the code and did more in the construction of the pressure vessel? Do you know?

MR. DRESSEL: Yes. I think our engineering staff should be asked to respond to this. There are other areas that I know of, right. For example, the ultrasonic inspection of clad. The cladding of this vessel was tested for bond to the base material which was not at that time a total bond.

CHAIRMAN JENSCH: Maybe I am not having an understanding of the vessel and so forth, but I wonder if you could tell me something about what, while there is a different type of reactor involved, maybe the kind of construction is the same, but what has Westinghouse done to make the pressure vessel for

Indian Point 2 better than those discovered down at Oyster Creek?

MR. WIESEMANN: I think the Oyster Creek problem was one which involved a feature in the vessel which we do not have in the design of our vessels. So it's a little difficult to answer your question in that respect. We have addressed this general question, however, Mr. Jensch, in several ways, and one of the reasons why I had asked for some time to look up the code reference was not that I did not know the reference to the piping code, for example, but I wanted to find out, in the safety analysis report we had identified, what we had required because we did require additional things to be done not only on the vessel but also on the piping. As a matter of fact, in the FSAR in Chapter 4, Section 4.5, which starts on page 4.5-1, there is a description of the reactor coolant system injection and in that section there are the areas, the principal areas of difference are listed. It also, in answer to a question, I believe it was asked by Dr. Briggs, way back in, let's see, I have a transcript reference, the question was asked in transcript 682, we gave a list of the quality assurance requirements beyond the code requirements which were based on the differences from the 1965 edition of the code which was applicable to the Indian Point vessel and they are fairly specific.

Also, in answer, in response to a question by the

Staff which was Question 4.5-1, which is included in one of the amendments to the safety analysis report, there is a discussion of how the initial requirements imposed upon the design and fabrication of the reactor coolant piping brought the basic standard to be 31.1 code, that Mr. Karman referred to, to essentially the standard that is included in D-31-7, Class 1, code for nuclear piping which, I believe, is essentially the piping code which is now incorporated in the ASME mechanical components code, which Mr. Maccary was referring to as being essentially consistent with the requirements for reactor vessels.

D3Rt1

And to go beyond that, there is quite a bit of detail given in these references that I have given you and if you have some questions, after you have had a chance to look at these I think we would be happy to address those.

CHAIRMAN JENSCH: Thank you. I think it is well to note wherein the manufacturer, the constructor, has done more than the code has required; but at the same time I hope that we don't get too many answers, "Well, these were all done according to the code" because I think we are finding many, many times that even the constructors believe they should go beyond the code and I would infer that the codes are inadequate because even the manufacturing went beyond it.

Will you proceed.

MR. TROSTEN: I might note for the record, Mr. Chairman, that the answer to the Board's question to which Mr. Wiesemann was referring, which is a question asked on March 24, 1971, was introduced into evidence at transcript page 887.

CHAIRMAN JENSCH: Thank you. Will you proceed, please.

MR. KARMAN: We are ready, Mr. Chairman.

Mr. Maccary, would you please respond to the Board's inquiry with respect to a discussion on burst stresses and pressures?

MR. MCCARY: In presenting the burst pressures, with respect to the Indian Point 2 reactor vessel, we must state that our calculations were based on the use of the minimum

D3Rt2

specification properties of the materials. These minimum properties, of course, are defined and specified in the applicable instruction code. We also note that in practice, and this is indeed the case with the Indian Point 2 vessel, the actual strength properties of the materials used in the construction of the vessel average slightly higher than the minimum specification values. When we compared our calculations for the burst pressures and made an appropriate adjustment for the actual values of the strength properties, we arrived at pretty much the same values as specified by Westinghouse.

In other words, we find that by adjusting the properties, roughly, on an average of five to ten per cent, we raised the burst pressure from our specified 7,455 to approximately 8,000.

CHAIRMAN JENSCH: Will you proceed.

MR. KARMAN: Mr. Maccary, the Board asked a question with respect to the ductile conditions under which the reactor vessel will be operated and the temperatures of the vessel material. Could you please refer to that?

MR. MACCARY: In our review of the operating conditions under which the Indian Point 2 reactor vessel would be subjected, we, of course, recognized that the reactor vessel, particularly, the temperatures approached those conditions which may be within the proximity of the Battelle regime of

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the material properties.

However, as we have indicated in our report, we have applied the AEC fracture toughness requirements to the Indian Point reactor vessel in which we have assured ourselves that the operations in this regime will have sufficient margain above the brittles properties and in arriving at a minimum operating pressure, we have defined the lowest pressurization temperature which can be applied when the vessel is subjected to pressurization, to full pressurization for operation.

To give you an indication of the margin that we have from the Battelle regime to what we believe is the ductile behavior regime, I will cite two figures. One, the maximum nil ductility transition temperature of any of the materials in the reactor vessel is 20 degrees Fahrenheit. In order to permit operation by pressurization, we will require that the melt temperature be 200 degrees here. This provides a safety margin from an operational standpoint.

In addition, the Board has requested discussion on the causes of nil ductility temperature in steel, the nil ductility temperature in steel and why does radiation cause this temperature to change. We can only respond to this question in a very general way. We recognize that from the safety standpoint, the AEC is principally interested in understanding the actual properties that the materials may have during their operating periods.

With respect to the question of nil ductility transitions in steeel, this, of course, is a characteristic property not unlike other physical properties of materials. We have not explored the fundamental bases and the reasons for such properties, but we have principally addressed ourselves to the fact that we know the actual measured properties of these materials in the Battelle condition and it is with this knowledge that we endeavor to assign margins for operations above this regime.

There is further discussion required on why does radiation cause this temperature to change. We can only state that Battelle non ductile behavior occurs gradually, which changes the temperature from a cleavage fracture along crystallographic boundaries to ductile rupture which lasted the formation. A discussion of the theories is beyond our level of competence. We have reviewed these in the literature. These are, indeed, much more complex fields than it was necessary for the AEC to review.

We restrict ourselves principally to understanding that we have margins of safety above the measured properties of the materials.

end

There is one additional question for which we can provide some response and that is to indicate with what certainty we know that the change found in the surveillance specimens will be duplicated in the thick wall of the reactor vessel. We recognize that all reactor vessels are required by the AEC to have a material surveillance program. As part of this program, materials that are directly obtained from the reactors that are introduced in the form of test specimens in a reactor vessel at locations within capsules to provide an acceleration of the effects of irradiation. The capsules, in each instance, are located closer to the core region of the reactor vessel in the vessel wall. When the capsules are withdrawn periodically, and the tests are conducted to measure the changes in the fracture toughness properties, we then have a condition of what the reactor vessel wall may experience much later in service life. And this gives us the assurance that if we discern considerable changes in the test specimens, that we can, indeed, correct and adjust the operating limitations to provide adequate ductility and toughness for the continuance of the operation of the reactor vessel.

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CHAIRMAN JENSCH: Those specimens aren't subjected to any stress, are they?

MR. MACCARY: No, they are not.

CHAIRMAN JENSCH: Does that give you a fair test?

MR. MACCARY: Yes. To review this very question, and we have found that stress radiation has no greater effect on steel inbrittlement than radiation alone.

MR. BRIGGS: Has the AEC reviewed these questions thoroughly and provided a report that describes the basis for the considerations that they use in deciding that the mode of vessel operation is a safe one? In other words, is there a report that the AEC has prepared that describes this?

MR. MACCARY: Only our Staff evaluation, which has been submitted to the Division of Reactor Licensing and to the Environment Committee on Reactor Safeguards.

MR. BRIGGS: This is in the Staff safety analysis at this point?

MR. MACCARY: Safety analysis.

MR. BRIGGS: But this in no way tells what experiments had been run and how thoroughly the information of the materials typical of those used in the Indian Point 2 vessel are known. Is that correct?

MR. MACCARY: We have not prepared a report addressing this general problem area. We have reviewed extensively all the available literature that is made available to us in our development of our AEC criteria.

MR. BRIGGS: Is there much information available on the difference in effects thatmight be observed on heavy sections as opposed to small sections that are normally used in the test?

MR. MACCARY: Yes. We have reviewed a considerable number of reports addressing this very question. We are also following very closely the AEC efforts with respect to the heavy section steel technology program, which addresses many of these questions and we continue to pursue the development in this area.

MR. BRIGGS: Are there differences between the results that one obtains with heavy specimens and with small specimens with respect to the effects of radiation on the --

MR. MACCARY: Yes, there are.

MR. BRIGGS: What kinds of differences are they and what direction do they go?

MR. MACCARY: One principal difference that is of immediate interest is, of course, that as the section thickness is increased in size, the degree of inbrittlement is indeed related to the cross sectional area. A gradient can, indeed, be developed in the wall thickness which relates to the different degrees of inbrittlement. We know, for example, that the inner wall will be much more inbrittle than the outer wall section of the vessel.

MR. BRIGGS: If you were given exposure, is a thick section more brittle or is a thin section more brittle?

MR. MACCARY: A thin section is more brittle.

MR. BRIGGS: And is this because the thin section

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receives a great total dose or is it something that -- in other words, does a thick section receive the same dose as the thin section on one wall and there is a gradient? Is that the effect that you are talking about?

MR. MACCARY: Yes. The effect is extenuation through the wall.

MR. BRIGGS: Is there a particular report that you use as a basis for many of your considerations, not necessarily an AEC Staff report but a particular report that describes the effects?

end

MR. MACCARY: Yes. I think I can cite one report which I have a copy of and which, perhaps, provides a very comprehensive summary of these particular questions and that is a report prepared by the Mayo Research Laboratory, Washington, D.C., titled, "Nutra Irradiation Embrittlement of Reactor Pressure Vessel Steels." It's authored by L. E. Steele and has been published as an atomic energy review, Volume 7, No. 2, as part of a presentation at the International Atomic Energy Agency in Vienna, 1969.

DR. GEYER: Mr. Maccary, you say that the standards set by the AEC requires that the vessel not be closer than 200 degrees of its nil ductility temperature. Under normal operating conditions, how close is it to nil ductility temperature?

MACCARY: 530, based on operating temperature of 50 degrees.

DR. GEYER: When does it approach the 200 level, under what conditions?

MR. MACCARY: We find a limitation that the approach to the 200 must be reached when the pressure within the system is 25 per cent of the designed pressure.

DR. GEYER: So the pressure on the system is actually very much lower than design pressure when it approaches its nil ductility to the 200 margin?

MR. MACCARY: That's correct.

DR. GEYER: Thank you, sir.

CHAIRMAN JENSCH: Will you proceed?

MR. KARMAN: Mr. Chairman, at this time I would like Mr. Kniel to respond to the question posed by the Board with respect to a failure of the vessel and consequences of such reaction. Mr. Kniel.

MR. KNIEL: Yes. The consequences of the failure of the pressure vessel from the standpoint of the release of reactor coolant at the pressure and temperature of the operating conditions have been discussed and our responses to similar questions raised by the Board at the hearing session dated March 24, 1971, reported in the transcript at pages 683 to 684, and I will response was dated July 8, 1971. Also, certain questions were raised by the Citizens Committee for the Protection of the Environment, Question A-44; and our response dated January 11, 1971.

In these responses we indicated that protection for the containment against the highly unlikely failure of the reactor vessel by a longitudinal splitting or by various modes of circumferential tracking had been provided by surrounding the reactor vessel and other components of the primary system with concrete shielding. The purpose of that shielding is twofold. First, to provide protection against the jet forces produced by the impingement of the high pressure fluids on the construction of the components inside its containment, and, second, to provide protection against potential missiles which might be generated from constructural failure of components. Our conclusion to these elements is discussed in the safety evaluation dated December 16, 1970, on page 36.

The Staff's position on a core meltdown has been stated in our response to a question raised by the Citizens Committee for the Protection of the Environment, the question I-2 response dated May 12, 1971. In this response, we stated that core meltdown must be shown to be of such low likelihood that specific safeguards to cope with this condition are not required. We would not recommend licensing a man if we thought melting of substantial or all of the core could occur. We recognize the desirability of having a basic understanding of the potential core meltdown accident.

However, we conclude that the best assurance of public safety is to prevent core meltdown from taking place. We have not identified a specific mechanistic model which would describe the likely consequences of the complete core meltdown and we do not conduct our evaluation on this basis.

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MR. KNIEL: The most recent Commission's study on core meltdown was conducted at the Battelle Columbus Laboratories. A final report on this study was published in July 1971 as BMI 1910 entitled, "An Evaluation of the Applicability of Existing Data to the Analytical Description of a Nuclear Reactor Accident, Core Meltdown Evaluation."

MR. BRIGGS: The Board understands the staff of the Applicant and I suppose the ACRS considered that a core meltdown is incredible. However, possibly for purposes of discussion I happen to see a news broadcast this morning in which it was reported that the Maginot Line was up for sale and one piece of it had been purchased. It was pointed out that this Maginot Line was built at the cost of one billion dollars back in the Thirties, and it was intended to prevent the invasion of France by German troops, and that somehow or other it failed because the factor had been overlooked that one could go around it.

When I read the statements concerning the measures that had been provided to protect against the splitting of the reactor vessel longitudinally or circumferentially, somehow I have to ask why has the consideration been so limited? Why has not the fate of the fuel elements been considered, also, if one looks at measures that ought to be provided against the splitting of the reactor vessel? I find no arguments as to why one should consider only the movement of the vessel and the prevention of missiles coming in contact with the containment, and that sort of thing.

So it seems to me that one must ask, if a reactor vessel failure must be considered at all, then what is the fate of the fuel elements following such a failure? Has the Staff looked at all at what would be the state of the core if there were a longitudinal or circumferential rupture of the reactor vessel?

MR. KNIEL: To answer that last part of your question directly, no, we have not, but I would like to comment on the opening part of the question regarding the Maginot Line. I think, however, unfortunately the history of the Maginot Line, we have several Maginot Lines here, or hopefully better than that. Our first front, so to speak, is in proper design of the plant so that it won't. Our second front is in the quality assurance and construction so that the primary system won't fail. Our third front, if you will, is the in-service inspection that is required to maintain that.

Going on down, we have the emergency core cooling system which is designed to accommodate the failure; that despite all the efforts we discussed just now to prevent this failure, and the emergency core cooling system on the basis of the very worst kind of conceivable failure.

So I believe we have certainly a number of defenses other than the single line, which was the undoing in the case you referenced. I think our situation is significantly better.

MR. BRIGGS: That's fine. Should one say that the measures that have been provided against failure of the reactor vessel should be essentially disregarded, they are unnecessary, there was no reason for putting them in?

MR. KNIEL: Well, the ACRS has concluded that these measures are desirable particularly in plants that are in higher population areas. The Staff approach, the historical Staff approach on providing protection to the public has been a concern with maintaining a radiation barrier so that in the event of a release of some type, the radiation is contained.

The principal reason for providing the extra missile shielding around the vessel was to maintain the protection provided by the containment. Even in the event of certain failures that could occur that wouldn't necessarily affect the fuel or the core, certain kinds of missiles that might be released as a result of certain failures. So that it is a step forward of maintaining the integrity of the containment. We feel that the emergency core cooling system does provide adequately for maintaining the core in the event of a primary system failure.

MR. BRIGGS: I guess we are sort of back at the question again. It seems desirable to provide these measures of protection in the event that the reactor vessel should fail. Should I infer from your answer that you believe the emergency core cooling system has a very high probability of cooling the core in the event of a reactor vessel failure?

MR. KNIEL: I think that's correct.

MR. BRIGGS: I took some time to look at the transcript from the construction permit hearings. If I recall correctly, in that transcript there was discussion on the failure of the reactor vessel, and it was indicated that the measures that had been provided would permit the circumferential failure of the reactor vessel below the nozzles, that this then would propel the upper part of the reactor vessel upward a few feet. It would, in my view of the discussion, pretty much destroy the pipes or at least seriously damage the pipes that are connected to the reactor vessel so there is no obvious connection of those pipes to the lower half of the vessel.

Under these circumstances, could one conceive of the emergency core cooling system providing cooling for the core?

MR. KNIEL: I don't think we can provide any assurance that it would provide cooling for the core under those circumstances.

MR. BRIGGS: Is it generally agreed that if the core were not cooled and were to melt down, that over a period of time it is highly likely that the containment vessel would be penetrated by melting down through the bottom of the vessel?

MR. KNIEL: I don't know whether there is any general agreement on that. But I think there is general agreement on the fact that it is extremely difficult to get a mechanistic model involving a core meltdown. Just what the sequence of events would be and what the consequences of those events would be, I think, has been shown to be a difficult problem, especially in terms of providing an answer that could stand against an extensive questioning kind of attacks such as we have seen here in the last few weeks.

CHAIRMAN JENSCH: What is your view as to agreement or not?

MR. KNIEL: What is my view with respect to what?

CHAIRMAN JENSCH: Meltdown in the containment.

MR. KNIEL: My personal feeling is that there is no real way of knowing just what would happen in a core meltdown. I have no strong feelings one way or another. I don't think it is at all clear that you would result in an uncontrolled situation. I don't think it is clear that you wouldn't.

I think the AEC has sponsored some additional work in this area. Conclusions of that work is as reported in the report that I mentioned, the BMI report.

I think that work has demonstrated again the -- that is the report of the Advisory Task Force on power reactor emergency cooling, which was held -- I guess, in '66 or '67; that there were no simple mechanistic models that you can rely on that would really tell you what the sequence of events was and provide you with any kind of real answers and to how much of a problem you have.

MR. BRIGGS: So the conclusion you reach is that there is some possibility that the containment would not be breached, but there is also -- I will put it this way: It may not be your words. There is a high degree of probability that the containment would be breached, is that not a conclusion of the Ergen Task Force and the Battelle report, also, if one reads it?

MR. KNIEL: I don't know if they tried to reach those kinds of conclusions. I think they looked at the overall potential that might exist. I think in terms of the potential, there is certainly a significant potential that the containment would be breached. But how you relate that to probabilities, I think, is a difficult question to answer because of the lack of really being able to come up with any mechanistic model where you would have any confidence in it.

MR. BRIGGS: That may be a better way of putting it. There is a high potential for the containment to be breached if there is a meltdown of the core. So as the AEC's position on the meltdown is what, concerning the core meltdown and concerning the integrity of the reactor vessel?

MR. KNIEL: Our position is that the specific safeguards to cope with this condition are not required.

CHAIRMAN JENSCH: We were considering, this is a convenient time to recess. Do you have anything?

MR. TROSTEN: I want to make a brief statement concerning Mr. Kniel's answer.

CHAIRMAN JENSCH: We will recess in a few minutes. There is no smoking in this room either during the hearing or in the recess. It is a low ceiling and it makes it worse for the lower ceiling.

Will you proceed.

MR. TROSTEN: I think it is worthwhile noting in connection with Mr. Kniel's answer to Mr. Briggs' question, that the subject of core meltdown and vessel failure has been the subject of a number of questions addressed to the Applicant in this proceeding. The Applicant was asked several questions in January and March of this year by the Board which were responded to, and we were also asked a number of questions by the Citizens' Committee for the Protection of the Environment on this general subject, answers to which were provided to the Board. I think it is worthwhile noting that it is Applicant's position that we are not required by the Commission's regulations or by the Commission's consistent regulatory practice, to design against the consequences of reactor vessel failure or core meltdown. I feel that I want to make that observation in connection with the response that Mr. Kniel made.

MR. BRIGGS: Mr. Trosten, is this a little bit like the pressure vessel code and the inspection code, that is a minimum requirement that there is no intent to discourage the Applicant for providing such measures if he wishes?

MR. TROSTEN: Let me put it this way, Mr. Briggs.

CHAIRMAN JENSCH: Try and answer yes or no, if you will, first.

MR. TROSTEN: I don't think it is quite like the

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pressure vessel code situation, I would say, Mr. Chairman. I would say we are dealing in a case here where judgment has been made by the Commission which is reflected in its regulations and its general design criteria, and which is reflected in the consistent practice of the Commission and Advisory Committee on Reactor Safeguards, that as a result of the extremely stringent measures which are required to be applied to the reactor for pressure vessel and the emergency core cooling system, that applicants are not required to design against the consequences of a failure of the reactor pressure vessel or against the consequences of core meltdown.

Mr. Kniel has, it seems to me, adequately described some of the rationale behind this. All I was trying to do, Mr. Briggs, was to describe just exactly what the Applicant's basic position, legal position is, and what Applicant's conceptions of the regulatory requirements of the Atomic Energy Commission in this respect are.

MR. BRIGGS: Certainly.

CHAIRMAN JENSCH: At this time let us recess to reconvene in this room at 11:10.

end

(A short recess is taken.)

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CHAIRMAN JENSCH: Please come to order.

Before we proceed, Applicant's counsel, I believe, yesterday, in a statement in the course of one of our discussions at least, he expected to have some communication from the attorney for the Citizen's Fund, whether there would be any cross-examination.

MR. TROSTEN: Yes, sir.

CHAIRMAN JENSCH: If you do communicate with him, the Board is considering if he does have any cross-examination, that he do it by a series of interrogatories on questions which would be submitted and answers submitted in reference thereto.

Of course, the recross-examination must necessarily be limited to the specifics of the redirect. So that it isn't going over the old grounds considered before.

MR. TROSTEN: We could certainly be agreeable to that, Mr. Chairman. According to Mr. Roisman yesterday, he said he would contact me by noon today with the indication that I would immediately convey this to the Board.

CHAIRMAN JENSCH: Thank you.

Had the Staff completed?

MR. KARMAN: We have completed our responses, Mr. Chairman.

CHAIRMAN JENSCH: Does the Applicant have further responses?

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MR. TROSTEN: No, we do not, Mr. Chairman. Our panel is available to remain here as long as the Board wishes. If the Board has no further questions of our pressure vessel panel, we would like to ask to have them excused.

MR. BRIGGS: I have one additional question here.

I don't know whether this will cause a problem. In a proprietary Class 2 report, WCAP 7673-L, reactor vessels weld cladding base material interaction, there is discussion of an observation that has been made concerning the interface between cladding and the base metal.

In a hearing such as this one, could the Applicant give any discussion of that, and in particular, is there any reason to believe that such a problem could exist in the Indian Point 2 reactor vessel?

MR. TROSTEN: Mr. Von Osinski will respond to your question, Mr. Briggs.

MR. VON OSINSKI: I do not believe that this question would pertain to the Indian Point reactor vessel at all for several reasons.

Number one, this problem occurred and the cause was determined due, number one, to a process of depositing cladding that was different from the process that was used in combustion engineering.

Number two, coupled with the type of clad process was the use of forgings. This vessel was constructed primarily

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of plate. So I don't think the technical mechanism that caused this problem on another vessel at another manufacturer wasn't used on this vessel. So that problem would not occur.

The combustion engineering people, when this problem became apparent, were contacted, as were all of the fabricators, and asked to perform tests to see if in fact this could occur, and combustion did perform tests not on Indian Point, of course, but on this same type of process that they used. They could not develop this type of anomaly.

My conclusion is, without getting into the technical discussion of what caused it, what this report is about--since I'm really not qualified from the metallurgical standpoing to discuss the details of what a conclusion is, that the mechanisms that caused this problem were not available in this vessel.

MR. BRIGGS: Would this condition have been detected in the Indian Point 2 vessel during the ultrasonic inspection of it?

MR. VON OSINSKI: No, sir. This particular condition that you are referring to, I believe, cannot be detected by any known non destructive means. This was found in a vessel initially in Europe where they removed cladding for the subsequent attachment of an additional fixture or an additional appurtenance. That's where the examination came in, after they removed the cladding. You might say a destructive

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examination occurred and they saw this anomaly under clad cracking situation. This was reported to all of the manufacturers who began a number of examinations on their own equipment. The latest I know about it is that the conclusions reached thus far is that the Indian Point reactor vessel is under Engineering Combustion Practices and would not cause this situation.

MR. BRIGGS: This subject doesn't deal with the reactor vessel. We have discussed it before. It has to do a little bit with Mr. Trosten's last statement before the recess.

Earlier in the hearing we asked a good many questions concerning the crucible that was planned for the Indian Point 2 plant. Some of the questions that will be asked will be a repetition of those that have been asked before. I would just like to get answers yes and no, or no, where it is possible, or, I don't know, where it is possible, or that is the answer, but would like to clarify certain things for the Board.

Before asking the questions, I would indicate that some of them are based upon reading of the construction permit hearings transcript. If there is any questions about what the transcript says about the accuracy with which I might quote it, don't hesitate to question it.

First, was it known to the Applicant at the time of the construction permit hearings that the AEC Staff and the ACRS considered the ECCS as proposed for the Indian Point 2 plant at that time to be inadequate?

MR. WIESEMANN: I'm not sure I can answer that question yes or no. I don't believe that the ACRS ever said that emergency core cooling system was inadequate, or the provisions that deal with the loss of coolant accident were inadequate.

In their letter at the construction permit stage, they recommended that we look into the possibility of doing some things to upgrade the emergency core cooling system.

Included in the letter, an instruction to come back to the ACRS and review with them the final design on emergency core cooling system prior to the time that there were other commitments at a time where if it was deemed necessary upon review of the final design, that we would still be able to do that.

MR. BRIGGS: That's related to the second question. Was it clear at the time of the construction permit hearings that the AEC Staff and the ACRS would require the ECCS to be improved sufficiently to prevent core melt-down under all credible circumstances?

MR. WIESEMANN: I believe it was clear that the--

MR. TROSTEN: Mr. Briggs, in view of the nature of your questions asking for events that took place in 1955 and 1956, could you explain to me, Mr. Briggs, the thrust of the questions that you are raising? I'm not quite sure whether or not I should be responding to them or one of the witnesses should. Could you help me on that, please.

MR. BRIGGS: All I am asking for is information really to confirm my understanding of what the situation was at the time as it is recorded in the ACRS letter, in the Staff safety analysis for the construction permit stage. Then the subsequent reasons for removing the crucible. I believe I have here somewhere--I might have to look for it a bit. --statements from the ACRS letter in which it said that the ACRS--and this is not a direct quote. --would require that the flow and/or the pressure delivered in the ECCS system be increased to provide an adequate system. I believe the Staff also indicated in the Staff safety analysis that this would be required, such that there would be no damage to the core in the event of an accident. I haven't indicated no damage, but I think you will find that statement in the Staff safety analysis.

In other words, that a substantial improvement in the ECCS system was going to be required to meet the AEC requirements.

MR. TROSTEN: You are referring to this AEC analysis of the construction permit stage?

MR. BRIGGS: Yes.

MR. TROSTEN: Thank you, Mr. Briggs, for the explanation.

What I should do is go back and ask the reporter to reread Mr. Briggs' question that led me to have this discussion. Would you do that, please.

(The last question referred to was read by the reporter.)

MR. TROSTEN: We are hunting here for a copy of the ACRS letter and also for the appropriate Staff safety evaluation. Perhaps what we ought to do is--

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MR. BRIGGS: Maybe I can ask this series of questions and you can consider them during the luncheon recess. As I go along, maybe I can quote some of the statements that are the basis for these.

First in the ACRS letter, it says that the Indian Point 2 plant is provided with two safety injection systems for flooding the core with borated water in the event of a pipe rupture in the primary system. The emergency core cooling systems are of particular importance in the ACRS and believes that an increase in the flow capacities of the systems is needed. Improvements of other characteristics such as pump discharge pressure may be appropriate.

I don't have the part of the Staff safety analysis but I think you will find the same statement in the Staff safety analysis and their concurrence with the ACRS recommendation.

Also in the Staff safety analysis -- I believe it is on page 69, research and development -- the Item No. 4, research and development is development of the emergency core cooling systems to prevent fuel damage following primary system piping failures. I believe there is a question of what constitutes damage in the sense of safety to the public in the event of such a failure.

The third question is, did the Applicant at any time prior to or during the construction permit hearings indicate that it would propose to remove the crucible from the design when it achieved an ECCS system that was satisfactory to the AEC Staff and the ACRS? In other words, in looking through the transcript, I found no either/or statements or no indication that the installation of the crucible was contingent on -- let's say it was contingent on the Applicant being unable to provide a satisfactory ECCS system.

Then there is a fourth question. Is it correct that at the time of the construction permit hearings, the Applicant was convinced that it could design the crucible on the basis of conservative engineering principles and without the results of a research and development program? I believe the Staff asked the Applicant the question about what the basis would be for the design of the system, whether research and development was required, and that the reply was that no research and development would be required; that the crucible could be designed on the basis of conservative engineering design principles.

Finally, in reviewing the FSAR and the other information that has been provided, I get the following understanding-- if it is wrong, I'd like to be corrected. It appeared to the Applicant that incorporating the accumulators would satisfy the AEC and the ACRS requirement for the emergency core cooling system. The potential problems that arose during the design reviews of the crucible made it highly uncertain whether the crucible could perform its intended function. That is the crucible as it was designed.

3. There would be substantial research and development required to prove the effectiveness of the design as it existed or to provide a satisfactory design.

4. The Applicant decided that the plant, with its improved emergency core cooling system, satisfied all the AEC criteria; that the cost of a research and development program, installation of an effective crucible and the likely delay and completion of the plant were greater than any benefit that might be expected from providing the crucible.

On the basis of these considerations, the determination was made not to provide it. This determination was concurred in by the ACRS and by the AEC staff.

I am interested, and the other members of the Board are interested in the answers to these questions to clarify in our own minds what situation existed at the time of the construction permit hearings and whether these were or were

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not the reasons for finally deleting the crucible from the design.

MR. TROSTEN: Thank you, Mr. Briggs. We will study your questions in detail over the luncheon break and be prepared to respond as soon as the afternoon session resumes.

CHAIRMAN JENSCH: At some time before we take a luncheon break, does the Applicant desire to go forward with the environmental statement that it has submitted on October 15, 1971?

MR. TROSTEN: Yes, we certainly can go forward with the environmental statement. Let me ask you this: Do you have any questions of Messrs. Moore and Roll or do you prefer to go on with the environmental matters?

CHAIRMAN JENSCH: We would prefer to take up the ECCS and radiological matters this afternoon. I thought we would use the time now, because as I understand it, you will have your panel here on your environmental matters. If you intend to follow the practice which I understand you wish, you seek to have it incorporated in the transcript as if read; is that correct?

MR. TROSTEN: Yes. This won't take a minute, Mr. Chairman. May I ask whether the Board has any further questions of our pressure vessel panel?

MR. BRIGGS: No.

CHAIRMAN JENSCH: No, we do not.

MR. TROSTEN: May they be excused?

CHAIRMAN JENSCH: Yes, sir.

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MR. KARMAN: Mr. Maccary as well?

MR. BRIGGS: I don't have any more questions.

CHAIRMAN JENSCH: Yes, we will excuse all witnesses on pressure vessel integrity, including Mr. Maccary and the Westinghouse witnesses.

MR. TROSTEN: Thank you, Mr. Chairman.

CHAIRMAN JENSCH: Does the State of New York have any questions?

MR. MARTIN: No, sir.

MR. TROSTEN: Several of our panel witnesses are out of the room at this moment, Mr. Chairman. We are looking for them right now.

CHAIRMAN JENSCH: We won't take a formal recess, we will just wait for their return.

MR. TROSTEN: Mr. Chairman, since we are not in formal recess, perhaps I could take this opportunity to save time later.

Just to put the matter of our testimony that I am about to offer into perspective, this testimony is being offered in connection with a motion which was submitted on September 24, 1971, for limited operation of license. That motion referred to a motion for 90 per cent of full power operation. Subsequently, on October 19, 1971, the Applicant filed a supplement to this motion which referred to various stages of action by the Board first with respect to a

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20 per cent license and then with respect to a 50 per cent license. Both the motion of September 24 and supplement of October 19 were filed under 10 CFR 50, Appendix D-Section D-2, and 10 CFR 50, Appendix D, Section C.

I might add that the Applicant's motion for a 50 per cent testing license is not opposed by the Environmental Defense Fund or the Hudson River Fishermen's Association, this point being reflected in the stipulation that was filed in this proceeding on November 4, 1971. Neither the EDF or HRFA will cross-examine nor present evidence on matters covered by the motion. I will also add that the motion is not opposed by the Citizens' Committee for the Protection of the Environment except on radiological safety grounds.

CHAIRMAN JENSCH: Excuse me. Did they file a stipulation to that effect?

MR. TROSTEN: Yes, dated November 2nd and filed on November 4th, sir.

CHAIRMAN JENSCH: That is a pretty sizable exception, I take it.

MR. TROSTEN: If I presume to speak for Mr. Roisman who is not here, sir, the point here is simply that the Citizens' Committee for the Protection of the Environment is opposing the issuance of a limited operation license as it is opposing the issuance of a full power license. On the basis of its opposition, the radiological safety considerations and no other considerations.

CHAIRMAN JENSCH: Doesn't that necessarily mean that we will have to go to an initial decision on the radiological safety?

MR. TROSTEN: Yes, it does.

CHAIRMAN JENSCH: And therefore the so-called rule under 50.57(C) is no longer applicable; is that right?

MR. TROSTEN: Yes, I believe that is correct. It means that the Board is obligated to write an initial decision with regard to the motion for the 50 per cent license since the Citizens' Committee for the Protection of the Environment is opposing the issuance of such a license on radiological safety.

CHAIRMAN JENSCH: And even on the 20 per cent?

MR. TROSTEN: Yes, they are opposing the issuance of a limited operation license.

CHAIRMAN JENSCH: Either 20 per cent or 50 per cent?

MR. TROSTEN: Either 20 per cent or 50 per cent, yes.

CHAIRMAN JENSCH: And therefore initial decision be required by the Board, and we will have to have the findings and the transcript references and discussion of everything?

MR. TROSTEN: That is correct.

CHAIRMAN JENSCH: Proceed.

MR. TROSTEN: There is a reference in a section of the stipulation which I don't have before me at this moment which sets forth the schedule for the submission of the findings and conclusions.

CHAIRMAN JENSCH: We will work out a schedule on that. We are not too concerned at the moment of how you folks decide it should be suggested. Thank you very much. Will you proceed.

MR. BRIGGS: Mr. Trosten, just a moment, please. I believe one of the papers that was filed includes the schedule of time that the reactor would spend at various power levels in this testing.

MR. TROSTEN: Yes, that's right.

MR. BRIGGS: Is this intended to represent all the time that would be required to carry out the testing of the system at the various power levels? Does it include some margin of uncertainty? What is the situation with regard to that schedule?

MR. TROSTEN: I would like to ask Mr. Cahill to comment on your question, your question dealing with the schedule that is included. Would the reporter please reread Mr. Briggs' question.

(The last question referred to above was read by the reporter.)

MR. BRIGGS: May I clarify that. I am only concerned about time that the reactor is operating at these various

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power levels, not intervening time or time limits not at power.

MR. CAHILL: You are referring to Figure 1?

MR. BRIGGS: Could you hold it up so I can see?

MR. TROSTEN: Figure 1 on page 16.

MR. BRIGGS: Thank you.

MR. CAHILL: This schedule covers simply the estimated time to perform the operations. That amounts toabout three months. It does not include contingencies with delays or inefficiencies in performing the test. So that the actual time will be somewhat longer than that, that the 90 days is an ideal time.

MR. BRIGGS: Suppose it took you twice as long. Would you still just operate the plant at 20 per cent of power for the time shown in that schedule, or would it be likely that you would operate the plant at 20 per cent power for twice as long as is shown in that schedule? In other words, the point is how much radioactivity do you build up in the fuel elements and that sort of thing? Is it represented by that schedule, or are those times that the various powers are likely to be extended if the total testing time were extended?

MR. CAHILL: This request we are discussing, Mr. Briggs, is for the purpose of the test to accomplish the start of the test programs. So that it is not contemplated that there would be extended operations at these power levels.

MR. BRIGGS: Thank you.

CHAIRMAN JENSCH: Will you proceed, please.

MR. TROSTEN: Mr. Chairman, just as a footnote to my preliminary discussion, I want to add that neither the Citizens' Committee for the Protection of the Environment nor the Applicant contemplate a separate record on radiological safety considerations, but rather that the record on the radiological safety issues which have been developed as of the time that the matter goes to the Board for its consideration would be the record that would be relied upon by the Applicant in support of its motion, and the Citizens' Committee for the Protection of the Environment in opposition. Accordingly, no additional hearing time would be involved.

I now would like to make the offer into evidence of the Applicant's testimony in support of its motion for issuance of a license authorizing limited operation. I refer here specifically to a document by that title, dated October 19, 1971. This constitutes our testimony in support of our motion, and I intend to offer it in evidence now.

end

CHAIRMAN JENSCH: Proceed.

MR. TROSTEN: I would like to identify, first, the panel who will be sponsoring this testimony. They are Mr. Cahill, Mr. Grob, Mr. Harry G. Woodbury, who is Executive Vice-President for Environmental Affairs at Con Edison, Mr. Bertram Schwartz, Vice-President of Con Edison, Dr. John P. Lawler, a consultant of Con Edison of the firm of Quirk, Lawler and Matusky, Engineers, and Dr. Gerald J. Lauer, also a consultant of Con Edison, being of the Institute of Environmental Medicine of New York University Medical Center.

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Mr. Cahill and Mr. Grob have both been sworn previously. I would now like to ask that Mr. Woodbury, Mr. Schwartz, Dr. Lawler and Dr. Lauer be sworn.

CHAIRMAN JENSCH: Will each of those gentlemen please stand and raise their right arms.

(Dr. Lauer sworn.)

(Dr. Lawler sworn.)

(Mr. Schwartz sworn.)

(Mr. Woodbury sworn.)

MR. TROSTEN: Referring now to Mr. Woodbury, Mr. Schwartz, Dr. Lawler and Dr. Lauer, I show each of them a copy of their professional qualifications. I ask each of you, is this statement of your professional qualifications, a copy of which has been distributed to the Board and a copy of which is now being distributed to the other parties in this room, whether this statement of your professional qualifications was prepared by you and is it true and correct statement of your professional qualifications?

DR. LAUER: Yes.

DR. LAWLER: Yes.

MR. SCHWARTZ: Yes.

MR. WOODBURY: Yes.

MR. TROSTEN: I ask you if you wish to have this statement of your professional qualifications introduced in evidence and incorporated in the transcript as if read?

DR. LAUER: I do.

DR. LAWYER: I do.

MR. SCHWARTZ: I do.

MR. WOODBURY: I do.

MR. TROSTEN: Mr. Chairman, I now offer the documents entitled, "Professional Qualifications of Harry G. Woodbury, Bertram Schwartz, John P. Lawler and Gerald J. Lauer, in evidence in this proceeding, and ask that these documents which I have just identified be incorporated in the transcript as if read.

(Documents follow.)

PROFESSIONAL QUALIFICATIONS
GERALD J. LAUER
ASSISTANT DIRECTOR
LABORATORY FOR ENVIRONMENTAL STUDIES

My name is Gerald J. Lauer. I am assistant director of the Laboratory for Environmental Studies of the New York University Medical Center, Institute of Environmental Medicine. Additionally, I hold the position of Research Professor, Department of Environmental Medicine. My business address is 550 Fifth Avenue, New York, New York 10016.

I received a Bachelor of Science degree with a major in biology from Quincy College in 1956. In 1959 a Master of Science degree with a major in zoology was conferred upon me by the University of Washington. In 1963 I received a Ph.D. in limnology also from the University of Washington.

In 1955, I served as a biologist aid to the Illinois Public Health Department. From 1955-56 I was a research assistant at Quincy College assisting in limnological studies on the Mississippi River. From 1956-59, I was research assistant at the University of Washington working on alkaline lake research. In 1959-60 I taught biology and chemistry at Ferguson-Florissent, Missouri High School. In March of 1960, I entered the U. S. Public Health Service from which I resigned my active duty commission (lieutenant commander) in April 1966. During this time I was successively staff biologist on pesticide pollution studies in southeastern states, principal biologist on pesticide pollution studies and Chief of the Training Branch of the Southeast Water Laboratory. From 1966-67 I was an associate professor at Ohio State University and Leader, Ohio Cooperative Fishery Unit of the U. S. Department of the Interior. From 1967-69 I was Associate Curator and Coordinator of the Limnology Department Consulting Program at the Academy of Natural Sciences of Philadelphia.

My research interests include: aquatic ecology; population dynamics; community diversity; physiological, organismal and population level effects of pollutants and other environmental stresses on aquatic life.

I hold membership in the Hudson River Environmental Society, American Association for the Advancement of Science, American Littoral Society, American Fisheries Society, Ecological Society of America, Midwest Benthological Society and New Jersey Water Pollution Control Association. I have also been elected to Sigma Xi.

I have had numerous papers published including works of the effects of power plant operation on Hudson River estuary micro-biota, effects of temperature on aquatic life in the Ohio River and chemical aspects of the New York Bight and estuaries.

PROFESSIONAL QUALIFICATIONS
JOHN P. LAWLER
CONSULTING SANITARY ENGINEER AND PARTNER
QUIRK, LAWLER AND MATUSKY ENGINEERS

My name is John P. Lawler, I am a Consulting Sanitary Engineer and a partner in the Consulting Engineering firm of Quirk, Lawler and Matusky Engineers. My business address is 505 Fifth Avenue, New York, New York.

I received a Bachelor of Civil Engineering degree with a major in Sanitary Engineering from Manhattan College in 1955. I received a Master's degree in Civil Engineering, again with a major in Sanitary Engineering, from New York University in 1958, and I was awarded a Ph.D. degree in Civil Engineering, again with a major in Sanitary Engineering, from the University of Wisconsin in 1960.

From graduation in 1955 to early 1956 I was an Engineer with F. G. Davidson Incorporated, a Consulting Civil Engineer in Rockland County. From 1956 through mid-1958 I was an Instructor in the Civil Engineering Department at Manhattan College. From 1958 through mid-1960 I was a University Research fellow at the University of Wisconsin. From 1960 through 1965 I was an Assistant Professor of Civil Engineering at Rutgers University, New Brunswick, New Jersey. From 1963 through 1967 I was a Visiting Associate Professor of Civil Engineering at Manhattan College in Manhattan's graduate program of Sanitary Engineering. From 1965 to the present I have been a partner in the Civil Engineering firm of Quirk, Lawler and Matusky. All of my teaching and research experience in the colleges and universities mentioned has been in the field of water supply, waste water disposal, and river and estuarine water quality evaluations.

I am a licensed professional engineer in several states including New York, New Jersey, Connecticut, Michigan and Virginia and am a member of the American Academy of Environmental Engineers and the Water Pollution Control Federation.

PROFESSIONAL QUALIFICATIONS
BERTRAM SCHWARTZ
VICE PRESIDENT
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

My name is Bertram Schwartz. My business address is 4 Irving Place, New York, New York 10003.

I graduated from Lafayette College in 1952 with a Bachelor's degree in Administrative Engineering and from Columbia University with a Masters degree in Business Management. I was employed by the United States Atomic Energy Commission (AEC) upon graduation from Columbia and worked for the AEC until 1965 in various aspects of its programs for the production of special nuclear materials. In 1965 I left the AEC and became Assistant to the President of Nuclear Materials and Equipment Corporation (NUMEC), later a subsidiary of Atlantic Richfield Company. At NUMEC my responsibilities included the general management of the business, with particular emphasis on marketing and new product development. When NUMEC became a subsidiary of Atlantic Richfield, I was assigned responsibility for advanced planning.

In 1968 I was employed by the Consolidated Edison Company of New York, Inc. as Special Assistant to the Chairman. In 1969 I was elected Assistant Vice President with responsibility for Purchasing and Fuel. In 1971 I was elected Vice President, System Planning.

PROFESSIONAL QUALIFICATIONS
HARRY G. WOODBURY
EXECUTIVE VICE PRESIDENT
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

My name is Harry G. Woodbury. My business address is 4 Irving Place, New York, New York 10003. I am employed by Consolidated Edison Company of New York as an Executive Vice President with particular responsibility in Environmental Affairs.

I graduated from Rhode Island State College in 1938 with a degree of Bachelor of Science in Electrical Engineering. In 1947 I received a degree of Master of Science in Civil Engineering. I was elected to the following honorary fraternities: Phi Kappa Phi, Tau Beta Pi and Sigma Xi. I am a licensed Professional Engineer in the State of New York and Nebraska.

For 30 years I served as an officer in the U. S. Army Corps of Engineers in grades from 2nd Lt. to Brigadier General. My duties included: Engineer Far East Air Forces 1944-45; Instructor and Department Head, The Engineer School, 1947-50; Engineer U. S. Forces Austria and Italy, responsible for program formulation design and construction of permanent cantonments, communications and defense facilities, 1950-53; Deputy District Engineer for Chicago, Illinois, responsible for design and construction of Nike anti-aircraft defense facilities, river and harbor maintenance and administration of navigation permit program of the Corps of Engineers in Chicago; Assistant Chief of Staff, Logistics, U. S. Force Headquarters Rynkyn Islands (Okinawa, Taiwan), 1957-60; and from 1960-63, District Engineer, Omaha, Nebraska, responsible for water resource planning and development and military design and construction including the underground NORAD Combat Operations Center. From 1964-68, I served as Engineer, Atlantic Pacific Interoceanic Canal Study Commission; Army representative on the National Water Resources Council; member of Vice Presidents Council on the multiple use of the coastal zone; President of the Coastal Engineering Research Board; U. S. member of Permanent International Association of Navigation Congresses; Director of Civil Works, U. S. Army Corps of Engineers.

Upon retirement from the Army I have served at Con Edison in turn as Vice President Construction, Senior Vice President and Executive Vice President responsible for planning, design, construction and operations of generations and transmission and since February 1971 in my present capacity. I am also chairman of the Environmental Task Force of the Northeast Power Coordinating Council (N.P.C.C.).

While serving on military duty I was actively engaged in terrain analysis and land use planning. When on civil duty my experience extended to land and water conservation and development for multiple benefits including fish and wildlife, recreation, public health, navigation, water quality, water supply, flood control and aesthetics. My duties with the Canal Commission included evaluating the environmental costs of constructing an interoceanic canal using either conventional construction methods or nuclear explosives. For three years at Con Edison I have been directly involved in facility planning and development and liaison with other private and public agents having related interests.

CHAIRMAN JENSCH: Is there any objection from the Staff?

MR. KARMAN: No objection.

CHAIRMAN JENSCH: A The State of New York?

MR. MARTIN: No objection.

CHAIRMAN JENSCH: Hudson River Fishermen's Association?

MR. MACBETH: No objection.

CHAIRMAN JENSCH: The Citizens Committee for the Protection of the Environment and the Environmental Defense Fund are not represented here today. The request of Applicant's counsel is granted and the statements of professional qualifications of Messrs. Schwartz, Woodbury, Lawler and Lauer may be incorporated in the transcript as if read.

Proceed.

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

Referring to the document entitled, "Testimony of Applicant in support of its motion for issuance of a license authorizing limited operation," dated October 19, 1971, which consists of sixty-six pages, I ask that the panel of witnesses which I have identified, whether this document was prepared by them or under their supervision and direction?

DR. LAUER: Yes.

DR. LAWLER: Yes.

MR. SCHWARTZ: Yes.

MR. WOODBURY: Yes.

MR. TROSTEN: I would like to ask if there are any corrections to this document. I refer my question to Mr. Woodbury.

MR. WOODBURY: There are.

MR. TROSTEN: Will you please proceed to give these corrections.

MR. WOODBURY: Mr. Chairman, on page 20 of the document I would like to make a correction of an apparent error.

CHAIRMAN JENSCH: Proceed.

MR. WOODBURY: In the left-hand margin under the classes of accident, Class 8, rod ejection accident. In column 4, the number .017 should be deleted and the number of 0.85 should be substituted in lieu thereof.

In column 6, 0.31 should be deleted and 1.55 should be inserted therefor.

In column 8, 0.4 should be deleted and 2.0 should be added in lieu thereof.

On page 23, line 9, there appears a number 18 at the head of the line. That number should be changed to 12.

On page 37, by way of clarification, sir, on line 19, delete the first two words, "Derived from," and substitute therefor, "Evaluated by."

In that same line, next to the last word, delete the word "use" and substitute therefor, "are attained by using."

In line 21 on that same page, delete the first two words, "Contact times."

On page 38, line 22 -- that's four lines, from the bottom. Delete the words, "to be discharged concentration."

On line 23, delete the words, "Be 2.5 minutes." Substitute therefor, "Vary from 9 to 40 minutes depending upon the operating mode."

On page 57, sir, line 4, delete, "8550," and substitute, "8400."

On line 14 on that same page, 57, down thepage, delete, "19.9 per cent," and substitute therefor "22.0. per cent."

CHAIRMAN JENSCH: Excuse me. You mean substantially less than desirable; is that correct.

MR. WOODBURY: That is correct.

On line 20, sir, delete "9.7 per cent." And insert in lieu thereof, "11.6 per cent."

That constitutes all the changes, sir.

F4Wt1

CHAIRMAN JENSCH: May I ask Applicant's counsel, will you correct the copies of this testimony which have been incorporated into the transcript so that all copies within the transcript are corrected as stated by the witness?

MR. TROSTEN: Yes, we will, Mr. Chairman.

CHAIRMAN JENSCH: Very well.

MR. TROSTEN: I ask the panel now whether with the corrections which Mr. Woodbury has offered in his testimony, is the testimony as corrected true and correct to the best of your knowledge?

MR. WOODBURY: It is.

MR. SCHWARTZ: It is.

DR. LAWLER: It is.

DR. LAUER: It is.

MR. TROSTEN: Mr. Chairman, I now ask that the testimony as corrected be received in evidence in this proceeding and incorporated into the transcript as if read.

CHAIRMAN JENSCH: Is there any objection by the Staff?

MR. KARMAN: No objection.

CHAIRMAN JENSCH: State of New York.

MR. MARTIN: No objection.

CHAIRMAN JENSCH: Hudson River Fishermen's Association.

MR. MACBETH: No objection.

FWWt2

CHAIRMAN JENSCH: The Environmental Defense Fund and the Citizen's for the Environmental Protection are not represented here today.

The request of Applicant's counsel is granted on the statement reflecting the testimony of the identified witnesses on environmental matters and consisting of 66 pages will be incorporated within the transcript as if read.

(Documents follow.)

BEFORE THE UNITED STATES

ATOMIC ENERGY COMMISSION

In the Matter of Consolidated Edison Company of New York, Inc. (Indian Point Station, Unit No. 2)	)))))	Docket No. 50-247

Testimony of Applicant in Support of Its Motion for Issuance of a License Authorizing Limited Operation

October 19, 1971

TABLE OF CONTENTS

1.0 Introduction

This testimony is submitted in support of Applicant's motion for the issuance of a license authorizing limited operation of Indian Point Unit No. 2. Applicant has requested that this licensing be accomplished essentially in three stages, permitting operation at up to 20%, 50% and 90% of full power respectively. Accordingly, the environmental effects of the proposed operation and the other subjects covered by this testimony, are discussed both in general and, where appropriate, for each requested power level.

2.0 Scope of Activities

2.1 General

This section describes the scope and expected duration of the testing activities planned for each stage.

Generally speaking, the activities consist of testing and calibrating plant equipment starting with initial criticality in the reactor and progressing at discrete steps to the authorized power level. Figure 1 shows these progressive power levels as a function of the startup testing schedule. As shown on that figure, the schedule envisions approximately 7 days of testing at up to 20% power, 42 additional days at up to 50% of power, and 14 additional days for testing at up to 90% of power. The schedule calls for completion of this portion of the testing program in 9 weeks.

These estimates represent a best circumstance goal. Experience indicates that this portion of the program could take as long as eighteen weeks to complete. As unplanned delays cannot realistically be scheduled in detail, the ideal schedule is used as a goal, but the longer period is anticipated for its actual completion. The information given in Figure 1 also assumes timely receipt of authorization to proceed to each successive power level.

During the testing period, there will be certain potential environmental effects associated with radiological, chemical and thermal discharges, and with operation of the circulating water pumps and entrainment of non-screenable biota, which are discussed in later sections of this testimony. It should be observed that delays from the schedule as presented in Figure 1 will not in general produce a proportionate increase in potential environmental effect, since much of the additional time is typically spent in a shutdown condition analyzing and otherwise taking steps necessary as a result of contingencies.

A detailed description of the testing program under the three phases follows:

2.2 Initial Criticality

Initial criticality is established by withdrawing the shutdown and control banks of RCC (Rod Cluster Control) units from the core, leaving the last-withdrawn control bank inserted far enough to provide effective control when criticality is achieved, and then slowly and continuously diluting the heavily borated reactor coolant until the chain reaction is self-sustaining.

Successive stages of RCC bank withdrawal and of boron concentration reduction are monitored by observing change in neutron count rate as indicated by the regular plant source range nuclear instrumentation as functions of RCC bank position and, subsequently, of primary water addition to the reactor coolant system during dilution.

Primary safety reliance is based on inverse count rate ratio monitoring as an indication of the nearness and rate of approach of criticality of the core during RCC bank withdrawal and during reactor coolant boron dilution. The rate of approach toward criticality is reduced as the reactor approaches extrapolated criticality to ensure that effective control is maintained at all times.

Relevant procedures specify alignment of fluid systems to allow controlled start and stop and adjustment of the rate at which the approach to criticality may proceed, indicate values of core conditions under which criticality is expected and identify chains of responsibility and authority during reactor operations.

2.3 Zero Power Testing

Upon establishment of criticality, a prescribed program of reactor physics measurements is undertaken to verify that the basic static and kinetic characteristics of the core are as expected and that the values of kinetics coefficients assumed in the safeguards analysis are indeed conservative.

Measurements made at zero power and primarily at or near operating temperature and pressure include verification of calculated values of RCC group and unit worths, of isothermal temperature coefficient under various core conditions, of differential boron concentration worth and of critical boron concentrations as function of RCC control group configuration. Preliminary checks on relative power distribution are made in normal and abnormal RCC unit configurations.

Concurrent tests are conducted on the plant instrumentation including the source and intermediate range nuclear channels. RCC unit operation and the behavior of the associated control and indicating circuits are demonstrated.

Detailed procedures specify the sequence of tests and measurements to be conducted and the conditions under which each is to be performed to ensure the relevancy and consistency of the results obtained. These tests will cover a series of prescribed control rod configurations with intervening measurements of differential control rod worths and boron worth during boron dilution or boron injection. As the successive configurations are established, the measurement techniques to be used will be:

1) <u>Dynamic Temperature Coefficient Measurement</u>
   Differential moderator coefficient measurement will be made by continuously increasing or decreasing the moderator average temperature and observing the resultant change in core reactivity.

2) <u>Dynamic Control Rod Worth Measurements</u>
   Control rod differential worth measurements will be made by monotonically withdrawing or inserting selected control rods or groups of rods and part length rods and observing the resultant change in core reactivity.

3) <u>Dynamic Boron Worth Measurements</u>
   Differential boron worth measurements will be made by monotonically increasing or decreasing main coolant boron concentration and observing the resultant change in core reactivity.

2.4 Power Level Escalation

In order to ensure that operation of the core is as expected in all respects, and that achievement of rated power is under carefully controlled conditions, a Power Escalation Test Program will be established to carry the plant from completion of zero power physics testing through full power operation. The Power Escalation Test Program provides for stepwise achievement of full power, with careful review of significant core parameters at each step, to ensure that fuel and control rod mechanical performance, flux distribution, temperature distribution hot channel factors and reactivity control worths are acceptable, before additional escalation is undertaken.

The Power Escalation Test Program provides for measurements to be made at convenient power levels in the vicinity of minimum self sustaining power, discrete levels approaching, and at rated power. In each case, progress to higher levels is contingent upon acceptable core performance.

Preparation for Power Escalation

In order to monitor performance, the following analytical results must be on hand before power escalation is undertaken:

1) Expected values for local power ratios in each of the in-core flux detector thimbles.

2) Expected values for relative power in each fuel assembly and in individual fuel rods of interest in various control group configurations.

3) Expected values of nuclear peaking factors.

4) Combined power and programmed temperature reactivity defect as a function of primary power level at expected boron concentrations.

5) Equilibrium xenon reactivity defect as a function of primary power level.

6) Identification and integral reactivity worth of the most significant single RCC assemblies in the control group, when fully withdrawn, with various operating control rod configurations, for both full and part length rods.

7) Identification and integral reactivity worth of the most significant single RCC assemblies among all groups, for both full and part-length rods.

Other conditions that must be met before commencement of the Power Escalation Test Program are as follows:

1) The following plant conditions are established:

   a. The Zero Power Reactor Physics Test Program has been successfully completed as prescribed.

Experimental values of zero power reactivity parameters have been produced and are available for guidance in the elevated power program.

b. Discrepancies between analytically predicted and experimentally measured values of reactivity parameters have been identified and appropriate revisions have been made in the values of expected primary coolant boron concentrations and RCC group positions listed in the Power Escalation Test Sequence.

c. The Reactor Coolant System and all required components of the Secondary Coolant System are fully assembled, mechanically tested and ready for service as required.

d. All control, protection and safety systems are fully installed; all required pre-operational tests are satisfactorily completed and all components are ready for service as required.

e. The reactor coolant is at required temperature, pressure, lithium and boron concentration.

f. Demineralized water is available in adequate quantity for extensive boron dilution.

g. Concentrated boric acid solution is available in sufficient quantity to permit increases in main coolant boron concentration as required.

h. All special equipment and instrumentation required for the Power Escalation Test Program is installed and calibrated and is available for service as specified.

i. Thermocouple correction constants derived from the hot, isothermal calibrations.

j. Reactor coolant flow coastdown measured and found acceptable.

2) A pre-test check-off list indicating the required status of all systems and auxiliary equipment affecting the power Escalation Test Program is available. The pre-test check-off list shall include, but shall not be limited to, provisions for verification and certification of all items specified in Condition 1, above.

3) Experimental procedures suitable for executing the Power Escalation Test Sequence, are available for distribution to all personnel concerned with the Power Escalation Test Program.

4) The procedure, schedule and personnel assignments and responsibilities are thoroughly discussed with and are understood by the operational and experimental personnel.

The following tests are to be conducted during the power escalation test program:

Electrical Trip Testing

Electrical tripping relays that are initiated by plant on-power malfunctions will be retested and the consequent trip sequence rechecked under operating conditions for correct operation and sequence.

Turbine Trip Testing

The turbine protection system will be checked to confirm that the appropriate initiation will either trip the turbine through the main trip solenoid or will mechanically trip the turbine. As the various setpoints or status conditions are reached, the trip or runback functions will be verified.

Elevated Power Reactivity Coefficient Evaluation

During the approach to full power and during initial operation at power, a sequence of reactor physics measurements will be carried out to experimentally determine power and temperature coefficients and power defects at various power levels, differential (full and part length) control rod worth and boron worths during boron dilutions, and xenon worth during initial operation. Measurements techniques are:

1) Dynamic Differential Power Coefficient

Differential power coefficient measurements are to be made at elevated power over a limited range in power level by initiating a small power level change. The change in core reactivity associated with the compensating control rod motion, is to be related to the net change in power level.

2) Dynamic Power Defect Measurements

The change in reactivity defect associated with a relatively large change in power level is to be measured by adjusting control rod positions during a ramp change in power level to maintain moderator average temperature at the prescribed value and by observing the compensating change in core reactivity due to control rod movement as indicated by the reactivity computer.

3) Dynamic Control Rod Worth Measurements

Control rod differential worth measurements are to be made at elevated power and by initiating a transient change in boron concentration in the coolant by adjusting control rod position during the transient to maintain moderator average temperature and power level essentially constant, and by observing the compensating change in core reactivity due to control rod movement as indicated by the reactivity computer.

4) Dynamic Boron Worth Measurements

Differential boron worth measurements are to be made at elevated power by monotonically increasing or decreasing main coolant boron concentration. Compensation for the reactivity effect or the boron concentration change will be made by withdrawing or inserting, respectively, control rods to maintain moderator average temperature and power level constant and observing the resultant accumulated change in core reactivity corresponding to successive rod motion steps.

5) Dynamic Xenon Transient Worth Measurements

Integral xenon worth transient measurements are to be made at elevated power, after a change in power level, by adjusting control rod position to maintain moderator average temperature and power level constant during the reactivity transient associated with the transient change in effective xenon concentration and observing the resultant accumulated change in core reactivity corresponding to successive compensating rod motion steps.

6) Elevated Power Transient Response Evaluation

As the power level is increased during the initial power escalation, a series of transient response measurements will be made to determine plant response to load changes. The test technique in each case will consist of establishing the transient change in plant conditions and closely monitoring system response during and after the transient period. The responses of system components are measured for 10% loss of load and recovery, loss of load with steam dump, turbine trip, loss of reactor coolant flow and trip of single RCC units, reactor coolant coastdown is also measured.

7) <u>Elevated Power Determination of Power Distribution</u>

At successive power levels and in prescribed control rod configurations (full and part-length), measurements of flux and power distributions within the core will be made and nuclear hot channel factors will be evaluated. Use will be made of the miniature in-core flux detector system, and of the in-core temperature sensors, to determine the nuclear power and thermal and hydraulic conditions within the core. Ex-core nuclear instrumentation will be calibrated to indicate actual in-core axial power distribution.

8) <u>Determination of Primary Coolant Flow Rate</u>

Primary coolant flow rate will be evaluated by measuring primary coolant pump power and elbow tap pressure differential.

9) Verification of Remote Control Stations

After the plant has been certified to operate at elevated power levels, the capability for manually taking the plant to hot shutdown from stations remote from the control room will be verified. This test will demonstrate that controls and information available in the local control stations are functioning properly and are sufficient to permit the operators to trip the plant, control heat removal, and borate in an orderly manner to reach and maintain the reactor in a hot shutdown status should the control room ever become uninhabitable.

Table 1 lists those principal tests planned under the various power level authorizations sought. See Table 13.3-1 of the Final Facility Description and Safety Analysis Report for Indian Point Unit No. 2 for further details on these tests.

TABLE 1

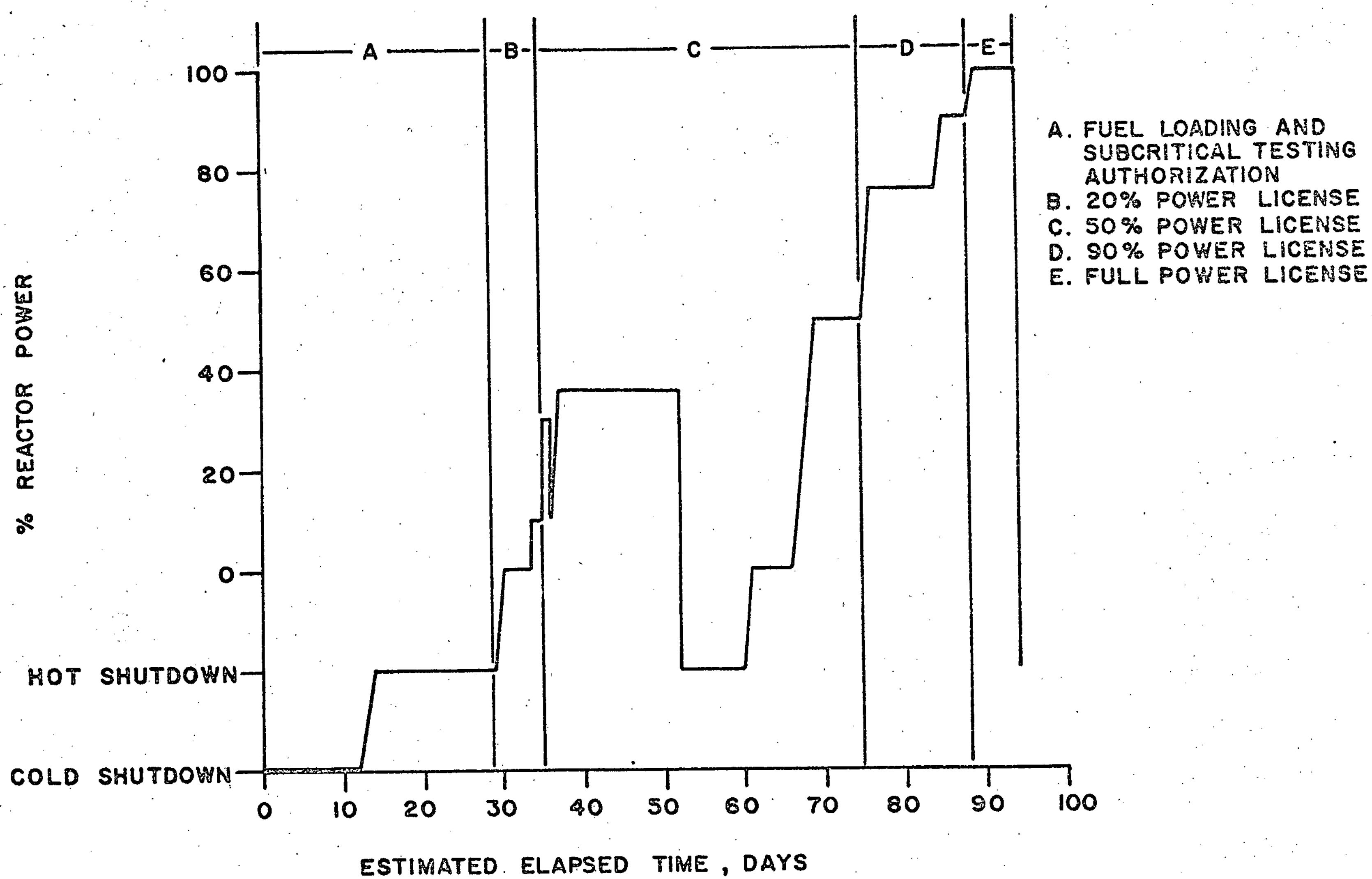
Major Tests at Various Power Levels

Hot Zero Power Up to 20% Power	20% Power to 50% Power	50% Power to 90% Power
1. Thermocouple/ RTD Intercalibration	1. Power coefficient measurement	1. Power coefficient measurement
2. Nuclear Design Check Tests	2. Power range instrumentation calibration	2. Power range instrumentation calibration
3. RCC Control Group Calibration	3. Load swing test	3. Power redistribution follow
4. Power coefficient measurement	4. Plant trip	4. Dynamic RCC drop test
5. Automatic control system checkout	5. Pseudo ejection test	5. Load reduction test
6. Minimum shutdown verification	6. Static RCC drop test	6. P/L group operational maneuvering
7. Pseudo ejection test	7. RCC insertion test	7. Load cycle test
8. Turbo-generator	8. Load cycle test	8. Control valve tests

FIGURE 1

INDIAN POINT NO.2 ESTIMATED STARTUP TESTING SCHEDULE

(WITHOUT CONTINGENCIES)



3.0 Radiological Effects

3.1 General

Radiological effects, both in terms of normal releases and accident potential, are significantly less than would be anticipated for full power continuous operation.

In general, both the normal releases and accident potential are dependent on the quantity of fission products present. Since the fission product inventory is proportional to power level, there is an equilibrium level associated with each power level which is substantially less than that for full power operation. For example, once equilibrium is reached, operation at a power level of 50% would mean at most half the inventory associated with full power operation.

Secondly, the inventory of fission products will be even less due to the short duration of the planned testing activities. Fission products are produced beginning with initial criticality and generally increase as a function of time and power level to an equilibrium value for each isotope. The full power equilibrium values of the fission product inventories, which were used in the analyses in Section 2.3.7 and Supplement 2, Section III of the Environmental Report, will not be achieved until after at least thirty days of continuous full power operation for such significant isotopes as I-131 and Xe-133. In the case of testing activities under each requested power level, the equilibrium values will not even be reached during the respective tests as presently planned.

3.2 Normal Releases

A. Gaseous Releases

Little or no gaseous radioactive releases will be made during the activities planned since the amount of radioactivity in gaseous form produced will be small, and adequate holdup facilities exist to preclude all but extremely small releases at the power levels planned.

B. Liquid Releases

Liquid radioactivity releases will be much less than those previously predicted for full power operation system design. This is to be expected since:

a. Operation is planned for limited duration
b. Operation is planned at less than full power
c. Performance of fuel and equipment is expected to be much better than worst case design estimates.

For both gaseous and liquid radioactive releases, the concentrations released are expected to be much less than those for full power operation, which are themselves small fractions of those allowed by 10CFR20.

Such small releases are of no environmental significance.

3.3 Environmental Effects of Postulated Accidents

The radiological effects of several classes of postulated accidents have been calculated. Supplement 2 to the Environmental Report for Unit No. 2 describes these accidents in considerable detail and shows the environmental consequence of each class of accident when considering continuous full power operation. For less than full power operation, however, and for the expected fission product activities, the inhalation and whole body doses at the site boundary due to these postulated accidents would be somewhat lower. Table 2 shows these doses for each class of accident and for several operating power levels. The doses presented were determined using realistic assumptions, and the maximum fission product inventory expected at each power level. This maximum inventory was based upon the actual time at various power levels envisioned in Figure 1, not equilibrium values at each power level.

TABLE 2

SITE BOUNDARY TWO-HOUR DOSE (MREM)

CLASS	DESCRIPTION	20% Power		50% Power		90% Power		100% Power	
		Inhalation	Whole Body	Inhalation	Whole Body	Inhalation	Whole Body	Inhalation	Whole Body
2	Volume Control Tank Leak	<.01	0.025	<.01	0.33	<.01	0.60	<.01	0.70
3	Waste Gas Decay Tank Leak	<.01	0.029	<.01	0.38	<.01	0.69	<.01	0.80
4	Fuel Clad Defects Alone	0	0	0	0	0	0	0	0
5	Steam Generator Tube Leak	<.01	<.01	<.01	0.012	0.011	0.021	0.013	0.03
6	Fuel Handling Accident Inside Containment	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
7	Fuel Handling Accident Outside Containment	<.01	0.014	0.014	0.19	0.025	0.35	0.03	0.6
8	Loss of Coolant	0.48	<.01	8.45	0.019	15.6	0.035	20.0	0.04
8	Waste Gas Decay Tank Rupture	<.01	0.25	<.01	3.31	<.01	6.05	<.01	7.0
8	Rod Ejection Accident	<.01	<.01	~~0.17~~ 0.85	<.01	~~0.31~~ 1.55	<.01	~~0.4~~ 2.0	<.01
8	Steam Line Break	<.01	<.01	0.013	<.01	0.023	<.01	0.03	<.01
8	Steam Generator Tube Rupture	<.01	0.025	0.021	0.33	0.039	0.60	0.05	0.70

4.0 Thermal Discharges

In general, for operation at levels less than 100% full power, the quantity of heat discharged to the river is proportionately reduced.

Plans currently call for full 6-pump operation at the higher range of the testing power levels and 3-pump operation during the lower power testing phases. Figure 2 is a series of curves predicting the condenser cooling water temperature increase for the various combinations of power level and circulating water pumps in operation which could be expected during the startup testing program. Also included with each curve is the intake flow and velocity across the intake screens.

While the temperature rise (ΔT) across the condenser is proportionately lower by less than full power operation with 6-pump operation, the ΔT associated with 3-pump operation would be twice that. For example, 3-pump operation at 50% of power would result in a ΔT equivalent to full power operation (approximately 15.1°F), but with half the flow. In no event, however, will the pumps be operated in such a manner as to exceed New York State Thermal Criteria. In addition, the thermal discharges from Unit No. 2 are released via the common discharge canal with the releases from Unit No. 1. Since the ΔT for Unit No. 2 during the activities planned will be less than 15.1°F, addition of this water will lower the overall ΔT of the discharge water below predicted two-unit operation. The extent of this reduction will depend primarily on the percent of full power level at which Unit No. 2 is operating.

The following is a brief description of the condenser cooling water system for Unit No. 2, and a discussion of the expected thermal effects of full power operation.

Unit No. 2 has three main condensers each served by two circulating water pumps. Each pump discharges to one of the two inlet waterboxes on the condenser serviced. The condensers are of the straight flow design suited to the large quantity of water circulated and the seasonal and temperature variations (32°F to 78°F) found at Indian Point. Each condenser is located directly underneath the low pressure turbine section which it serves.

The normal mode of operation is to keep the two circulating water pumps serving each condenser in operation while the unit is on the line. However, it is possible to stop one circulating water pump and dewater that half of the condenser for inspection purposes with the turbine generator continuing in operation. There are two de-icing pumps which are isolated from the discharge canal by means of individual slide gates. The de-icing pumps may be put in service individually or in combination to recirculate warm water in the discharge canal back to the intake structure whenever there is a possibility of ice forming at the trash bar screens.

Downstream of the de-icing pump slide gates, a special discharge canal returns the circulating water to the river.

The combined cooling water flow from Indian Point Units 1 and 2 (about 1,157,000 gpm including service water) will be discharged into the Hudson River utilizing the outfall structure designed with the aid of the modeling study discussed later herein.

The actual outfall structure is approximately 270 feet long. Heated water (temperature increase about 14.9°F) will be discharged through twelve (12) ports, 4 feet high by 15 feet wide, spaced 20 feet apart (center to center). The entire structure of ports is submerged to a depth of ~~18~~ 12 feet (center to surface) at mean water. The ports described above will be equipped with adjustable gates such that the discharge velocity through each port will be a minimum of 10 fps for any combination of units in operation and river conditions.

Any discharge to a tidal estuary will be distributed through the estuary. Factors affecting this distribution include tidal amplitude and current, river geometry, salinity distribution, and fresh water discharge. Quirk, Lawler & Matusky Engineers (QLM) and Alden Research Laboratories (Alden) have made extensive studies of the influence of these factors and have assisted Con Edison in the study of the transport of discharges in the river.

QLM conducted Hudson River studies which included the construction of a mathematical model to predict temperature distributions at various tidal and salinity conditions, for the Indian Point thermal effluent. Northeastern

Biologists, Inc. obtained field data used in the development of a mathematical model, performing temperature distribution measurements of the Hudson River in July 1966 and April 1967. Measurements were taken at different tidal cycles while Indian Point Unit No. 1 was in operation.

This resulted in a QLM report "Effect of Indian Point Cooling Water Discharge on Hudson River Temperature Distribution", dated January 1968 (see Appendix J to the Indian Point Unit No. 2 Environmental Report, Supplement).

Mathematical analyses were developed to estimate the expected cross-sectional area-average temperature rise along the longitudinal axis of the river and the departure from this average at any point within the cross-section.

The temperature distribution across the river cross-section was represented by two different mathematical expressions. These are "the exponential decay model" and "the reciprocal decay model". The "exponential decay model" represents temperature as an exponentially decreasing function of river cross-sectional area. The "reciprocal decay model" represents temperature as being approximately inversely proportional to cross-sectional river area.

At the time these models were derived, the New York State thermal criteria then proposed the dividing of the river's cross-section at any point along its length into a mixing zone and a passage zone. The mixing zone allowed dilution of the heated effluent with cooler water. No specific constraints were affixed to this zone except that it should not exceed 50% of the total cross-sectional area. The remaining portion of the cross-section is called the "passage zone", which provided a passageway for migratory fish and other aquatic life. The criteria for this zone included a maximum temperature of 86^{O}F.

The effect of the expected river temperature rise on river dissolved oxygen concentration was evaluated, and was not expected to cause any significant changes in the dissolved oxygen content of the water as it passes through the plant.

In August 1969, criteria governing thermal discharges were adopted effective immediately. The new regulations, discussed later herein, differed from the criteria which had been proposed, and necessitated additional analyses by QLM. In particular, the criteria on water surface temperature required replacement of the planned surface discharge by a submerged outfall. A revised QLM report, dated February 1969, reflected the changed circumstances (see Appendix K to the Indian Point Unit No. 2 Environmental Report Supplement). Texas Instruments, Inc. conducted airborne infrared temperature surveys of the Hudson River in the Indian Point vicinity in October 1967 and April 1968. The surveys were undertaken to collect data for compilation of isothermal maps of the river surface and provide a verification of the mathematical model. The mathematical model was then adjusted to yield the observed values when operating at the Unit No. 1 heat load. The adjusted model showed that the area average temperature rise across the plane of discharge is between 50% and 75% of the values previously predicted. Also, temperature decay above and below the plane of discharge becomes much more rapid, resulting in a substantial reduction of the extent of temperature rises greater than 1°F. (This improved dilution and dispersion was attributed to salinity-induced circulation in the estuary).

Comparison of the values predicted by the unadjusted mathematical model for Unit No. 1 behavior with the field measurements are presented below:

	AREA - AVERAGE TEMPERATURE RISE, °F			
	July 1966		April 1967	
Location	Measured	Predicted	Measured	Predicted
Across Plane of Discharge	0.20	0.25	0.09	0.17
Across Plane 800 Feet Below Discharge	0.14	0.24	0.08	0.17

Results obtained from operation of the Indian Point Hydraulic Model II at the Alden Research Laboratories* were employed to check and confirm the rapid heat dispersion as predicted by the adjusted mathematical model. Summer conditions constitute the critical biological condition, which consist of a sustained drought flow of 4000 cfs and a heat transfer coefficient of 135 BTU/sq.ft/day/°F.

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* A brief description of river modeling techniques is provided in Appendix L to the Indian Point Unit No. 2 Environmental Report Supplement.

Hydraulic model studies conducted by Alden Research Laboratories showed that the 14°F effluent channel temperature rise should be reduced markedly, before reaching the river's surface, by discharging the cooling water through a submerged discharge in order to maintain river surface temperatures below the new 90°F criterion. Model studies showed that rectangular ports located along the bottom of the West wall of the discharge canal would yield maximum surface temperatures substantially lower than the 90°F criterion.

In October 1969, QLM prepared for Con Edison a report on "Effect of Submerged Discharge of Indian Point Cooling Water on Hudson River Temperature Distribution" (see Appendix M to the Indian Point Unit No. 2 Environmental Report, Supplement). This study consisted of the development of a mathematical model in three stages. The first stage was the mathematical development based on a consideration of the fluid mechanics of submerged jets. Secondly, a comparison was made between the theoretical model and observations of actual submerged jet behavior both in the Alden model and the Hudson River.

The mathematical model consists of a set of twelve simultaneous equations. It incorporates the effects of plant intake temperature, density and salinity; plant outfall temperature, density, salinity and flow; outfall geometry including port size, shape, edging, orientation and submergence; and linear velocity (both runoff and tidal), tidal phase, and ambient temperature, density, and salinity.

The major assumptions made in the development of this model are that initial jet momentum, induced buoyancy, and entrained river flow and momentum are the controlling mechanisms and that drag forces and river boundaries, such as the river's bank, surface and bottom can be neglected.

The computed results agree in general with measurements made in the undistorted hydraulic Outfall Model, and with measurements taken in the river in the vicinity of the submerged outfall of Orange and Rockland Utilities' Lovett Unit No. 4.

The computed results showed that the submerged discharge would meet New York State thermal discharge criteria.

QLM made an additional study which was reported in a document entitled "Influence of Hudson River Net Non-Tidal Flow on Temperature Distribution" and dated October 1969, (see Appendix N to the Indian Point Unit No. 2 Environmental Report, Supplement), which confirmed the existence of the salinity-induced circulation in the estuary. The report shows that this salinity-induced circulation results in different speeds and times of tidal reversals nearer the river's bottom than in its surface layer.

When flood tide conditions were surveyed on October 1, 1969, two interesting phenomena were observed. The turn of the tide occurred about one-half to three-quarters of an hour earlier along the west bank of the river than at mid-river. It was also found that at mid-river, the bottom water turned approximately one hour earlier than the surface water. The difference in turning time, therefore, seems to be attributable to momentum differences between the fast-moving mid-channel surface water and the slower moving bottom and bank waters. The maximum flood velocity at the down river section was approximately 1.5 fps and a slightly higher velocity of 1.8 fps was measured at the Grassy Point section where the river narrows.

Salinity measurements taken later in the day showed that there was no significant density gradient. The salinity varied between 4 and 6 ppt. The specific weight with these conditions was between 62.5 and 62.6 lb./cu. ft., slightly higher than fresh water. During this survey, the water temperature was essentially constant over the depth, at about 70°F.

When ebb conditions were surveyed on October 7, 1969, results showed that the bottom turned approximately one hour later than the surface current. This behavior was the opposite of that found with the flood condition and indicated that forces other than those due to inertia and pressure gradients governed the water motion during this phenomena. Salinity measurements revealed a pronounced density stratification. The specific weight varied between 62.5 and 62.9 lb./cu. ft. The average water temperature was 68°F with insignificant variation.

Analysis of these salinity and current measurements showed that over a tidal cycle, there is a net upstream movement of sea water in the lower layers and a net downstream movement of fresher water in the upper layers of the Lower Hudson River. The surface of no net motion which separates the two layers usually occurs above mid-depth. These net movements are induced by density differences which exist on account of the vertical and longitudinal distribution of salinity. Such movements exist mainly in the saline portion of the estuary. This effect is called the net non-tidal flow or density-induced circulation.

At Indian Point, the net non-tidal flow is present when the fresh water runoff in Lower Hudson is less than 20,000 cfs. When tidally averaged, the effect is strongest when the salinity is the lowest.

Field measurements showed that when the Lower Hudson fresh water runoff is about 7,300 cfs, there is a seaward flow of about 22,000 cfs at Indian Point in the upper layer, and an upstream flow of some 14,700 cfs in the lower layer.

The net non-tidal flow concept reconciled the measured area-average temperature rise at Indian Point with the predicted area-average temperature rise at the Indian Point plane of discharge within 9% of the area-average temperature rise measured in July 1966.

Alden Research Laboratories has been modeling the hydraulics of effluents from Indian Point since 1964. These models simulate the geometry and hydrodynamics of both the tidal estuary and the thermal discharge. The river topography is modeled in concrete and tidal flow is controlled by synchronized weirs and gate valves at each end of the model. Modeled power plants include orifice flow meters and pumps and all models are enclosed in large sheds with monitored environments. The temperature measurements are made with either thermistor or thermocouple temperature sensors, located at critical locations such as the inlet and outlet sections of the model, and the intakes and discharges to the modeled plants. The sensors are also placed in various sections of the model to measure the temperature distribution and flow patterns of the warm water.

Three models have been used to simulate various aspects of the Indian Point thermal discharge. In order of construction, these are designated Model I, Outfall Model, and Model II.

The first model (Model I) was constructed to study the recirculation problems of Indian Point Unit No. 1. This led to a discharge canal design which minimized the recirculation of heated discharge water.

In the winter of 1967-68, a model (Model II) of the Hudson River simulating 9000 feet above and below Indian Point was constructed (see Appendix O to the Indian Point Unit No. 2

Environmental Report, Supplement). The layout of Model II was scaled 1:250 in horizontal dimensions and 1:60 in the vertical. It is vertically distorted so that viscous friction does not affect the flow patterns, while simulating a significant horizontal extent of the river.

Prior to the initiation of the final testing of this model, the New York State Thermal Criteria were formulated. Because of these criteria, it was necessary to design and construct a submerged discharge to dilute the heated effluents from Indian Point in the river water. In order to optimize this design, a supplemental Outfall Model was constructed at Alden. The supplemental Model was undistorted, scaled 1:50, and simulated 900 feet along the east shore and 400 feet of the river's 4,000 foot width.

The plant parameters for which Alden tested outfalls were: (1) the plant flow and temperature rise for three units (Units 1, 2 and 3 operating at initial licensed power levels, water flow of 2.05 million gpm, 14°F temperature rise), (2) the total dynamic head available from the circulating water pumps, and (3) the property line and bulkhead line of Con Edison. During tests on the Outfall Model, the thermal criteria were modified and finalized by the State. These current criteria led to the outfall now under construction (Appendix O to the Indian Point Unit No. 2 Environmental Report, Supplement). The tide simulated in the test was 0.4 fps steady ebbing flow. The expected dilution at the point where the plume reaches the surface was shown by this model to be approximately 1:2.

A submerged discharge designed through the studies conducted in the Outfall Model was incorporated into Model II. These studies were conducted with assistance from QLM. Final tests with Model II were conducted with this submerged outfall. These tests simulated two unit plant operations and indicated that the transient thermal plume would comply with the thermal criteria. The QLM mathematical models reported in February and October 1969 (Appendices K and M to the Indian Point Unit No. 2 Environmental Report, Supplement), also supported this conclusion.

The detailed criteria adopted by New York State which cover thermal discharges into the Hudson River at Indian Point, classified as "an estuary", are as follows (6 NYCRR 704.1 (b) (4)):

> "The water temperature at the surface of an estuary shall not be raised to more than 90°F at any point provided further, at least 50 percent of the cross sectional area and/or volume of the estuary including a minimum of 1/3 of the surface as measured from water edge to water edge at any stage of tide, shall not be raised to more than 4°F over the temperature that existed before the addition of heat of artificial origin or a maximum of 83°F, whichever is less. However, during July through September, if the water temperature at the surface of an estuary before the addition of heat of artificial origin is more than 83°F, an increase in temperature not to exceed 1.5°F, at any point of the estuarine passageway as delineated above, may be permitted."

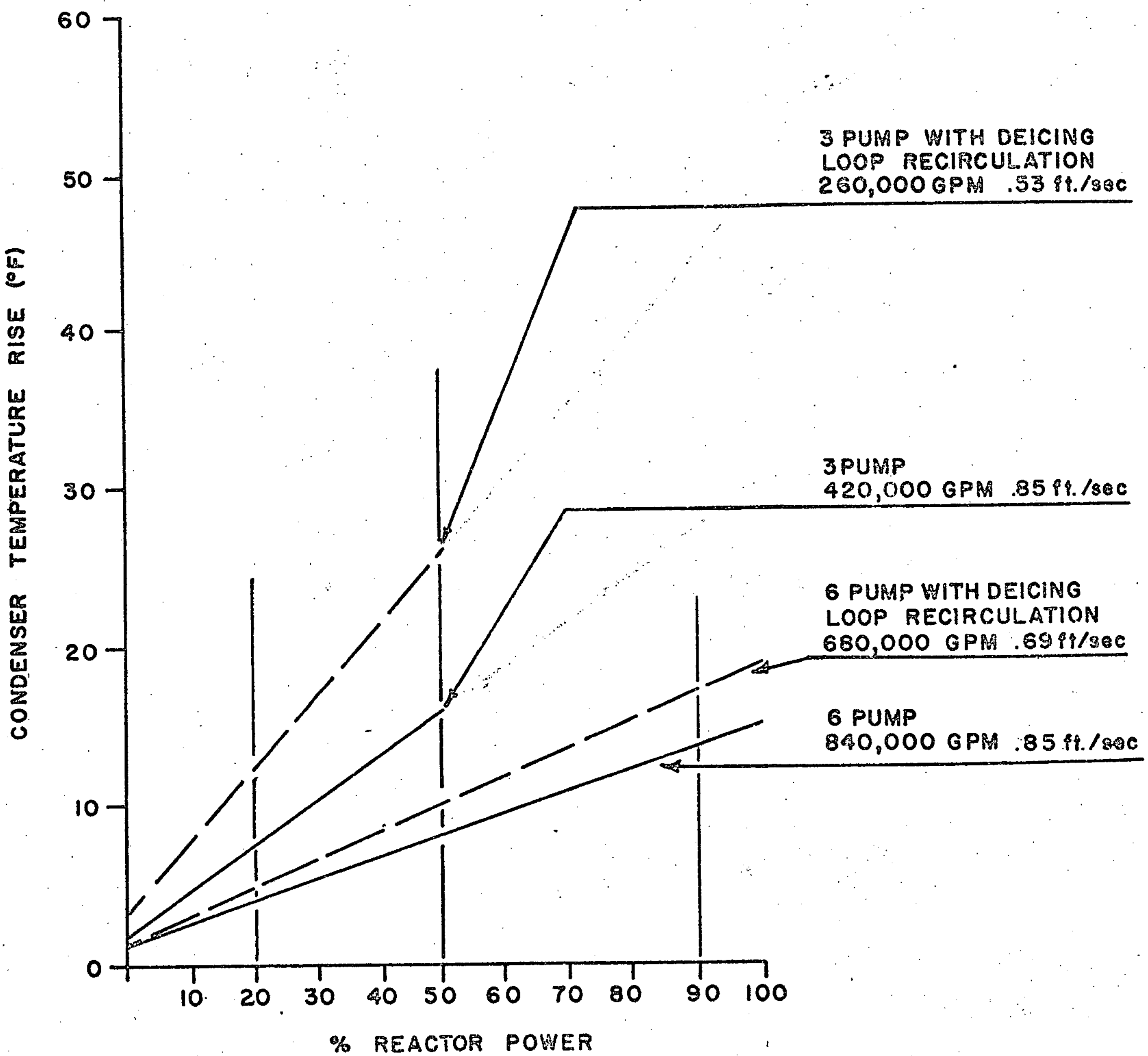
These detailed criteria effect the water quality standards of New York State. As discussed elsewhere in this testimony, Con Edison has developed a design for effluent discharge facilities in order to assure compliance with these criteria.

On December 7, 1970, in accordance with the requirements of Section 21-b of the Federal Water Pollution Control Act, the New York State Department of Environmental Conservation issued a Certificate to the effect that the effluent to be discharged from Units 1 and 2 will not contravene the applicable water quality standards.

The thermal discharge from Unit No. 2 will be added to the common discharge for Unit No. 1. Model studies (discussed previously) have indicated that the plume from such combined discharge will not extend more than 2,500 feet across the river from Indian Point. It would appear, therefore, that migration of fish in the vicinity of Indian Point Station will not be affected by a thermal barrier as a result of the combined discharge. Also, as discussed previously, these thermal discharges will result in a temperature distribution in the Hudson River within the surface temperature limits established by the New York State Criteria Governing Heated Discharges. Moreover, the actual temperature distribution with Units 1 and 2 in operation will be well below these limits most of the time. Therefore, it can be stated that thermal discharges will not adversely effect the aquatic environment. It may also be added that the sphere of in-fluence of this thermal discharge is small as compared to the extent of the river in the vicinity of Indian Point and, therefore, effects on biota, if any, will be local.

FIGURE 2

INDIAN POINT NO. 2
CONDENSER COOLING WATER TEMPERATURE RISE (°F)
vs
% REACTOR POWER



5.0 Chemical Discharges

During operation at reduced power levels, water is circulated through all facility systems (primary, secondary, condenser and service water). Since water treatment procedures are governed by the use of the systems rather than by the operating power levels, chemical additions and subsequent discharges are initially the same as for full power operation with minor exceptions. The predominant chemicals utilized in the various systems are summarized in Table 3.

The primary method of treatment of chemical effluents from the Indian Point Generating Station is dilution with circulating water so that chemical concentrations are reduced to levels well below those acceptable for discharge. Under all circumstances and modes of operation (long-term operations at full power or short-term testing operations) concentrations at the confluence with the Hudson River will be maintained so as to never exceed the concentrations as given in Table 4. The concentration limits as set forth in Table 4 were evaluated by ~~derived from~~ extensive bioassay studies and are attained by using ~~use~~ relatively conservative estimates with respect to dilution water volume, ~~contact times~~ and neutralization effects. Hence, as in the case of full power operation, chemical releases to the environment during reduced power operations are expected to have minimum ecological impact.

Since some flexibility is available in the number of circulating pumps utilized as well as the numbers of condensers in operation, chlorination of circulating cooling water may vary according to the pump-condenser-flow utilization. Although chemical discharges are not power dependent, concentrations of chemicals will be flow dependent. As mentioned earlier, various concentration limits will not be exceeded, but the lower flow rates will provide discharge concentrations closer to the proposed limits than higher power operations at full flow rates. Due to the extremely conservative estimate of dilution water volume utilized in arriving at these limits (100,000 gpm as opposed to 840,000 gpm under normal operating conditions), these variations are not expected to be significant. This variable flow operation may exist for a limited time period only.

Several other factors contribute to the conservative nature of the proposed limits:

1) It is extremely unlikely that the entire list of chemicals will be simultaneously discharged.

2) When acids and bases are simultaneously discharged, they will neutralize the toxic effect of each other.

3) During the bioassay survey permissible concentrations were determined by 48-hour exposures while the actual exposure time to the discharge concentration is estimated to ~~be 2.5 minutes~~ vary from 9 to 40 minutes depending upon operational mode.

4) The discharge concentrations are subject to an almost instantaneous 50% further reduction resulting from

dilution when the discharge water empties from the canal into the river.

Based on the results of the bioassays and a consideration of the method of discharge, Con Edison is confident that there will be no detrimental effects to aquatic life from the discharge of chemicals at Indian Point.

TABLE 3

Summary of Chemical Discharges

Chemical	Use	Location	Concentration* (ppm)	Maximum Flow (gpm)	Sustained Released (lbs/day)
Phosphate	pH control	secondary steam generators; service boilers	10	200	24
Hydrazine	O_2 control	steam generators	2	200	5
Cyclo-hexylamine or Morphaline	pH control	feedwater	5	200	12
Lithium Hydroxide	pH control	primary system	2.2**	25**	2**
Boric Acid	chemical shim	primary system	2000**	25**	600**
Potassium Chromate	corrosion inhibitor	closed cooling water system	100+	25+	30+
Sodium Hypochlorite	chlorination	main condensers	0.5++	5++	--
Sodium Hydroxide	demineral-izer regen-eration	primary demineralizer	5000**	25**	12**

* on a sustained basis unless otherwise noted; values are for concentrated waste stream before dilution in the discharge canal

** only under the adverse condition of evaporator breakdown

\+ assuming maximum leakage; no routine discharge planned

++ not on a sustained basis but only one hour, 3 times per week; concentration given is the chlorine residual using 15% hypochlorite solution at maximum flow; this is the concentration in the discharge canal prior to entering the river

Table 4

Proposed Concentration of Chemicals at Confluence of Discharge Canal and Hudson River

Chemical	Concentration (ppm)
Phosphate	1.54
Hydrazine	0.1
Cyclohexylamine	0.1
Morpholine	0.1
Lithium Hydroxide	0.01
Boric Acid	50
Potassium Chromate	0.05 (hexavalent chromium)
Residual Chlorine	0.5
Sodium Hydroxide	10
Sulfuric Acid	10
Soda Ash	5
Detergent	1.0

6.0 Environmental Effects on Fish and Entrained Organisms

A. Fish Diversion

As described in Section 2.3.6.2 of Con Edison's Supplemental Environmental Report filed on September 9, 1971, Indian Point Unit No. 1 has experienced problems of fish impingement with its cooling water intake. Because of a number of changes which have been or are being made in the Unit No. 2 intake structure and which are described in that report, there is reason to expect substantial improvement over Unit No. 1 general experience. Based on a limited amount of data available from testing of the Unit No. 2 pumps, as well as Unit No. 1 information, it is possible to make predictions of fish collections for Unit No. 2 for the periods involved in the various limited operation phases.

The quantities of fish predicted to be collected daily at Unit No. 2 will depend on the abundance of fish in the area of the intake, the volume of water being withdrawn and the intake velocity approaching the screens. The intake velocity at Unit No. 2 would depend on (1) whether the de-icing loops are operating, and (2) the number of pumps operating.

Table 5 gives the intake water velocity and temperature rise, for three and six-pump operation with and without de-icing loop operation. Pump operation in some mode will occur when the reactor is producing power or is in a hot shutdown condition. The expected modes and duration of operation of the reactor and the circulating water pumps during the various limited licensing phases are given in Section 2.0 above.

The time of year is important as higher collections would be predicted for winter months. During the spring of the year (April through June), a minimal daily collection rate will occur. During May of 1971 two pumps were operated at Unit 2 in order to establish the extent of the problem at that time. Between May 3 and 28, with one pump operating at 105,000 gpm flow and one pump operating at 140,000 gpm, an average of 4.0 lbs/day was collected:

Mean weight of fish per day collected at
Unit No. 2 May 3 to 28, 1971

Flow rate (GPM)	Mean Weight of fish per day (pounds)
Pump 22 (105,000)	0.5
Pump 26 (140,000)	3.5

The weight is based on a mean weight of 0.4 oz per fish which is the approximate mean weight of white perch collected at Unit 1. The fish collected at Units 1 and 2 are of a consistently small size, 2 to 4 in, and 0.4 oz is a good approximation of the weight of an individual fish.

TABLE 5

Pumping Conditions	Flow gpm	Temperature Rise °F 50% Power	Temperature Rise °F 90% Power	Intake Velocity ft/sec (in front of fixed screen)
WITHOUT DE-ICING LOOP FLOW				
6 pumps (full flow)	840,000	8.0	13.8	0.85
3 pumps (full flow)	420,000	16.0		.85
WITH DE-ICING LOOP FLOW				
6 pumps (full)	680,000	10.1	17.0	0.69
3 pumps (full)	260,000	25.8		.53

Based on the sampling in 1971, the weight of fish collected with 6 pumps operating at full flow can be estimated by multiplying the collection rate at full flow (pump 26) by six. The weight of fish collected with 6 pumps operating at reduced flow (de-icing loop in operation, 113,000 gpm/pump) can be estimated by multiplying the collection rate at reduced flow (pump 22) by six. With six pumps operating at full flow an estimated 21 lbs/day will be collected and with 6 pumps at reduced flow an estimated 3 lbs/day will be collected during the spring of the year at Unit 2.

During the winter months the collection rate is expected to be at a yearly peak. Data are available from Unit 2 for early February. From February 4 to February 10 three pumps were operated at Unit 2 with the following results:

Average weight of fish per day collected at Unit 2 February 4-10, 1971

Flow rate (gpm)	Average weight/day pounds for time interval
Pump 22 (105,000)	53.9
Pump 23 (105,000)	91.7
Pump 26 (140,000)	98.9

Based on the sampling from February, 1971 the weight of fish expected at Unit 2 during the winter months can be estimated as it was for the spring. The average of pumps 22 and 23 was used for the reduced flow condition. With six pumps operating at full flow an estimated 593 lbs/day will be collected and with 6 pumps at reduced flow an estimated 437 lbs/day will be collected at Unit 2.

Based on Indian Point Unit No. 1 experience, the fish impinged would be predicted to consist primarily of the following:

Species	Estimated % of Total Catch on a Yearly Basis
White perch	80.4
Striped bass	3.6
Tomcod	5.3
Herrings (primarily blueback)	2.8
Bay anchovy	2.1
Other	5.9

During the winter, white perch are more than 90% of the catch. Striped bass are collected throughout the year in low numbers. Tomcod are abundant in the spring and summer and blueback herring and anchovy are abundant in summer and fall.

The collection rate of fish at Units 1 and 2 has been highly variable on a daily basis making prediction difficult. The estimates above assume a direct relationship between flow and quantity of fish collected. In actuality, the daily movements of fish in the vicinity of the intakes is the most important factor influencing the collection rate. Therefore, the expected weight of fish collected on any given day could be greater or less than the above estimates.

For the time periods and modes of operation involved in the various phases of limited operation, the fish collections described above would not be detrimental to the fish populations in the river. This is due to the high abundance of these species in the river as a whole, and the fact that a very high mortality occurs naturally to the young fish, i.e., many caught on the screens would otherwise succumb to natural causes. In any event, any effect on the general fish population which were to occur due to limited operation during the pending NEPA review would be temporary. The reproductive mechanism of the fish species involved is such that a very high mortality to young fish will not be detrimental to the ability of the population to maintain itself. In other words, there will be no irreversible effect on the populations involved.

Further assurance in this regard exists with respect to the activities to be authorized at up to 20% and 50% of full power because of the limited periods of time involved and the substantial use of three-pump operation planned during those periods.

B. Effects on Entrained Organisms at Indian Point Unit No. 2

Various life stages of fish and phyto-and zooplankton are the types of organisms which will be carried by the cooling water flow into the intake structure. The planktonic organisms, including fish eggs and larvae, are non-screenable and will be carried through the intake pumps and condensers of the plant.

In November 1970, New York University Institute of Environmental Medicine was contracted by Con Edison to perform studies on the effect on passing aquatic organisms through the condenser. These studies are being done at Unit No. 1 located at Indian Point. Two consecutive years of such investigation are envisaged. Studies also will be conducted on non-screenable organisms passing through the condenser of Unit No. 2 which is scheduled to go into operation in 1972.

Scope of this work includes studies on survival, extent of mechanical damage, thermal shock tolerance and effects on reproductive potential of entrained organisms. Effect on the productivity of the entrained phytoplankton is also under investigation. Consideration is being given to such aspects as recycling of already exposed organisms to the condenser passage, time required for passage through the condensers, exposure in the discharge canal and reproduction rates of organisms in the ambient water.

The expected temperature rise during passage through the condensers for the various modes of operation is given in Section 4.0. The expected ΔT is less than 25.8°F for any of the potential operation modes. Preliminary results of a current study of entrainment effects indicate no mortality to zooplankton due to condenser passage, but mortality (not yet quantified) to some fish larvae. Very few fish larvae are present in the river in the fall and winter of the year and, therefore, no significant effect will occur at those times. Phytoplankton are not expected to be affected by the predicted ΔT.

Any loss of organisms which does occur as a result of condenser passage must be related to the populations of these organisms present in the river. It is now felt that little ecological impact will occur because of the rapid regeneration time of the plankton and because the plant is below the area of major fish spawning in this river. Thus, relatively few fish larva will be withdrawn. In any event, the various phases of limited operation during the ongoing NEPA review will not have an irreversible ecological effect because any loss would be well within the capacity of the populations to replace.

The return of the water at Indian Point will be at approximately the same level as its withdrawal. The biological oxygen demand (BOD) will not be changed by the operation of Indian Point Unit No. 2.

Scouring at the Unit No. 2 intake and at the combined discharge will occur over a small area. Scouring has occurred at other plants but only in a relatively small area. We estimate that the species diversity and/or biomass of benthic organisms will change at the intake and discharge. These changes are very localized and their deleterious or beneficial effects on the ecosystems will be insignificant.

7.0 Foreclosure of Alternatives

Physical construction of Indian Point Unit No. 2 will be complete at the time it is ready to achieve criticality. This includes the condenser cooling water system (already complete), which is the most likely area of attention in the environmental review. Therefore, limited operation under the various phases, including the planned testing, will have no effect whatsoever on the feasibility or difficulty of adoption of various possible alternative ways of ameliorating environmental impact in the areas of thermal or chemical discharges or fish protection.

The only sense in which the plant will be significantly different after the limited operation activites from before is that the primary coolant system will be made radioactive. Hence, the adoption of subsequent modifications in the radwaste system might require some work on radioactive systems where the same work performed before criticality would not. Such work on radioactive systems is routine and in fact will be performed for currently planned modifications to the radwaste system. Thus, the difficulty of accomplishing any modifications which might be required will not be substantially increased as a result of limited operation activities. The radwaste system is, of course, complete at this time.

8.0 Effects of Delay Upon the Public Interest

8.1 Need for Power

The immediate need of the people living in Con Edison's service territory for the electric power to be produced by Indian Point Unit No. 2 cannot be over emphasized. Since June 1, 1969, commercial operation of the completed unit has been delayed; its unavailability since then has contributed to unprecedentedly critical power supply problems for the New York metropolitan area and threatens an even greater power crisis for the summer of 1972.

As of October 13, 1971, Unit No. 2 was ready for fuel loading, and Con Edison was awaiting appropriate action by the Atomic Safety and Licensing Board and the Division of Reactor Licensing authorizing fuel loading and sub-critical testing. If this authorization is granted promptly, it is estimated that Unit No. 2 will be ready for criticality in mid or late November 1971. Because of the pending contested licensing proceeding, it is expected that the NEPA review could not be completed nor a full power license issued for several months or longer. Because of the length of time required to conduct testing required prior to full power commercial operation, it has become necessary for Con Edison to obtain authorization for limited operation to permit completion of this testing prior to the summer of 1972.

It should be emphasized that full operation of the unit is needed as much in advance of the summer as possible to minimize the "shakedown" character of power production from this unit at peak periods. As shown below, the likely power shortage in the New York metropolitan area in the summer of 1972 constitutes an emergency situation for which the public interest requires operation of Indian Point Unit No. 2. Limited operation, both below and above 50% of full power should be authorized to the fullest extent necessary to ensure that the unit will be available for full operation by next summer.

In order to estimate the significance of this need, it is important to understand the nature of Con Edison's electric service area, which covers the five boroughs of New York City and most of Westchester County. The population of this service area is approximately 8,650,000. An adequate and reliable supply of electric power is essential to the life of this key metropolitan area. A lack of such a supply will jeopardize a vast array of critical services and facilities vital to the preservation of the public health and safety such as water supply, fire protection, sewage and garbage disposal, hospitals, nursing homes, railway and subway transportation, law enforcement, traffic control, drawbridge operation and all forms of local and interstate communications. As a national and international center, a lack of power in this area will have effects beyond its geographical borders.

Since 1969, Con Edison has been faced with a continuing crisis in supplying electric energy to the communities which it serves. Immediately prior to 1969, the Company's planned reserve capacity, including purchases from others, was 1,532 megawatts or 21% of its anticipated peak load.

In 1969, however, delays in the addition of new capacity by other utilities limited the amount of the purchased power actually available for the peak in that year to 260 megawatts, approximately one-third of the 710 megawatts for which Con Edison had contracted. In addition, there were several equipment outages and deratings* experienced during the summer period, which is the period of peak demand in the Company's system. As a

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*"Deratings" result from equipment problems which, while they do not require that a generating unit be completely removed from service, restrict its operation to less than its full capacity.

consequence, the Company had to request large customers to reduce load voluntarily, to appeal to the general public to conserve electricity and to institute voltage reductions on eight different days on which the loss of capacity ranged from 800 to over 2,000 megawatts. On two occasions, the voltage reduction reached the maximum allowable level of 8%*, after which the only load control device available is to totally discontinue electric service to some of our customers.

Again in 1970, the Company experienced power shortages even though the planned capacity resources had been increased from 8,882 megawatts to 9,839 megawatts. This represented a reserve of 27% of the anticipated peak load, and was to be principally achieved by the addition of almost 1,200 megawatts of gas turbine capacity to the system. Construction and startup delay, as well as a strike which affected one of Con Edison's suppliers, caused slippage in the schedule for adding the gas turbines. The summer started with none of the gas turbines in operation. They came into operation at various times thereafter, and Con Edison had 874 megawatts in operation at the end of the summer. This, together with equipment deratings and forced outages, made it necessary for Con Edison to make appeals again for the conservation of electricity by the public and to institute voltage reductions on fifteen days. On one occasion,

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* Voltage reductions in excess of 8% would cause damage to customer's equipment.

Con Edison had to resort to discontinuance of service to approximately 1% of its customers. Discontinuance of service to any customers is a drastic measure and every effort must be made to avoid its recurrence.

As far as the peak load period of 1971 was concerned, Con Edison added 624 megawatts of additional gas turbine capacity and, after re-rating some of its older units, it had a reserve installed on its own system equal to only 9% of the estimated peak load. Con Edison had also contracted for 920 megawatts of firm capacity purchases, thus raising the reserve to 21%. After further adjustment for the requirements of the steam system, the reserve was reduced to 17.3%.

This reserve, considering the re-ratings, is of the same order of magnitude as those with which Con Edison faced the summers of 1969 and 1970, and again Con Edison has had to resort to the frequent use of voltage reduction. Through September 30, 1971, Con Edison has reduced voltages on its system on fifteen occasions during the year.

Major problems were avoided because forced outages of large units were less than in previous years and there were no prolonged hot spells.

If Indian Point Unit No. 2 should not be available in 1972, the power supply situation is likely to be substantially worse than in the recent past. The estimated peak load is ~~8,550~~ 8,400 megawatts, and installed capacity, assuming that Indian Point Unit No. 2 is on-line, is expected to be 9,996 megawatts. This includes 400 megawatts from Con Edison's share of Bowline Point Unit No. 1, scheduled to go on-line in July 1972, and 348 megawatts from barge-mounted gas turbines, also scheduled for July 1972. The Company has, in addition, contracted for 325* megawatts of purchased capacity and expects to sign a contract for an additional 70 megawatts shortly. This would provide a reserve after steam system requirements of ~~19.9%~~ 22.0%, which is substantially less than is desirable. It is at this level of anticipated reserve, and greater, that Con Edison has experienced severe difficulties for the past three years. If the 873 megawatts of capacity from Indian Point Unit No. 2 were not to be available, Con Edison's reserve margin for 1972 would be cut almost in half, i.e., to ~~9.7%~~ 11.6%. This margin would represent a serious threat to the power supply of the New York metropolitan area, and would be even worse in the event of a delay in completion of Bowline Point Unit No. 1 (525 MW, including the 125 MW purchase) and the new gas turbines (348 MW).

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* Of this, 125 megawatts are from Orange & Rockland's share of the Bowline Point Unit No. 1.

The New York State Public Service Commission described the scope of the electricity supply problem in our service area in a recent opinion** (page 6), as follows:

> "In the summer of 1971 and, it appears, for a number of summers to come, the New York metropolitan region may be forced to adjust to shortages of electric power serious enough, at least, to cause inconvenience and, at worst, to weaken the capacity of both the city and its surrounding areas to function."

That statement was written on the assumption that Indian Point Unit No. 2 would be available during the summer of 1972.

The environmental impact of the unavailability of Indian Point Unit No. 2 must also be considered. The immediate effect in 1972 would be that Con Edison would be forced to make greater use of older fossil-fueled plants. The result would be that additional amounts of pollutants would be added to the New York City atmosphere. The quantities are shown in Section 8.3.

Con Edison's latest evaluation of load growth and prospective power supply indicates that the capacity of Indian Point Unit No. 2 will represent a significant portion of the reserves which are to be maintained in future years to assure adequate reliability of service

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** Case 25937 - Proceeding on motion of the Commission as to plans and procedures of electric corporations for local shedding in times of emergency. Second Interim Report August 3, 1971 to our customers. As discussed above, Con Edison has had difficulty in the recent past in meeting peak load requirements. It now has an extensive construction program to prevent the recurrence of these difficulties and to meet future load growth. It is estimated that Con Edison will require additional power equal to that of a large new plant every other year. Indian Point Unit No. 2 is an integral part of this program. In the years subsequent to 1972, the available of capacity from Indian Point Unit No. 2 along with capacity from other units which are now planned, will allow Con Edison to increase installed generating reserve margins to a level which is deemed acceptable.

In addition to meeting the requirements of load growth, the availability of planned new capacity including Indian Point Unit No. 2 is essential to allow the retirement of units which are now 40 to 50 years old and which would have already been removed from service were it not for delays already experienced. These units are inefficient and environmentally undesirable. Moreover, despite substantial expenditures for maintenance, they provide a much less reliable source of capacity than that provided by the newer units, and their reliability will continue to deteriorate. Any delay in the operation of Indian Point Unit No. 2 relying on the postponement of the retirement of these units would be ill-advised because they might be unable to provide dependable output when required.

There is no way by which Con Edison's reserve margin for 1972 can be substantially improved if Indian Point Unit No. 2 is not in commercial service.

Other new plants are not feasible to meet 1972 requirements. Fossil-fueled plants require an estimated 4 to 6 years to complete and an alternative nuclear power plant would require an even longer time. Gas turbines are not technically alternatives for a base load plant such as Indian Point Unit No. 2. Our experience indicates that installation of gas turbines requires more than one year even on a crash basis so that the earliest that gas turbines equivalent to the capacity of Indian Point Unit No. 2 could be installed would be after the summer of 1972.

Purchased power is likewise not a feasible alternative for Indian Point Unit No. 2 for the year 1972. Con Edison has already arranged for 395 MW of purchased power for the summer of 1972. The Company has solicited offers from sources in the northeastern states and Canada and has obtained indications that there may be some additional power available for purchase. However, in all these cases except for approximately 200 MW, the availability of additional purchased power for the summer of 1972 is contingent upon the completion of the construction of new facilities which are not even scheduled for service until the spring of 1972 at the earliest. A large part of the capacity available on this contingent basis depends on the timely completion and licensing of nuclear facilities. The remaining offers are contingent upon the completion of non-nuclear facilities and known delays already jeopardize the construction schedules. The generally prevailing experience of slippages in utility construction projects cast serious doubt on the availability of the power involved in each of these offers.

Con Edison has in the past made emergency purchases of energy from outside the system. Such purchases and other short duration purchases will probably be available in varying quantities from day to day as load and system conditions of other utilities permit. However, there is no assurance as to the availability of such power, and it would be extremely imprudent to plan to meet load demands utilizing emergency purchases without any basis to predict when and how much will be available.

In the event Indian Point Unit No. 2 is not in commercial operation by the summer of 1972, it will probably be necessary for Con Edison to implement, for the short term, various emergency procedures which have been developed to provide for situations where there is a shortage of generating capacity resources. These procedures could, depending on the severity of the power shortage, ultimately involve load conservation measures such as voltage reduction and disconnection of customers. The number of instances in which the public will have to be inconvenienced by those measures will depend largely on the magnitude of forced outages of other generating equipment installed on the Con Edison system and the availability of capacity in other utility systems for sale to Con Edison on an emergency basis.

The emergency procedures which would be implemented in the event of a power shortage have been prescribed by the New York Public Service Commission in Case 25937. The Commission ordered a sequence of 23 steps. The most significant steps affecting customers are an 8% voltage reduction and load shedding by disconnection of customers. The latter procedure could have a statewide effect because all members of the New York Power Pool have agreed to disconnect their customers to assist a power deficient company.

In accordance with the Public Service Commission's order, the Company would make every effort to contract for the purchase of supplemental and emergency capacity from neighboring utilities. The availability of such capacity will depend upon two factors: the installation of new capacity in neighboring systems and the transmission capability between systems. Since neighboring systems have experienced delays in meeting service dates and outage problems similar to those of Con Edison, this source of power cannot be relied upon for other than emergency conditions. Also, Con Edison's attempts to strengthen the transmission system have experienced delays caused by local opposition along transmission line routes.

If it should be necessary to disconnect load equal to the capacity of Indian Point Unit No. 2 (873 MW), it would mean the interruption of more than 400,000 customers in the less dense areas of Westchester, Staten Island, Northeast Bronx and Northeast Queens. This would initially affect approximately 1,250,000 people, primarily in private homes and small commercial establishments. If such a load disconnection were required for more than two hours, additional people would be affected as Con Edison rotated the service interruption to different parts of its system.

In recognition of these problems, the Company has initiated programs to reduce the demand for electric power. Con Edison has discontinued promotion of electric sales and is conducting a program of consumer education on conservation of electricity.

The Public Service Commission in its opinion in Case 25937, after discussing all possible emergency measures, concluded as follows (at page 28):

> "There can be no doubt, of course, that this great region will face awesome difficulties if Consolidated Edison does not, reasonably soon acquire additional generating and power import capacity. It is to that solution, however, that all energies should be turned and not to measures that so plainly invite economic disaster."

8.2 Cost of Delay

The costs of delay to Con Edison, and to its customers, during the period of ongoing NEPA review if limited operation is not authorized as requested, will consist of about 3.5 million dollars per month, the estimated cost of incremental operation and maintenance and out-of-pocket cost of replacing energy which would otherwise have been produced by Unit No. 2, plus almost one million dollars per month, the amount of interest during construction which would accure during the period of delay.

8.3 Environmental Costs of Delay

There is a substantial, positive environmental benefit to be derived from allowing Unit No. 2 to operate as soon as it is available. Without the unit, Con Edison would be forced to make greater use of older fossil-fueled plants.

The Company has analyzed the dispatch of various groups of units which would occur during 1972 with and without Indian Point Unit No. 2 in service. Table 6 indicates the increased energy output and increased sulfur dioxide, nitrous oxides and particulate matter by station that would be emitted in New York City if Indian Point Unit No. 2 were not in service as presently scheduled. The increase in the emission of pollutants is expected to be 1,245 tons per year of particulates, 29,000 tons per year of sulfur dioxide and 16,000 tons per year of NO_x.

TABLE 6

Increased Generation and Stack Emissions at Con Edison Generating Stations as a Result of Indian Point Unit No. 2 Not in Service in 1972

Station	Increased Generation (10^6 KWH)	Additional Particulates (Tons)	SO_2 (Tons)	NO_x (Tons)
Arthur Kill	241	68	2000	1000
Astoria	103	16	400	200
East River	376	48	1100	600
Hell Gate	1387	318	7200	3800
Hudson Avenue	964	242	5400	2900
Ravenswood	1028	254	5700	3000
Sherman Creek	427	103	2300	1200
Waterside	372	95	2200	1100
59th Street	315	86	2000	1000
74th Street	67	15	300	200
Gas Turbines	387	0	400	1000
TOTAL EMISSIONS		1245	29000	16000

F4wt3

MR. TROSTEN: Thank you, Mr. Chairman.

Mr. Chairman, we have no further direct examination to offer with respect to our motion for a limited operation license.

CHAIRMAN JENSCH: The subject has been mentioned parenthetically before. We will expect it to be supplemented at some time during the course of the hearings. I take it that that will necessarily await some later time. We would like to be informed by the Applicant every two weeks as to how your repair work is getting on. If the Staff could give us some comments on the report as to when those information sheets are submitted to us, too, it would be appreciated.

MR. TROSTEN: I might add that we are submitting to the Board and to the parties represented here today a copy for the information of the Board and the parties of the report which applicant submitted to the Atomic Energy Commission on November 14th, 1971, relative to the fire which occurred on November 4.

I would like to inquire of the Chairman concerning the point he has just made because we are submitting a motion here for limited operation. It is unclear to me, Mr. Chairman, of the scope of the request you have just made. We are asking for authority to proceed. We have filed our testimony in support thereof. The motion is unopposed by any of the parties with the exception of the Citizen's Committee for the

F4Wt4

protection of the Environment, insofar as radiological health and safety grounds are concerned. We are prepared today, in reponse to a question that the Chairman may have, to comment further to the extent that we are now able, with regard to the status of the fire and the status of the repair. But it is unclear to me why the matter must be held open on an indefinite basis as the Chairman appeared to indicate a moment ago.

CHAIRMAN JENSCH: The Board is anxious to expedite this proceeding in every way. The Board feels that it will be able to do that with these additional data. These reports need not be formally filed as a part of the evidence in this proceeding, but as supplementary submittals by the Applicant.

To answer you directly, what importance is it to the Board, we feel it is of importance to the Board and we appreciate the statement that Mr. Cahill made last Friday as to the status of the matter. We feel, as the Applicant has indicated in many ways, that it does not like to see any delay in this proceeding. We will proceed to a consideration of all matters related to the motion and the authority which is sought. When this statement is made and no one opposes this, except almost parenthetically the Citizen's Committee for the Protection of the Environment--I know the reference wasn't intended to be casual. It places this case in a contested aspect as to radiological safety. There are some very substantial considerations that the Board will undertake in reference to this proceeding.

It is not clear to me yet that the Board has completed its statement of concern of radiological safety. There must be further matters considered during the course of our deliberations. We are most anxious to expedite this case and avoid delay and avoid concerns.

As I say, the Applicant expressed in many ways about delays. We feel that this will fit the necessities of the case.

MR. TROSTEN: Thank you, Mr. Chairman. We will certainly endeavor to keep the--

CHAIRMAN JENSCH: If there isn't anything further in your statement that you have filed with the Atomic Energy Commission other than what Mr. Cahill gave us Friday, you need not submit it here. We feel perfectly informed of the present status. I feel Mr. Cahill's statement was clear. He enumerated the problems that were involved. We are mindful of those problems. Unless you want to keep the record open to put your statement in, we will be glad to receive it if you desire to offer it. We will be glad to receive any evidence that the parties feel is relevant and we feel is relevant.

MR. TROSTEN: We have no offer of evidence at this time, Mr. Chairman. I merely made that point if there were a question that the Board wished to ask Mr. Cahill, that he was prepared to respond.

CHAIRMAN JENSCH: We thank you. We don't think there is. We think he covered it very well last Friday. It is indeed unfortunate that this event has occurred. We would necessarily be guided as we go along with our main directive on the completion of the processing of this case. We are not overlooking the reality of the situation. As we understand it, but Mr. Cahill and Mr. Madsen of the Compliance Section indicated that.

MR. TROSTEN: We will endeavor to keep the Board and the parties advised as further information is developed, concerning the fire situation.

CHAIRMAN JENSCH: If you can just give us a report or letter every two weeks, that will help. Thank you.

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MR. BRIGGS: Mr. Trosten, I don't know as of now what approach the Citizens Committee is going to take concerning the radiological safety of this testing. But they have asked many questions concerning the emergency core cooling system during the past two weeks. I don't find anything in this additional evidence that shows that there may or may not be different requirements for the emergency core cooling system during this testing period from the requirements that exist during long periods of steady operation during full power.

Is it intended that that subject be addressed at any time?

MR. TROSTEN: Mr. Briggs, the evidence that we propose to introduce during the emergency core cooling system during the testing program and full power operation is that which we have adduced to this point in time. We have responded to all cross-examination propounded to us from the Citizens Committee with respect to all facets of the ECCS. We do not at this time have any additional testimony to offer concerning the performance of the ECCS during the contemplated testing program. Am I being responsive to your question?

MR. BRIGGS: I think so. If the Board were to conclude that the Citizens Committee had made a good case for indicating that there was a serious question concerning the performance of the ECCS under long time operation and full power, then you would say this would be the conclusion that one should reach for a testing program such as is shown here; is that right?

MR. TROSTEN: No, not necessarily. There might well be a difference between those two situations. I would certainly think that since we are now talking about a 50 per cent testing license -- we are actually talking about it in two stages, the 20 per cent operation and 50 per cent operation; that the findings and conclusions which will be set forth by the parties definitely should be addressed to the question of 20 per cent and 50 per cent operation. If there is any proper distinction between these two points of view, it would seem to me it might well be appropriate to draw that distinction, Mr. Briggs. So I don't think the fact that there might be a problem with full power operation over a long-term program necessarily applies to the limited power operation necessarily.

CHAIRMAN JENSCH: That might be a matter of evidence, is it not?

MR. TROSTEN: Yes, sir, it might.

CHAIRMAN JENSCH: Before we recess before our normal recess time, let me ask the State of New York. Has the State of New York approved or has the Environmental Protection Agency approved the water temperature standards for the Hudson River?

MR. MARTIN: I don't have the answer to that, Mr.

Chairman.

CHAIRMAN JENSCH: Will you give consideration to that and give us the status of the relationship between the State of New York and the Environmental Protection Agency on the thermal releases? Is there any other matter we can take up before we recess?

MR. TROSTEN: Let me ask you, Mr. Chairman. Are we going to proceed with examination by the Board of our Environmental panel this afternoon, or are we going to proceed with the ECCS interrogation?

CHAIRMAN JENSCH: Is your panel on environment going to have a long lunch or can they get back at --

MR. TROSTEN: They will be here.

CHAIRMAN JENSCH: Let us make that decision after lunch. We do have some ECCS matters. If there is any preliminary interrogation they would like to take on this matter-- the only party that will be interested, as I understand your statement, in this situation for 20 per cent power or 50 per cent power, would likely be the State of New York; is that correct?

The Hudson River Fishermen's Association is not concerned about this testing; is that correct?

MR. MACBETH: Under the terms of the stipulation, we will not have any cross-examination of the Applicant on the 50 per cent testing.

CHAIRMAN JENSCH: Does that mean you do not oppose it?

MR. MACBETH: We do not oppose it.

CHAIRMAN JENSCH: Very well.

MR. TROSTEN: Mr. Chairman, let me say this: As I indicated in my statement this morning, we are most anxious to proceed today, and for the rest of this week, with regard to any interrogation which the Board wishes to make of our environmental panel. There will be, as I understand it, no questions propounded by any of the parties to the proceeding other than questions by the Board. We will have our panel here as long as is necessary in order to respond to the Board's questions.

CHAIRMAN JENSCH: We appreciate that. The Board will be here to receive any and all evidence that any of the parties desire to submit or present for our consideration. We will extend the hours of the hearing as long as convenient to the parties and the two schedules. Therefore, if there is nothing further at this time, we will recess until --

MR. MARTIN: Mr. Chairman, the State of New York does not oppose the issuence of the license for 50 per cent testing on environmental grounds or radiological safety grounds. I have brought this matter before the Department of Environmental Conservation. It is my understanding -- I'd like to check on it. It is my understanding that the necessary approvals have been obtained but I would like to check further. Certainly, as far as this hearing is concerned, the State of New York does not intend to introduce any evidence or undertake any cross-examination of the Applicant's witnesses on that testimony.

CHAIRMAN JENSCH: Very well. If you will check whether the Environmental Agency has approved that, we would appreciate it.

At this time let us recess to reconvene in this room at 2:00 o'clock.

(The luncheon recess is taken.)

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

CHAIRMAN JENSCH: Please come to order.

Does the Applicant desire to speak to the matters raised by Mr. Briggs on the crucible and ECCS?

MR. TROSTEN: Yes, Mr. Chairman. I would like to have Witness Moore resume the stand.

CHAIRMAN JENSCH: Having been previously sworn, he need not be sworn again.

(James S. Moore resumed.)

MR. TROSTEN: Mr. Chairman, we have a copy of the questions that were put to us by Mr. Briggs before the luncheon recess. Now Mr. Moore has a set of questions, our only copy, in front of him, and I think I am simply going to ask Mr. Moore to take Mr. Briggs' questions and indicate briefly what the nature of the question was by reference to the excerpt from the transcript and then to respond.

Would you please do that, Mr. Moore.

CHAIRMAN JENSCH: Very well. Proceed.

MR. MOORE: Well, there is some preamble on the first page here that doesn't specifically state a question. The first question I come to is "Did the Applicant at any time prior to or during the construction permit hearings indicate that it would propose to remove the crucible from the design when it achieved an ECCS system that was satisfactory to the AEC and the ACRS?"

In response to that question, no, the Applicant did not indicate that the crucible would be removed when a satisfactory ECCS system was achieved.

The next question, "Is it correct that at the time of the constructionpermit hearings the Applicant was convinced that it could design the crucible on the basis of conservative engineering principles and without the results of a research and development program?"

Yes, in this sense, and this was covered to some extent also in the hearing for the construction permit, in that we felt that we could design a crucible based on application of conservative engineering principles and on the basis of existing experimental data. So we agreed that there was a considerable amount of design detail to be done, but we felt we could do the design without additional experimental programs. So in that sense we felt it could be done without R & D.

CHAIRMAN JENSCH: What was the experimental data that you had available for the crucible, could you tell us, please?

MR. MOORE: Yes. The questions that arose with respect to the crucible design were primarily concerned with the heat transfer mechanisms of a molten material and contact with a refractory material, and this was complicated by the fact that this specific molten material had an internal heat source.

We were hopeful that we could determine the heat transfer mechanisms and characteristics on the basis of existing literature with respect to refractory systems. This was not refractory furnaces, et cetera. Crucibles, so to speak, had been designed for other applications in use of cooling molten materials. So we hoped to draw on that kind of literature or experimental evidence without performing any specific large-scale experiments using molten UO_2.

CHAIRMAN JENSCH: Thank you. Will you proceed.

MR. MOORE: Finally Mr. Briggs indicated an understanding in reviewing the FSAR and other information with respect to the crucible, and he stated this understanding, and if it's wrong he said he'd like to be corrected. I will restate his understanding and proceed to correct it in some places.

No. 1, he said, "It appeared to the Applicant that incorporating the accumulators would satisfy the AEC and the ACRS requirement for the emergency core cooling system."

With respect to that statement I would disagree in that the Applicant felt that that incorporating the accumulator would more than satisfy the original stated requirement of the AEC and ACRS and specifically indicated in the ACRS letter where there was a request for improvement in flow rate and possibly pressure with respect to the coolant pumps. We in fact developed a whole new design concept using the accumulator system which not only had the effect of increasing rates, but also the very beneficial effect of getting water to the core much more quickly than a pumping system. So in that sense I would say that we more than satisfied the specific AEC-ACRS requirement that was spelled out.

CHAIRMAN JENSCH: Well, it was done by the accumulators, is that correct?

MR. MOORE: That's correct.

CHAIRMAN JENSCH: Proceed. Thank you.

MR. MOORE: The next statement, "The potential problems that arose during the design reviews of the crucible made it highly uncertain whether the crucible could perform its intended function."

I would basically agree with that statement. Yes, that was that statement.

There is the following statement. "There would be substantial research and development required to prove the effectiveness of the design as it existed or to provide a satisfactory design."

I would agree with that statement and add to it perhaps that there wasn't a high degree of assurance that even after having completed such a program that you would have had an acceptable design.

The next statement, "The Applicant decided that the plant with its improved emergency core cooling system satisfied all the AEC criteria."

We would agree to that.

Next statement that the "cost of a research and development program, installation of an effective crucible and the likely delay in completion of the plant were greater than any benefit that might be expected from providing the crucible."

We would disagree with that characterization. Cost really wasn't the fundamental consideration or any real consideration at all in this matter. It was with respect to our really being able to come up with a viable design that we could in fact have confidence in with respect to the reactor crucible. There was just so much uncertainty there that that was the primary reason, not cost.

Finally,"On the basis of these considerations the determination was made not to provide it."

This determination was concurred in by the ACRS and by the AEC Staff. That's correct.

I believe that answers the questions as I find them in this part of the transcript.

MR. BRIGGS: I believe the record shows that the decision to eliminate the crucible from the plant was made in 1968 and that the first -- let's see - - that the amendment to the safety analysis was provided in the final safety analysis

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report and that the FSAR constitutes the public recording of the change in the design of the plant, that there was no other public information provided, is that correct?

MR. TROSTEN: That is correct, Mr. Briggs.

CHAIRMAN JENSCH: Could you explain a bit more, Mr. Moore. You say you came up with a wholly new design concept which included the accumulators. What was the original and what was the whole new design concept that you provided for the emergency core cooling system?

end

MR. MOORE: The original emergency core cooling system as described in the PSAR for the Indian Point 2 Plant consisted of essentially pumping systems which would be operated from diesels on site and these pumping systems would then pump water into the primary system to make up the loss of water associated with the loss of coolant.

There existed rather apparent limitations on the size and magnitude of the pumping systems that could be provided, primarily because the requirement that these systems be able to operate without off site power.

So we had pumping systems which took some time in order to get sufficient water into the system to recover the core. The new design approach, the different concepts, was to use the accumulator system which consisted of then pressurized tanks sitting ready to inject water very rapidly following a blowdown as the primary system pressures decreased.

So the main effectiveness of the accumulator system was to get water at a very high rate at a very early time back into the system and therefore effectively turn the temperature around in the core very early in the transient, so that it was a different concept in that sense. It did not require external power and it was a passive system there sitting ready to be discharged in the loss of coolant.

CHAIRMAN JENSCH: And that is what you meant by a whole new design concept, this change to let the accumulator flush out when the valve was opened, is that about it?

MR. MOORE: That's correct.

CHAIRMAN JENSCH: Thank you. I don't have any further questions. The Board has no further questions.

Excuse me. Dr. Geyer has.

DR. GEYER: I would like to ask one question about the accumulator design.

Are they designed to withstand the full pressure of the primary system?

MR. MOORE: The accumulators themselves?

DR. GEYER: Yes.

MR. MOORE: No, they are not.

DR. GEYER: Well, what security is there against an

*** opening of one of the valves while you are under pressure?

MR. MOORE: Yes. The accumulator is isolated from the coolant system by two check valves in series. So even were you to postulate a failure of one of the check valves, there is another check valve there to prevent any pressurization of the accumulator system.

DR. GEYER: Then do these check valves open automatically or is there another valve in the connection that you open?

MR. MOORE: No. There is a valve that's available for maintenance purposes or when the plant is depressurized and shut down that can isolate the accumulators. But during normal operation the only valves between the accumulator and the reactor coolant system are these two check valves. So that when a reactor coolant system is depressurized to below the operating pressure of the accumulators then the check valves will open up just on the pressure differential and discharge the water.

DR. GEYER: What security do you have that that valve is open at all times? It has to be open for the accumulator to work.

MR. MOORE: That's correct. You are talking now of the motor-operated valve?

DR. GEYER: Right.

MR. MOORE: That's right. There are procedures and operating procedures and indications in the control room as to the status of this valve and I believe alarms to indicate the status of this valve as to whether it's opened or not, and the tech specs require that these valves be open during normal operation.

DR. GEYER: Thank you.

CHAIRMAN JENSCH: The Board has no further questions.

MR. TROSTEN: Mr. Chairman, while Mr. Moore is on the stand, before the break Mr. Briggs asked a question which I responded to briefly, which I think it would be appropriate for Mr. Moore to supplement.

He asked if we had information, as I recall it, concerning performance of the emergency core cooling system for Indian Point 2 relative to the AEC's interim policy statement at power levels up to 50 per cent testing of the plant as contemplated by Applicant's motion dated October 19, 1971. If I recall, Mr. Briggs, that was the thrust of your question. Am I correct, sir?

And Mr. Moore will comment with respect to that question.

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MR. MOORE: Yes. We have reviewed the loss of coolant situation that might occur from 50 per cent power in conjunction with this interim license. The primary effect, of course, is the fact that we are at half power level so the peak power is reduced by a factor of two from that design value used at full power. And then in looking at the loss of coolant transient and using the interim criteria, the peak clad temperature from this condition would be less than 1200 degrees Fahrenheit instead of the 2300 degrees that was the case for the full power situation.

This in itself should preclude any possible clad bursting. But also there is another mitigating factor in that operation at 50 per cent power for the period of time, even longer periods of time than envisioned for this interim license, will not be sufficient to create any significant internal pressure due to fission gas build-up within the fuel rods themselves.

By this I mean anything over 100 psi. So that there is very little internal pressure which could contribute to either swelling or bursting. So for this particular situation, that this would be the case as I have described it.

MR. TROSTEN: We have no further questions for Mr. Moore in response to the Board's inquiry.

CHAIRMAN JENSCH: We will have some further questions later about the emergency core cooling system. We will deal

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specifically with that matter later.

Very well. Thank you, Mr. Moore. You are temporarily excused, subject to call for further inquiry.

While there is a pause, let me inquire of the State of New York what is the situation in reference to the approval or lack of approval by the Environmental Policy Agency respecting the thermal releases as set up by the State of New York?

MR. MARTIN: During the recess I called the New York State Department of Environmental Conservation and I have been informed that New York's standards adopted were approved in 1967 and that modifications to those standards were proposed in 1969 and those modifications are not yet approved. They are in the discussion stages.

CHAIRMAN JENSCH: Well, in any event the approval required by the 1970 Environmental Policy Act has not been secured by the State of New York, is that correct?

MR. MARTIN: I don't know the answer.

MR. TROSTEN: Mr. Chairman, would you repeat that question, sir. I am sorry.

CHAIRMAN JENSCH: The approval required by the Environmental Policy Act has not been received by the State of New York, is that correct?

MR. TROSTEN: The Environmental Policy Act, sir? The water quality?

CHAIRMAN JENSCH: Water quality act, yes.

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MR. TROSTEN: Yes, yes, sir. It is Applicant's understanding that the New York State Water quality criteria have been approved in accordance with the Federal Water Pollution Control Act as amended. New York State does have approved criteria within the meaning of that statute and they are listed, officially listed by the Environmental Portection Agency as one of the states which has approved criteria. The criteria were approved by the Secretary of the Interior in 1967.

CHAIRMAN JENSCH: Yes. But since that time the thermal release standard has not been improved by the Water Quality Act or the Environmental Policy Agency, has it?

MR. MARTIN: Mr. Chairman, it's my understanding that the State of New York's criteria is approved. This is the approval I just spoke to you about.

CHAIRMAN JENSCH: Yes, 1967.

MR. MARTIN: That's correct.

CHAIRMAN JENSCH: I am talking about thermal releases approved.

MR. TROSTEN: Oh, are you referring, sir to the Section 21B?

CHAIRMAN JENSCH: Yes.

MR. TROSTEN: Yes. The New York State Department of Environmental Conservation has issued a certificate, a reasonable assurance with respect to the Indian Point 2

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facility, in December of 1970, pursuant to Section 21B of the Federal Water Pollution Control Act as amended. This statement of reasonable assurance was furnished to the Atomic Energy Commission submitted to the Atomic Energy Commission in accordance with the requirements of the statute and is referenced in various documents on file here, including the environmental report of the Applicant.

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CHAIRMAN JENSCH: I am talking about thermal releases.

MR. TROSTEN: Yes, sir, that's what I was talking about.

CHAIRMAN JENSCH: Have they been approved by any federal agency?

MR. TROSTEN: Thermal releases from the Indian Point 2 plant?

CHAIRMAN JENSCH: Yes, the proposed thermal releases, that the temperature increases proposed if the plant is authorized to operate.

MR. TROSTEN: Are you referring to the approvals-- which agencies, sir, are you referring to?

CHAIRMAN JENSCH: As I understand it, the Water Quality--

MR. TROSTEN: Improvement Act?

CHAIRMAN JENSCH: Yes. That has been transferred from the Department of Interior to the Environmental Protection Agency. Has that latter agency approved the thermal releases for the operation of the Indian Point 2 plant?

MR. TROSTEN: Let me respond in this way to your question, Mr. Chairman. The certificate of reasonable assurance which was submitted to the Atomic Energy Commission under Section 21B of the Federal Water Pollution Control Act, we are advised, was submitted by the Atomic Energy Commission

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to the Environmental Protection Agency as required by that section of the statute.

I might add, in addition, that the Consolidated Edison Company has filed an application under the Refuse Act for a Refuse Act permit with regard to Indian Point 2 as required by the Refuse Act, and the application in accordance with the regulations of the United States Corps of Engineers, has been furnished to the Environmental Protection Agency for its review in accordance with the April 1971 regulations of the Corps of Engineers.

Does that respond to your question, Mr. Chairman?

CHAIRMAN JENSCH: Not quite. I'm trying to get, yes or no, has the Environmental Policy Administration approved the thermal releases of the proposed operation of the Indian Point No. 2 plant? Try that yes or no.

MR. TROSTEN: Mr. Chairman, in attempting to answer your question, I wasn't giving a yes or no answer because I wanted to be sure I understood it. There is no legal requirement, that the releases from the Indian Point 2 plant be approved as such, excepting in the sense in which I have been describing, sir.

CHAIRMAN JENSCH: I think where it comes down is to whether the State of New York's thermal releases have been approved and would affect the Indian Point 2 plant. Is that correct, Mr. Martin?

MR. MARTIN: The State of New York standards have been approved and the State of New York--

CHAIRMAN JENSCH: You are talking about 1967?

MR. MARTIN: Yes.

CHAIRMAN JENSCH: I am talking about something in 1970.

MR. MARTIN: The thermal discharge.

CHAIRMAN JENSCH: Have you had anything since 1970?

MR. MARTIN: Not since 1970.

CHAIRMAN JENSCH: I believe that takes care of the inquiry.

MR. TROSTEN: Thank you, Mr. Chairman.

I would simply want to observe that the Water Quality Improvement Act of 1970 and the reorganization plan which transferred the Secretary of the Interior's responsibility to the Environmental Protection Agency did not require a new approval of the water quality standards of the State of New York subsequent to the approval by the Secretary of the Interior in 1967. I just wish to observe that.

CHAIRMAN JENSCH: This is something that we can give further consideration to, as to whether it is required or not. As I understand, Mr. Martin, something has been submitted, has there not? What did you say, has been submitted recently still under the discussion stage?

MR. MARTIN: This is a matter of updating the

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standards that were approved in 1967. New York State does have standards.

CHAIRMAN JENSCH: They are updating those and seeking approval thereof; is that correct?

MR. MARTIN: Yes.

CHAIRMAN JENSCH: What is the change, from what to what?

MR. MARTIN: I don't know what those changes were. I just am relating the information. The Department of Environmental Conservation, that yes, New York did have standards and were adopted and approved in 1967, that there are modifications and continuing discussions are going on about them. I asked when they would be completed and they could give me no time estimate. They did reassure me that there are standards and that they have been approved to that extent.

As far as the Department of Environmental Conservation is concerned, they have reviewed the discharges.

CHAIRMAN JENSCH: What is it that New York State now seeks to have approved and which it hasn't yet--

MR. MARTIN: Perhaps the Applicant could tell you that.

MR. TROSTEN: Mr. Chairman, the new material which is under discussion by the State of New York and the Environmental Protection Agency is described in the Applicant's environmental report. We will seek the reference and provide it to the Board very shortly.

CHAIRMAN JENSCH: That is in this larger volume; is that correct?

MR. TROSTEN: Yes. I am referring to the supplemental environmental report filed by the Applicant on September 9, 1971, which will be offered in evidence at a future session of the hearing.

CHAIRMAN JENSCH: And that document, the Board would note, we will be giving further review before completing our considerations of the environmental matters and before completing the expressions of our concern in the environmental field.

As I understand it, that is the session that the parties discussed having convened on December 14, 1971.

MR. TROSTEN: I'd like to make an observation with regard to that, Mr. Chairman.

As you know, Section D-2 of Appendix D provides, and Section D-1, as well, provides for motions to be filed for authorization of limited operation while the NEPA environmental review, including the hearing by this Board, is going on for the Indian Point 2 plant. The full scale NEPA environmental review and hearing will, of course, involve consideration by the Board and introduction into evidence of Applicant's environmental report, a document to which I just referred.

Applicant is not offering in evidence, Mr. Chairman, that environmental report in support of a motion for limited operation which is before the Board and was before the Board on September 24th, and supplemented on October 19th. We are offering in evidence, in support of that motion, only the testimony which was offered in evidence today and sponsored by our panel.

It is Applicant's position that by offering that evidence, we believe that we have sustained the burden of going forward with the evidence called for under Section D of Appendix D.

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MR. TROSTEN: I would like to also make the point, Mr. Chairman, that with regard to radiological safety matters--

CHAIRMAN JENSCH: Excuse me. You don't have any objection to the Board looking at the supplemental report filed on September 1971?

MR. TROSTEN: No.

CHAIRMAN JENSCH: Since there was opposition from the radiological safety point of view, from the Citizens' Committee for the Protection of the Environment, that Section 50.57(C) could not be utilized because of the fact that the initial decision has to be issued even at 20 per cent of power; is that correct?

MR. TROSTEN: Section 50.57(C) is utilized, sir. It is just a particular portion of 50.57(C), the portion that requires, in the case of a contest, the Board will make appropriate findings and make an initial decision.

May I make this observation, too, Mr. Chairman, with regard to the radiological safety matters. We wish to have the Board, as do all the Intervenors, the Citizens' Committee for the Protection of the Environment, EDF and HRFA wish to have the Board consider the motion that is before the Board now on the basis of the state of the record as of the conclusion of the session of hearings, not the session of hearings commencing on December 14. The objective here was to put before the Board, as far as radiological safety matters are concerned, all of the record in the proceeding to date. It was not the intention to adduce additional evidence on radiological safety matters insofar as the 50 per cent license is concerned.

Of course, if some situation should develop whereby Applicant felt that some additional evidentiary presentation was required with specific reference to the 50 per cent license, that has not already been put before the Board, then, of course, we would proceed to do so. That is not our intent at the present time.

CHAIRMAN JENSCH: We don't want you to have the option entirely yourself. The Board is much concerned about this general statement as has been found by this panel today. We will indicate to you in a general way of our concerns.

We intend there should be much more environmental data available. Whether you and the Hudson River Fishermen's Association and Citizens' Committee for the Protection of the Environment and Environmental Defense Fund believe that this record is what you want the Board to consider, the Board feels that it will make a definite indication to the parties respecting the scope of the record. We are not satisfied with the general conclusions which are set forth in the statement. We will try to indicate to you today, those things, such further matters will await further review of the matters pertaining to environmental matters.

In addition, we do not feel that we will be in a position to completely consider the relationship of a 20 per cent power request or a 50 per cent power request without a statement from the Staff.

The Staff, as we understand it, is in the process of working up a statement in reference to both power levels sought for testing here. In that connection, of course, we would hope that the Staff, and we request the Staff, to secure statements from those Federal agencies who have been shown in the original Staff safety evaluation, where comments were received in certain respects which did bear on environmental matters. We ask the Staff to secure comments from the expertise of the outside agencies who would have concern in these fields.

Does the Applicant have anything further to state on the environmental point of view?

MR. TROSTEN: Mr. Chairman, we have no further direct evidence to offer at this time.

CHAIRMAN JENSCH: Very well.

MR. TROSTEN: We are certainly prepared -- you indicated a moment ago that you had some general concerns that you wished to put forward.

CHAIRMAN JENSCH: Yes.

MR. TROSTEN: We are prepared to respond to these concerns to the extent that we are able to today.

CHAIRMAN JENSCH: We will that right now.

MR. TROSTEN: Mr. Chairman, I also have the reference in the report that I said I would provide to the Board. May I give that now?

CHAIRMAN JENSCH: Yes, please.

MR. TROSTEN: The criteria in effect at the present time are described and quoted on page 2.3.3 - 13 of Applicant's September 9, 1971, supplemental environmental report. The changes between the present and the former criteria are described in Appendix K to that document.

CHAIRMAN JENSCH: Could you briefly indicate what the changes are that are sought for approval by the State of New York?

MR. TROSTEN: Yes. Dr. Lawler will respond to that question.

CHAIRMAN JENSCH: Please do. Are you reading from a document or --

DR. LAWLER: I can respond to that question generally, Mr. Chairman.

CHAIRMAN JENSCH: Very well.

DR. LAWLER: You wish now, as I understand it, the difference between the criteria submitted and approved by the State of New York in 1967 and the criteria adopted by the State of New York in 1969, re: thermal discharges?

CHAIRMAN JENSCH: Has there been any later adoption by the State of New York after 1969 that you know of?

DR. LAWLER: To the best of my knowledge, no.

CHAIRMAN JENSCH: Very well. Proceed, please.

DR. LAWLER: The criteria adopted by the State of

New York in 1969 given on page 33 of the testimony that was submitted by this panel this morning.

DR. GEYER: May I ask a question?

CHAIRMAN JENSCH: Yes.

DR. GEYER: A moment ago it was said that the 1967 standards were in force. You are talking about 1969. I am confused.

MR. TROSTEN: I believe we were talking before, Dr. Geyer, in a context of standards that had been approved by the Department of the Interior, now the Environmental Protection Agency. It was the context in which we were discussing it. The 1969 standards are in force in the State of New York, but these standards have not received the approval of the Environmental Protection Agency.

CHAIRMAN JENSCH: Is this showing on page 33 of this statement submitted this morning of the Applicant in support of its motion for issuance of the license authorizing limited operation -- does that reflect all of the data reflected in Appendix K of the environmental report submitted by the Applicant of September 9, 1971?

MR. TROSTEN: What page was that, Mr. Chairman?

CHAIRMAN JENSCH: Dr. Lawler will tell you the page he gave us.

MR. TROSTEN: And these are the same criteria as those reported on the page that I mentioned, Mr. Chairman.

CHAIRMAN JENSCH: Are there any other data in Appendix K related to the thermal releases as reflected in your filing of September 9, 1971?

DR. LAWLER: Appendix K addresses itself to the criteria adopted by the State of New York in 1969. Actually, Appendix K discusses both criteria. Appendix K was written primarily because of the change in criteria by the State of New York. The thrust of the change in criteria by the State of New York is that they generally were made more restrictive as applies to a thermal discharge.

CHAIRMAN JENSCH: Maybe perhaps this is a legal question and let me address it to Applicant's counsel or to Mr. Martin.

The State of New York has adopted the criteria reflected on page 33 of the statement submitted by the Applicant this morning; is that correct?

MR. MARTIN: That's correct.

CHAIRMAN JENSCH: So that what is in effect as far as the State of New York is concerned are the criteria reflected on page 33 of the statement; is that correct?

MR. TROSTEN: Yes, that's correct.

CHAIRMAN JENSCH: There have been no Federal approvals of those criteria, as I understand it, Mr. Martin; is that correct?

MR. MARTIN: That is correct.

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: So the matter is awaiting some determination in that regard. Do you know what date it was submitted by the State of New York to the Environmental Protection Agency?

MR. MARTIN: I don't know.

MR. TROSTEN: I believe it is approximately October of 1969.

CHAIRMAN JENSCH: They certainly got ahead of the Environmental Agency all right. Do you know if there has been any letters acknowledging receipt or indicating the status of the consideration of the criteria adopted in 1969?

MR. MARTIN: During the recess I was advised by a representative of the Department of Environmental Conservation that DEC and the Federal Agency have been cooperating to review this, and review towards approval. This, as is indicated, is a continuing process. Whether or not there is correspondence, I don't know.

CHAIRMAN JENSCH: I imagine it will be continued until it is concluded. I was wondering how long it has been continuing to see when it might be concluded.

MR. MARTIN: I asked the question if he knew when it might be concluded and he said no.

CHAIRMAN JENSCH: Since the State of New York is welcomed as a party to this proceeding, if you will endeavor to secure some more specific information on what endeavors have been made to secure approval, having called up the Environmental Policy Agency and said, we have something here and have you had a chance to look at it and have there been any conferences about it or is it just laying dormant until somebody gives it a push. Is there anything to indicate to us how well this is progressing or not progressing, who is not doing something or who is doing something? Anything in that regard we will be glad to have.

So if we take the criteria presently adopted by the State of New York, I take it that these concerns we should have foremost in consideration for environmental considerations for the thermal releases; is that correct?

MR. TROSTEN: That's correct, sir.

CHAIRMAN JENSCH: Very well.

DR. GEYER: For purposes of clarification, I would like to ask some questions about the document submitted this morning, entitled, "Testimony of Applicant in Support of its Motion for Issance of a License Authorizing Limited Operation."

MR. TROSTEN: Dr. Geyer, I don't mean to interrupt you, sir. I wanted to ask you one question about one of the witnesses, Mr. Robert Wiesemann. Mr. Wiesemann has had a death in his family and has asked if he may be excused for the remainder of the session so that he may go home. Is that all right?

CHAIRMAN JENSCH: Oh, indeed. We certainly express regrets in his absence.

MR. TROSTEN: Thank you. Go ahead, Dr. Geyer.

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DR. GEYER: Referring to page 34 of this document, the second sentence in the long paragraphb beginning about the middle of the page it says, "Model studies have indicated that the plume from such combined discharge will not extend more than 250 feet across the river from Indian Point."

How is the plume defined? Is it a four-degree boundary plume or one and a half-degree boundary plume or neither of these? What is its definition?

MR. WOODBURY: The plume is limited by a four-degree isotherm, sir, on the surface.

DR. GEYER: On page 39, "Experience has shown that some of the difficulties at the thermoelectric power plants which have been attributed to thermal effects have in fact been due to misuse or accidental release of chemicals of different kinds."

In the case of Indian Point what proportions are taken against either accidental overdoses or inadvertent use of the wrong chemicals or too much of the chemicals?

MR. WOODBURY: Mr. Cahill will address that question.

MR. CAHILL: The control is through the analysis measurement of the chemicals in use in the plant which are known before discharge and are under control by virtue of the large amounts of dilutant water available in the circulating water system.

DR. GEYER: What supervision is provided over the person who adds chlorine, for example?

MR. CAHILL: Let me check with our operating people.

Well, as I thought, the regular operating personnel, a trained operator would supervise the addition of the chemical, but a Staff man, a technician versed in chemistry, would also be in surveillance over the operation. So there is a line and a Staff control.

MR. TROSTEN: May I inquire in that regard, Mr. Cahill, is this an automatic injection system?

MR. CAHILL: There is what we call a meter and pump. It's a pump that discharges with a fixed amount of injection, but it's under manual control.

CHAIRMAN JENSCH: That is it doesn't inject every 24 hours?

MR. CAHILL: No, it's not automatic.

CHAIRMAN JENSCH: How often are you planning to inject your chemicals? This is to clean the condenser tubes.

MR. CAHILL: This is to maintain the condenser tubes in a state of cleanliness, to avoid the build-up of slime on the tubes.

CHAIRMAN JENSCH: What is the chemical, chlorine?

MR. CAHILL: It's sodium hypochlorite.

CHAIRMAN JENSCH: Yes.

MR. CAHIL: Which is HDH which we use in swimming pools.

CHAIRMAN JENSCH: And how often are you planning to have the injection of the chlorine?

MR. CAHILL: I can check on just what the time period is. It's determined from the point of view of using a minimum amount of the material consistent with the maintenance of the cleanliness of the tubes.

So this is determined by observation and maintains the tube minimum and also controlled from the point of view of not having any residual chlorine left after it's used up in cleaning the tubes and does not have a residual.

Let me just check on the time period that is planned at this time.

CHAIRMAN JENSCH: And also what is the experience at Indian Point 1.

DR. GEYER: This is right before us. On the footnote on the table on page 40 appears the answer.

MR. CAHILL: This is given in Table 3 of our testimony and I will summarize it.

It's planned to be three days a week on alternating days and the injection lasts about a half hour. Indian Point 1 is using the same type of cycle. It's injected on Monday, Wednesday, and Friday, and the plant at Indian Point 2 will be injected on Tuesday, Thursday, and Saturday.

CHAIRMAN JENSCH: In different quantities, however, and volumes, I expect, is that correct?

You will use more for the Indian Point 2?

MR. CAHILL: There is more water flow, of course, through Indian Point 2 by virtue of the larger size. And the amounts of control from the point of view of conservation that's necessary to keep the tubes clean and to stay within the minimum residual concentration.

CHAIRMAN JENSCH: Have we had a chemical analysis from the releases from Indian Point 1 as they get to the river and returning from the condenser tubes?

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MR. CAHILL: Yes, sir. We are keeping within this residual limit which is one-half part per million.

CHAIRMAN JENSCH: Well, as I understand your testimony you are doing it three times a week for Indian Point 1 and you will do the same for Indian Point 2. I would infer from your statement that you are planning it this way without necessarily a chemical analysis before you investigate the chlorine and hypochlorite, is that correct?

MR. CAHILL: The plan is that. This will be checked of course when we actually do it. We check chemically for the residual chlorine in the coolant water after it's gone through the condenser.

CHAIRMAN JENSCH: What kind of analysis do you make before you inject the chlorine as to the necessity of doing it?

MR. CAHILL: As to the need for keeping the tubes clean?

CHAIRMAN JENSCH: Yes.

MR. CAHILL: This is based on observation. Right now it's based on experience with Unit 1 and other condensers on this system and in plants in the vicinity as to just how much is needed. This is also based on observations of the performance. If the condenser tubes become fouled, the back pressure will rise. That's a determinant in the frequency of the chlorination.

And finally, there is injection of the tubes from time to time to see whether they are slimy.

CHAIRMAN JENSCH: Well, you can't inspect the tubes while the water is flowing through them, can you?

MR. CAHILL: No, but there are outages that occur and the tubes are looked at.

CHAIRMAN JENSCH: There is not outages during the week. There is outages during shutdown or repairs, is that it?

MR. CAHILL: That's right.

CHAIRMAN JENSCH: And that is infrequent and irregular, correct?

MR. CAHILL: If there are not outages that coincide for other reasons, during the period when youwere trying to establish a program and test its effectiveness, a short outage to look at a segment of the condenser can be taken during a lull period, and also these condensers are separated and it's possible to look into one waterbox while the plant's underway.

CHAIRMAN JENSCH: Do you keep records of your determination for the need before you chlorinate the water for cleaning the tubes?

MR. CAHILL: Let me check, please.

We keep records of chlorine demand. That is the amount of chlorine that is used up by the river water or absorbed, that is reacted with the river water in passing through the condenser. These are maintained as records and are submitted to the State of New York.

CHAIRMAN JENSCH: Well, I don't know if that was quite my question. As I understand it, you are going to do this on alternate days during the week if it's needed. And I wondered if you keep records of the need: Based upon some determination does the tube need to be cleaned?

MR. CAHILL: There isn't a record maintained. This is an infrequent type of determination. It's made to establish a program. This experience that we will get is sufficient to verify whether or not the program is effective or more than effective and that would stand for a long time.

CHAIRMAN JENSCH: Well, the algae in the river will change according to the seasons, will it not, and that is what you are trying to keep out of the condenser tubes, isn't it?

MR. CAHILL: Well, it's not just algae. It's other biota.

CHAIRMAN JENSCH: Well, the other biota, the levels of the other biota will change according to the seasons, will they not, and affect your needs for chlorine?

MR. CAHILL: Perhaps somebody else on the panel would know that.

MR. WOODBURY: Dr. Lauer.

DR. LAUER: In respect to the kinds of organisms growing in there, it wouldn't be expected that these would be algae, sir, because they require light, but it would be slime organisms, molds and slime, fungi, things of that type. It would be expected that their growth characteristics would vary seasonably, but would not be completely dependent upon the ambient temperatures in the river, since the temperatures are elevated in the condenser tubes themselves. So the growth characteristics in the tubes would be different for those organisms than it would be out in the river itself.

But there would be expected to be a seasonal pattern of abundance of these organisms in the river coming into the condenser tubes.

CHAIRMAN JENSCH: Yes. Thank you.

I have understood that that was the situation, so I was wondering how they determined the need if they just did it on a pattern of every other day during the week, and I understand you don't have anything further. This can be something we can inquire further into at the next session.

Thank you.

MR. WOODBURY: I think I would be able to help you. Originally, Indian Point 1 we chlorinated every day. We undertook a series of tests to determine the minimum amount of chlorination. Those tests enabled us to reduce the chlorination from once a day seven days a week and once each shift to three times a week, one hour at a time, making a very substantial reduction, and it's this rate that we now use on Indian Point 1 and that we propose to use on Indian Point 2.

The same data has been furnished to other utilities on the river who are adopting it.

CHAIRMAN JENSCH: I understood there was something about the difference in the heat transferred across the condenser tubes that affected the need for chlorination.

MR. WOODBURY: Yes, that's correct, sir.

CHAIRMAN JENSCH: Maybe you can give us some data on that the next session. Thank you very much.

MR. WOODBURY: I can advise you at this time that the measurement of heat transfer is not sensitive enough to be a basis for controlling the introduction of chlorine.

CHAIRMAN JENSCH: I am sure that will be very interesting to all the utilities which do use that program.

Thank you very much.

DR. GEYER: My next question has to do with the table that we have just looked at. Table 3 on page 40. The first three chemicals listed are used in the steam supply system, which is a closed system. It's stated in the next to last column that the maximum flow in gallons per minute is 200. This certainly isn't a continuous release, is it? If so, what is the release of these chemicals or chemical solutions? For example, what is the average rate of release?

MR. CAHILL: I'd have to check further on that, sir.

DR. GEYER: All right. While checking, the second part of the same question, the last column gives sustained releases in terms of pounds per day.

MR. CAHILL: Yes.

DR. GEYER: Are these average figures or is this released continuously, or does this release occur in what period of time?

MR. CAHILL: We will have to confer and check on that.

CHAIRMAN JENSCH: In the same table down in the next to last item, sodium-hypochlorite, the maximum flow given there is five gallons per minute at half a part per million. The half a part per million must be in the total condenser flow, must it not?

MR. CAHILL: That's correct.

CHAIRMAN JENSCH: So this five is wrong, I presume.

MR. CAHILL: No. That's .5 parts per million. Half a part per million is the residual concentration of sodium-hypochlorite.

DR. GEYER: In the condenser water?

MR. CAHILL: Yes.

CHAIRMAN JENSCH: But there is certainly more than five gallons per minute of condenser water.

MR. CAHILL: Oh, I see. That's the concentrated solution.

DR. GEYER: So the .5 could be for the concentrated solution or the five should be the total condenser flow. The two numbers don't go together is the point.

MR. CAHILL: Right.

DR. GEYER: The next question has to do with the last item, sodium hydroxide. This is demineralized for regeneration discharge from the primary system demineralizer. It is double-starred, but the double star says, "Only under adverse conditions of evaporator breakdown," is that correct?

MR. CAHILL: Yes.

DR. GEYER: You mean you discharged demineralizer regeneration water only under adverse conditions of evaporator breakdown?

MR. TROSTEN: Mr. Chairman, in view of the questions that you have raised I think that we'd ask one of our supplemental witnesses to be sworn and take the stand.

CHAIRMAN JENSCH: Very well. If you will identify him, have him come forward, he can be sworn.

MR. TROSTEN: I'd like to ask Mr. Walter Stein to come forward, please, and be sworn.

(Walter Stein is sworn.)

CHAIRMAN JENSCH: Would you give us your name, please.

MR. TROSTEN: I am reaching for a set of professional qualifications of Mr. Walter Stein, Superintendent of the Consolidated Edison Company of New York. I would like to show these to the Board, have them distributed to the Board and parties, Mr. Chairman, and have these introduced into evidence.

CHAIRMAN JENSCH: Will you proceed, please.

MR. TROSTEN: Mr. Stein, I show you a document entitled, "Professional Qualifications, Walter Stein." Was this document prepared by you?

MR. STEIN: Yes, it was.

MR. TROSTEN: Are the statements contained in it true and correct and is this a correct statement of your professional qualifications?

MR. STEIN: That is correct.

MR. TROSTEN: Do you desire to have this statement of your professional qualifications received in evidence in this proceeding?

MR. STEIN: I do.

MR. TROSTEN: Mr. Chairman, I offer in evidence the document entitled, "Professional Qualifications, Walter Stein," and ask that it be incorporated in the transcript as if read.

CHAIRMAN JENSCH: Is there any objection by the Staff?

MR. KARMAN: No objection.

CHAIRMAN JENSCH: State of New York?

MR. MARTIN: No objection.

CHAIRMAN JENSCH: Hudson River Fishermen's Association?

MR. MACBETH: No objection.

CHAIRMAN JENSCH: Citizens Committee for the Protection of the Environment?

No objection, the request is granted and the reporter is instructed to physically incorporate in the transript the professional qualifications of the witness, Walter Stein.

MR. TROSTEN: Right.

CHAIRMAN JENSCH: Will you proceed.

DR. GEYER: Maybe I can ask another question first that will clear this matter up for me.

The demineralizer in question apparently is used only when an evaporator is not in service, correct?

MR. STEIN: No, that is not.

DR. GEYER: Please explain the situation.

MR. STEIN: The demineralizer in question is the demineralizer that's used to polish the condensate from the borone evaporator which is used in the borone recycle system. This demineralizer is to remove the traces of boric acid that are in the overhead. The demineralizer is generally not radioactive because prior to entrance to the evaporator the water has been cleaned by ion exchange filtration. The overhead is therefore generally clean with the exception of tritium. The ion exchange resin which removes the traces of boric acid is regenerated with sodium hydroxide in order to make the resin usable again.

This sodium hydroxide would then be processed normally by another evaporator, the waste evaporator in the system. The waste evaporator bottoms, of course, which would concentrate sodium hydroxide are drummed to be shipped off site.

If, however, that waste evaporator should break down, the sodium hydroxide would be discharged.

DR. GEYER: Thank you. That clarifies it.

MR. TROSTEN: Dr. Geyer, you asked some earlier questions which I believe we'd be in a position to have Mr. Stein respond to. May we go ahead and do that now?

DR. GEYER: Certainly.

MR. TROSTEN: Yes.

MR. STEIN: I'd like to discuss the whole subject of chlorination, if I may, again.

Statements made were essentially correct. I'd like to add some statements regarding the method of control and addition.

The chlorine demand of the river water is measured twice a month in order to establish the quantity of chlorine injection required to maintain a residual. The residual that's required to be maintained by the State of New York Department of Environmental Conservation permit is less than a half a part per million. Generally, however, since we chlorinate only one-half of the cooling water the chlorine residual at the discharge, at the outfall, is much lower because the chlorine demand of the Hudson River averages close to one part per million. So therefore if you are discharging at a chlorine residual of a half part per million into water that has a discharge and a chlorine residual of nine-tenths to one part per million, the measured chlorine residual is undetectable.

So that normally, and this is on a report that is generated by the station forces, it's submitted to the State monthly. The chlorination residuals are reported and are eventually measured at less than a tenth of a part per million discharging in the outfall through the condenser.

On the subject of using heat transfer measurements to control the amount of chlorine required, if you wait for the heat transfer to be effected you will be at a situation where chlorine will kill the organisms growing on the condenser tubes, but the bodies will remain there, and therefore the heat transfer will still be impeded, and you will have to remove the skeletons with an acid wash, which is standardly done in conventional power plants, which probably has more impact on the environment than all the chlorine you have been putting out.

DR. GEYER: Thank you.

MR. TROSTEN: Thank you. That's all we have.

I am sorry. Yes. Mr. Stein has some additional information to convey to the Board with regard to the table, particularly the first three --

CHAIRMAN JENSCH: Excuse me. Before you leave that subject I wonder at our next session if Mr. Stein could give us a little discussion about this acid wash and why, as I understand it, other utilities seem to be able to get along with these heat transfer calculations where they use chlorine and apparently they don't have the trouble with the organisms, skeletons, bones, clogging up the condenser tubes.

MR. STEIN: I have no knowledge that the generally accepted practice is to control chlorine addition by measurement of heat transfer. It is not a practical solution. There may be some utilities in some locations because of the chlorine demand of that water where there is a possibility. But in general that's not the case.

CHAIRMAN JENSCH: You use a term "the chlorine demand in the water." It's really the chlorine demand that you want to use to clean the condenser tubes.

MR. STEIN: That's partially correct, but the chlorine demand of the water is the function of the organic and oxidizable material that's present in the Hudson River water or any cooling water. This will use up the chlorine in other reactions, some of which are to kill organisms, some of which are also to oxidize the materials that are not living materials. This chlorine demand is a standard term used in publications as a standard test method. ASTM, APHA define this term in their tests.

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CHAIRMAN JENSCH: Yes. That's fine for their tests. What we're interested here is that you want to put some chlorine in the water to clear some slime organism out of your condenser tubes; is that correct?

MR. STEIN: You want to prevent them from growing on the surfaces, your heat transfer surfaces.

CHAIRMAN JENSCH: You will kill some if any happen to get in?

MR. STEIN: Naturally.

CHAIRMAN JENSCH: So you take the Hudson River water and you find out how much chlorine you want to put in to accomplish your objective; is that correct?

MR. STEIN: That's partially correct. You ought to establish, by experience, how much is necessary in terms of the frequency of chlorination to keep the condenser free from this growth.

CHAIRMAN JENSCH: Do you make tests of the water before you use it and do you make any records of the tests of your needs before you have the chlorine?

MR. STEIN: Yes, we do. We do twice a month tests on the chlorine demand of the Hudson River, and we report the results of the chlorination which includes the chlorine demand to the state on a monthly basis.

CHAIRMAN JENSCH: Do you do that by a basis of showing what the residual is coming out of the condenser tube?

MR. STEIN: That's correct, as well as reporting the quantity of the use, the concentration of the material used and the flow rate at which the chlorine was put in in terms of the river water.

CHAIRMAN JENSCH: Do you make any tests of the condition of the water before it goes into the tube?

MR. STEIN: Yes. The basic test I am talking about on chlorine demand is before it goes into the tubes. It is out in the Hudson River proper. Sample is taken from that water before it enters the condenser tubes.

CHAIRMAN JENSCH: How often do you make that test?

MR. STEIN: Twice a month.

CHAIRMAN JENSCH: What experience gives you the alternate day program for ingesting chlorine?

MR. STEIN: As I think Mr. Woodbury stated, we started off chlorinating once a watch, three times a day, seven days a week. We gradually reduce the frequency to the point at which we began to get growth in the condenser which would have impeded heat transfer had we let it go any further, and would have required a cleaning, a chemical cleaning to remove the people. As soon as we detected that minimum point, we stopped and arrived at this chlorination frequency.

CHAIRMAN JENSCH: Did New York State suggest you reduce from one part per million to .5 parts per million?

MR. STEIN: The .5 parts per million has been on discharge of concentration since the beginning of operation.

CHAIRMAN JENSCH: Had the New York State Department suggested to reduce it to any respect?

MR. STEIN: Below 1.5 parts per million.

CHAIRMAN JENSCH: Or make any change in your chlorination program?

MR. STEIN: Not to my knowledge.

CHAIRMAN JENSCH: Proceed.

MR. TROSTEN: Mr. Stein will proceed to discuss the first three chemicals on this Table 3.

MR. STEIN: The phosphate concentration, I think that question, was the first one to be used. That is the concentration in the secondary steam generator as indicated. The flow rate listed there is the maximum flow rate that it would be discharged at from blowdown of the steam generators, and the sustained release is the amount that we would expect to release under normal conditions of blowdown.

DR. GEYER: Is there release just during blowdown?

MR. STEIN: Yes, that's correct.

DR. GEYER: Do you blow this system down every day?

MR STEIN: The steam generators are blown down as required. The number is based on continued blowdown. It is a conservative number. It is based on doing this 24 hours a day. The same general statements are true for the hydrosteam and the cyclohexanene. The numbers there are also based on

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24-hour continuous discharge, at the flow rate listed there, yes.

CHAIRMAN JENSCH: Can you give us, at your next session, what your actual experience is on blowdown with those chemicals?

MR. STEIN: As far as Indian Point 2 is concerned, we do not have the experience since the steam generators have not been operating yet. As far as Indian Point 1 is concerned, our experience is that we discharge much less than we expected to.

CHAIRMAN JENSCH: Could you give us some information on that, please.

MR. STEIN: Yes. The typical blowdown for Indian Point 1, for example, ranges from about five to ten gpm, per steam generator. The maximum of a drum or surface below, which is the oneyou would continuously use, is approximately 30 gallons a minute as compared to five to ten per steam generator typically. The concentrations are the same approximately.

CHAIRMAN JENSCH: How often is that?

MR. STEIN: On Indian Point 1, there is generally continuous blowdown. On Indian Point 2, there is a blowdown flash tank. With that there is only periodic blowdown.

CHAIRMAN JENSCH: Thank you.

Did you have something further, Applicant's counsel?

end

MR. TROSTEN: No, sir. We don't at that time.

DR.GEYER: The next questions deal with figures in Table 4 on page 41.

First with regard to the heading, it says these are proposed concentrations of chemicals at the confluence of the discharge canal in the Hudson River.

Are these concentrations in the condensor water?

MR. STEIN: These concentrations are in the outfall, which total coolant water discharge to the Hudson River.

DR. GEYER: Taking the first number, the phosphate, 1.54, that sounds like a lot of phosphate for that much water.

MR. STEIN: It is correct. That is not the expected discharge concentration but rather the supposed limit for discharge.

DR. GEYER: Did you get information on the expected values of these numbers?

MR. STEIN: The expected value for the phosphate discharge based on a minimum flow rate of 100,000 gallons per minute would be approximately .03, three hundredths of a part per million. Would you like to go on?

DR. GEYER: Let's take a couple of more. For example the boric acid looks kind of high.

MR. STEIN: The expected boric acid discharge concentration, again, at 100,000 gallons per minute, is 2.8 parts per million.

DR. GEYER: And sulfuric acid.

MR. STEIN: Expected sulfuric acid discharge from Indian Point 2 is none because it is not used. For Indian Point 1, it is used in the make-up water treatment system, and there it would be approximately nine parts per million.

DR. GEYER: In the make-up water?

MR. STEIN: In the discharge from the make-up water demineralizes that use sulfuric acid. Let me point out that these would not be sustained discharges. On the sulfuric acid the regeneration takes place for approximately one hour every four days.

DR. GEYER: Thank you.

The next question is on page 47. The second sentence of the first full paragraph reads, "This is due to the high abundance of the species in the river as a whole and the fact that a very high mortality occurs naturally to the young fish, i.e., many caught on the streams would otherwise succumb to natural causes."

This sentence, particularly the first clause, is an example of a statement that hadeny numbers connected to it. So the question is here, what is the abundance? What is high abundance? The reader is interested in knowing how the numbers are related to the numbers that are in court.

DR. LAUER: My name is Lauer and I will respond to that in general terms. I will be hard put, although I think

I can come up with some specific numbers, too.

As far as these fish are concerned, we have indications from trolling studies, Gill nets,Sonar scanning and beach seines, to indicate that there is an extreme abundance of fish in the river at all depths and also laterally across the cross section of the river throughout the river.

In terms of the smaller forms, it would appear that this would be for the large size fishes. It would appear that we would have concentrations of fish of that size. This is dependent on spawning seasons, from zero per meter in October up to 80 fish per cubic meter. As they get bigger, of course, due to mortality rates, the abundance of fish of the larger size would be less than this figure of .8 per cubit meter, which is about a maximum that has been observed for the fish larve.

The actual abundance of particular species would be very difficult to answer. It depends upon the individual species and the time of the year, whether or not the fish as compared to residents, and so forth. But it does appear that there is a vast abundance of fish in the river at the present time which are underutilized as far as fish industry resources are concerned for other than the fact of the availability of the fish. We could get into a lot more specifics by going into the specific results of studies that have been conducted in the river by not only NYU but others, over the past approximately three years' time period.

We do have studies that go back over three years from NYU and other studies that also span a three-to-four-year time period when taken in toto. It is very difficult to capsulize in detail all of those reports. They are very abundant and every fishery's biologist who has taken a look at this figure or problem has come away with the same feeling. What he can't say with precision is exactly what that abundance is for each species at each time of the year.

It is my understanding that a study to try to determine that kind of estimate for each species is now proposed to be undertaken in the near future.

DR. GEYER: The last question is a general one and has to do with the material that appears on page 49. It says, "It would be appreciated if the actual data and experiments on which the conclusions on this paper is based will be supplied if it is not already in the environmental impact report supplement."

MR. TROSTEN: These are in the environmental impact report supplement. We can look at these right now and give you a reference.

DR. GEYER: I will be able to find them if they are there. That's all I have, Mr. Chairman.

CHAIRMAN JENSCH: While we are at page 49, at the top of the page, do I understand the statement there to mean that there will be a heat rise by virtue of the proposed operation even at 20 per cent of power, of 25 degrees Fahrenheit, 25.8 degrees Fahrenheit.

MR. CAHILL: Heat temperature rise could be that high, sir, because there are various notes of operation of the circulating water system with more or less pumps in operation with the least number of pumps. Let's say with the lowest cooling water flow. The temperature rise could go up as high as 25.8. The normal flow full load Delta T is about 15 degrees.

CHAIRMAN JENSCH: What is your normal flow load?

MR. CAHILL: 840,000 gpm.

CHAIRMAN JENSCH: 840,000 gallons per minute for just Indian Point 2?

MR. CAHILL: Yes.

CHAIRMAN JENSCH: And about half of that for Indian Point 1?

MR. CAHILL: Indian Point 1 is something like 240,000 gpm. I mean 280,000.

CHAIRMAN JENSCH: What is the heat rise from Indian Point 1, 280,000 gpm, and also at the lowest coolant flow?

MR. CAHILL: Indian Point 1 is something like 12 to 14 degrees at full load with full flow.

CHAIRMAN JENSCH: Then for the lowest coolant flow that you gave for 25 degrees at Indian Point 2, what is it for Indian Point 1?

MR. CAHILL: With the lowest flow, that would go up to about twice that Delta T, say 25.

CHAIRMAN JENSCH: What determines whether you are using the lowest coolant flow?

MR. CAHILL: During the winter periods when there are a lot of small fish in front of our streams, we have been operating with reduced flow in an attempt to reduce the number of fish entrained on the stream.

CHAIRMAN JENSCH: I don't know whether this is an environmental matter. Where are you dumping the fish now?

MR. CAHILL: They are returned to the river.

CHAIRMAN JENSCH: Alive?

MR. CAHILL: Those that are alive are returned alive.

CHAIRMAN JENSCH: And those that are dead?

MR. CAHILL: Are returned dead. I might add, this procedure is in response to the direction of the New York State Conservation Department.

CHAIRMAN JENSCH: Did you petition for that result or did they issue a directive?

MR. CAHILL: No, sir. That is their determination as the best way to dispose of them.

CHAIRMAN JENSCH: Again on page 49, as Dr. Geyer pointed out, the data for those conclusions are in this environmental impact report supplement. I take it the references are plankton and   plankton and the results of the studies that have been carried on by Consolidated Edison, I guess, since 1966. Are those all reflected in this environmental impact report supplement?

DR. LAUER: I think they are in a general way, sir. My name is Lauer. Also the studies are ongoing. Especially the more precise studies to determine the effects of temperature elevations at different exposure times are the most recent. We are getting data on that day by day and I would be happy to give you a bit of a capsulization of what that experience has been if you like it, now.

CHAIRMAN JENSCH: Perhaps you can write it up if it is not in the environmental impact report, and I would better be able to have it in hand if you can submit it that way.

DR. LAUER: Yes.

CHAIRMAN JENSCH: I appreciate your studies are ongoing. As I recall, many of these construction permit hearings, they were ongoing then. Give us some data on those surveys. For instance, you go back on page 48 and there is quite a recitation of the studies and what they will include and how they are carried on, and we'll study this and we'll study that. If you can just give us some study that has been going on, it will be helpful to have that.

MR. TROSTEN: Mr. Chairman, there are volumes of data in the environmental report. The studies are ongoing because the company has a continuing interest in studying the effects of these things. The status to date and the data available to date are contained in the environmental report.

CHAIRMAN JENSCH: Very well. We will find it in there. Thank you. At least this did not seem to give us the data we were looking for and we did not want to confine ourselves to these conclusions, as I indicated in this testimony which has been submitted in support of your motion for limited operation license.

MR. TROSTEN: I might add, Mr. Chairman, I completely understand the interest of the Board in looking at the supplemental environmental report. It may be that particular portions of the environmental report may well be introduced in evidence in connection with this motion. It was felt that introducing the testimony in this fashion seemed to be the best way to the problem, but Applicant would certainly have no objection whatsoever to introduce portions of the environmental report to which reference is made here, and evidence in connection with the motion as well.

CHAIRMAN JENSCH: Thank you very much. Let me turn to this section of the statement of testimony. In reference to the plume, back on page 34, it is 33 and 34.

It says, "On a river such as the Hudson River which is tidal in character, how does this plume measure in character and vary as the tide changes."

DR. LAWLER: You want this in just general terms, Mr. Chairman?

CHAIRMAN JENSCH: If you feel that you can do a better job with more specifics, and do it in writing, that will be agreeable. I won't ask you to give the answer now. If you submit it in writing, I would appreciate it. Is that agreeable to you?

DR. LAWLER: The first thing we can do is reference the report of the modeling study that is referred to on one of these pages, Appendix M. The appendix is K and M in the environmental reports. They contain, among other things, data on the hydraulic model, which shows very clearly the effect of the tide on the plume. Primarily that effect is in terms of the direction and, of course, the extent across the river. The great extent across the river is seen during slack conditions, and the smallest extent is during flood and tides.

CHAIRMAN JENSCH: Thank you. We intended to get to that supplemental report for the December session. I am glad you gave me the reference you have.

Is this a surface discharge of thermal releases at Indian Point Plants 1 and 2?

DR. LAWLER: No, a submerged discharge.

CHAIRMAN JENSCH: How deep in the river?

DR. LAWLER: The depth of submergence is twelve feet.

CHAIRMAN JENSCH: Let me ask you your judgment on this. There have been some suggestions that surface release permitted better cooling because it had the advantage of evaporation. Do you agree?

DR. LAWLER: In a qualitative way that is true. The heat is rejected to the atmosphere proportional to the temperature difference at the water surface. However, when you look at the numbers, you find, for instance, if we take the four degrees isotherm as definitive of the plume, you find that if you have a surface discharge roughly five per cent more of the total heat discharge from the plant will have gone off to the atmosphere if you have a surface discharge as opposed to a submerged discharge. In other words, if you have a surface discharge in Indian Point, you come out to the river at roughly fifteen degrees, and between fifteen degrees and four degrees you reject a certain percentage of the total heat load to the atmosphere.

That will be roughly five per cent more than the heat that you will discharge to the atmosphere in the submerged mode between the maximum surface temperature that you will see from the submerged discharge, which is about seven degrees, and the four degrees isotherm.

CHAIRMAN JENSCH: How far do you feel that the thermal discharge will extend out along the bottom of the river?

DR. LAWLER: The computations as well as the observations made in the model study show that this particular plume will not touch the bottom of the river with the possible exception of some unique wintertime conditions where the density situation would be such that you might drop the plume lower than normally. In that situation in touching the bottom, if you wanted to find it in that fashion, it will occur at velocities very similar to normal tidal velocities in the river.

CHAIRMAN JENSCH: For that wintertime, how far out do you expect that that thermal discharge can go along the bottom?

DR. LAWLER: It would be on the order of the first one hundred to two hundred feet.

CHAIRMAN JENSCH: Does your model support that?

DR. LAWLER: Yes.

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CHAIRMAN JENSCH: I know this is in the FSAR, but just offhand how wide is the river?

DR. LAWLER: The river is 4,000 feet wide at Indian Point.

CHAIRMAN JENSCH: And this plume will be out 2600 feet, is that?

DR. LAWLER: That statement in the test says that it will not exceed--or let me find that precisely.

On page 34 it says, the plume from such combined discharge will not extend more than 2500 feet. That 2500 feet is synonymous with the thermal discharge requirement of the State of New York which requires that no more than two-thirds of the river surface see temperatures equal to or greater than a four-degree rise.

Now for the fifty per cent operation we would expect that the maximum extent would be on the order of 800 feet.

CHAIRMAN JENSCH: And what do you expect for the full power plume, assuming we get to that stage?

DR. LAWLER: What do we expect? We would expect something in the order of 1200 to 1500 feet.

CHAIRMAN JENSCH: Now when does the plume first show in the surface of your submerged release?

DR. LAWLER: When do you mean--

CHAIRMAN JENSCH: Distance.

DR. LAWLER: How long does it take or in distance?

CHAIRMAN JENSCH: Distance.

DR. LAWYER: Roughly a hundred to a hundred fifty feet from the point of discharge. That will depend on what the tide is doing and it will be closer to the shore in a strong tide.

CHAIRMAN JENSCH: Were these figures that you just gave of 800 feet and 1200 feet for slack tide?

DR. LAWLER: Yes, that's correct.

CHAIRMAN JENSCH: And there will be a diminution or a lesser amount for a full tide flow either way, is that right?

DR. LAWLER: That is correct. The slack tide we find to be the most extensive in the lateral direction.

CHAIRMAN JENSCH: Is this plume somewhat circular in form or is it like a teardrop or some such?

DR. LAWLER: You might describe it more like a teardrop than circular, but this again is a function of what the tide is doing.

CHAIRMAN JENSCH: Well, assume the slack tide for the moment.

DR. LAWLER: The slack tide, it would tend to be closer to circular than at any other time.

CHAIRMAN JENSCH: What is the diameter of that circle teardrop formation?

DR. LAWLER: At four degrees?

CHAIRMAN JENSCH: Well, taking the teardrop, aside from four degrees--it's four degrees at the edge of your plume, is it not?

DR. LAWLER: Right. We are using four degrees to define the plume for two reasons. One, it fits with the specific criteria of the State of New York, but secondly, once you get below four degrees, oh, better, three degrees, then the drift, the definition of the plume is less good. You are getting into the full mixing with the river by that time.

CHAIRMAN JENSCH: What is the depth of your plume?

DR. LAWLER: The depth? The depth of the plume will again vary from the point of discharge. I would have to look at some numbers to determine that precisely.

CHAIRMAN JENSCH: Are they in the report?

DR. LAWLER: They probably should be, yes.

CHAIRMAN JENSCH: We will find it if it's in there.

DR. LAWLER: They are in Appendix K.

CHAIRMAN JENSCH: Very well. Thank you.

Well, I think that the Board would feel that if there are conclusions in this statement of testimony of the Applicant in support of its motion which are supported by data in the environmental impact report supplement that we will limit our questions at the moment and look to the report.

MR. TROSTEN: Yes. And as I say, Mr. Chairman, we would be happy to introduce into evidence the appendix, for example.

CHAIRMAN JENSCH: Well, we can't indicate to you our concern at the moment about that, but we will at our next session.

I think this is as far as the Board can go in its expression of concerns on the environmental matters at this time. We will certainly want to reserve and request the parties to be ready for further concerns at our December 14th session. But we thought we'd recess now and then we will consider some emergency core cooling concerns the Board has.

MR. TROSTEN: Yes. Well, may I ask this question, Mr. Chairman. You have indicated that you want to have another session and you have indicated that you wish the general nature of the testimony or the concerns that the Board has. Now the Applicant has pending before the Board a motion dated October 19 for an expedited hearing pursuant to Section D of Appendix D, and in that motion we asked the Board to consider the specific request. The specific motion before the Board was that you order that any hearing with respect to the issuance of such a license shall commence immediately following the conclusion of the hearings on radiological safety issues commencing on November 1, and that the hearing on the limited operations license shall not exceed three days in length.

This motion was pursuant to that portion of the Section D-2 which authorizes the parties and authorizes the Board to limit the time and to prescribe the time within which the proceeding or any portion thereof be completed, and we ask the Board to rule in our favor on this motion and to limit this hearing to three days' duration, in accordance with the Commission's regulations, and to have the hearing be conducted within this period of time, Mr. Chairman.

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CHAIRMAN JENSCH: Well, we certainly will give consideration to the motion. I think that we have indicated already, however, since there is opposition to the motion by the Citizens' Committee for the Protection of the Environment that an initial decision will have to be issued in that regard and therefore presumably that would be a factor that would have to be considered before we could proceed to a consideration of the environmental matters.

Do the parties desire to speak to this matter?

MR. TROSTEN: Yes, Mr. Chairman. I would like to speak to it, if I may. The opposition by the Citizens' Committee for the Protection of the Environment in no way, sir, relates to the environmental aspects of this proceeding. They are not opposing the proceeding in any way or taking any position with regard to the environmental aspects of this motion. The Citizens' Committee opposition to this motion is based on strictly and entirely radiological safety considerations and based solely on the record that the radiological safety proceedings adduced to this time, plus, of course, any cross-examination that Mr. Roisman indicates that he wishes to conduct.

I might add, while I am on that point, Mr. Chairman, that not hearing from Mr. Roisman by noon today, I spoke with Mr. Macbeth at approximately 1:30 and Mr. Macbeth advised me that he had spoken to Mr. Roisman at approximately that time, and thereafter I called Mr. Roisman at approximately quarter of two and inquired concerning the further matter of cross-examination. And Mr. Roisman indicated at that time that he was going to be back in touch with me, but I am not aware that he has contacted me since that time. I expressed, I conveyed to Mr. Roisman, the information that transpired at today's meeting and the Board's suggestion with regard to interrogatories. I told Mr. Roisman that the suggestion with regard to interrogatories was entirely satisfactory to the Applicant, and I might add in this connection, Mr. Chairman, that we would be very pleased to have the Board issue an order that would have Mr. Roisman propound his interrogatories not later than Friday of this week, and the Applicant would be prepared to respond not later than one week thereafter, and thereafter the record for cross-examination on ECCS matters would be closed.

I also expressed to Mr. Roisman the point of view that the Applicant -- Mr. Roisman has some difficulty with a matter of interrogatories and he still as of the time I spoke to him at a quarter of two today was not absolutely sure whether or not Mr. Ford wished to conduct -- Mr. Roisman through Mr. Ford wished to conduct any cross-examination, recross with regard to our redirect.

I suggested to Mr. Roisman as an alternative to the interrogatory route, which as I say is perfectly satisfactory to us, that if he is unhappy with that we would be prepared to have a deposition taken on Friday of this week, following a practice which I believe the Chairman has followed in the past, of having a deposition taken in Washington with the Chairman presiding. We would only wish to have a deposition taken, however, if the Chairman presided as has been customary in the past, but with you, Mr. Chairman. If that is satisfactory to Mr. Roisman it would be all right with us, although we would prefer the interrogatory route suggested by the Board we would not object to have a deposition taken.

CHAIRMAN JENSCH: Well, let the Board give consideration to that. I think that is a good suggestion, that if you have any further interrogation that if it's desired to be oral that we will try to make some arrangements for a deposition in that regard. The Board will want to confer with respect to that matter.

Do the other parties desire to speak to the motion by the Applicant and Staff?

MR. KARMAN: Mr. Chairman, the Staff is in a position where with respect to Applicant's motion under Appendix D, Part D, Section 2 we feel that it would be very difficult for the Board to make any kind of a finding with respect to any significant adverse impact on the quality of the environment about a Staff response similar to the one which we provided to this Board and to the parties on the fuel loading license.

Now, this is our fifth, sixth or seventh time today that that report is not ready yet.

MR. TROSTEN: Mr. Chairman, perhaps Mr. Karman and I should argue this point before the Chairman. We have a motion pending. The Staff is obligated under the Commission's rules to answer within the specific period of time. The Staff has not answered within the period of time and under the Commission's rules is deemed to have accepted the position of the motion, if we were to follow that provision in the Commission's regulations.

CHAIRMAN JENSCH: Well, I think the Board would be inclined to desire a statement from the Staff and we hope that the Staff will be able to develop the statement as soon as possible. But the Board has considered the matter prior to this mention now and desires to express its view that it does desire a statement from the Staff.

MR. TROSTEN: Well, will you be ruling separately then, Mr. Chairman, on our motion?

CHAIRMAN JENSCH: Excuse me?

MR. TROSTEN: I am sorry. Will you be issuing a ruling on our motion?

CHAIRMAN JENSCH: In due course of time we will, yes. Is this a convenient time to recess?

Mr. Martin, did you have something?

MR. MARTIN: Mr. Chairman, I have the Department of

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Environmental Conservation's answer to your question.

CHAIRMAN JENSCH: Very well.

MR. MARTIN: And I am prepared to state those at this time. In compliance with the 1965 Water Quality Act, New York State Department of Environmental Conservation submitted water quality standards to the Federal Government and received approval of those standards. This is in 1967. Submittal and approval.

In 1969 the New York State Department of Environmental Conservation voluntarily upgraded these standards and had them approved by the New York State Water Resources Commission. These upgraded standards were submitted to the Federal Government in July of 1969 and at which time numerous telephone conversations were held over a period of several months while Federal review was conducted.

In November of 1970 the State was informed by letter that those standards, as upgraded, were unacceptable. The State requested Federal comments as to what modifications would make them acceptable, and in April of 1971 a conference was held with the United States Environmental Protection Agency in an attempt to resolve all the differences. It's reported by the Department of Environmental Conservation, and progress was made, but that New York State did not agree to all the suggestions made by the Federal Government. New York State felt that some of these suggestions were not applicable to New York State's specific situation.

In June or July of this year, 1971, the New York State Department of Environmental Conservation made an appeal in writing for approval of the criteria in areas in which there was disagreement with the Federal agency. Reasons were given explaining why New York State thought that they should not be considered applicable to the New York State situation. A reply was received from the United States Environmental Protection Agency earlier this month, November of 1971, concerning the New York State appeal. That reply has not been reviewed by our Department of Environmental Conservation. Even assuming that the reply was favorable that New York State will agree with any comments made by NEPA in the various areas there still remains a series of hearings to be conducted by the New York Water Resources. Now, before New York would finally adopt standards as revised and the standards would then be submitted again to the Federal NEPA for approval.

CHAIRMAN JENSCH: Thank you very much, Mr. Martin, for your detail.

At this time let us recess to reconvene in this room at 3:55.

end

(Brief recess.)

CHAIRMAN JENSCH: Please come to order.

Before we proceed, there are some considerations about the emergency core cooling matters. The Board would request the Applicant, at an opportunity to be provided for the Board and such members of the other parties that desire to attend, the Board review the site, particularly the locus and focus of this fire.

MR. TROSTEN: As a matter of fact, Mr. Chairman, you literally took the words out of my mouth.

CHAIRMAN JENSCH: That will be the day.

MR. TROSTEN: Thank you, I think. Yes, Mr. Chairman, we would be very pleased --

CHAIRMAN JENSCH: 8:30 tomorrow morning, is that agreeable?

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: We will be there. Thank you very much.

The Board does have some matters of emergency core coolant we would like to discuss with Mr. Moore.

MR. TROSTEN: I have a question of the Board. That is whether you desire to have the environmental panel remain in attendance this afternoon.

CHAIRMAN JENSCH: No. We have completed our present statement and concerns about the environmental matters and thank you for being here.

MR. TROSTEN: Do you wish them tomorrow morning?

CHAIRMAN JENSCH: No. In fact, we are hoping we would go on tonight far into the night, if necessary, but we hope to conclude and recess tonight until December 14. I should say we invite comments from the parties at the recess as to their readiness to proceed on December 14th. If the Staff has not completed its study, I think some consideration will have to be given to schedule matters at that time.

MR. KARMAN: We had anticipated, Mr. Chairman, that once we were recessed here and I had a chance to get back to Bethesda and ascertain the present status, we will keep the Board advised.

CHAIRMAN JENSCH: Thank you.

MR. BRIGGS: There are a few general questions that we might start off with. I'm not sure whether Mr. Moore would answer the first one or whether someone else might.

In the cross-examination there was some discussion of some information that all GE had obtained from their tests concerning reactions between the inconel, I guess it was, and the zircalloy clad, and information that Westinghouse had obtained from some tests. It seemed that there was a substantial difference in the amount of reaction that was observed, if I understood this correctly.

Has Westinghouse or has the Staff compared the results of these various tests, and do they have an explanation for the differences in the amount of reaction between zircalloy and inconel in the two series of tests?

MR. MOORE: Mr. Briggs, I think Dr. Roll could probably respond to that better than I.

MR. BRIGGS: That will be fine, if he could.

DR. ROLL: I believe, sir, you were referring to my discussion yesterday morning in which I made reference to a report, IN-1453, in which there were a series of FLECHT tests described, and in particular these series of tests they did have evidence of the zirconium, nickel or zircaloid inconel eutectic formation. The thrust of my presentation yesterday morning was more to put into perspective what really one can glean from this IN report.

That is, I attempted to clarify that the high temperatures evidenced in that report were not really a result of the reaction of steam with that eutectic. I believe you are questioning really not what standing the interpretation of that report, how do we compare our results with results reported by this IN report; is that correct?

MR. BRIGGS: If there is a difference in the results, how is the difference explained, that's right.

DR. ROLL: I believe in this test which is reported, the simulated fuel rods themselves were filled with alumina, and that during the test, the alumina and zirconium reacted producing the alumina to aluminum, and at the temperatures of the test, the aluminum then was liquid and either it reacted with the zirconium to form an aluminum-zirconium eutectic, or it may have gotten out through weakened spots in the rod which may have formed by zirconium and inconel eutectic, or it may have gotten out some other way. But the high temperatures of this test are attributed by the authors to the reaction between the steam and the aluminum, and not between the steam and the zirconium inconel eutectic.

The tests we ran, we were looking only at the formation -- first we were looking at the formation of the eutectic and then, secondly, if the eutectic formed, to what degree could we observe it.

In the tests that are reported in our WCAP 7379-L, Volume 1, we report conditions there for eight tests, and in only one case did we find any evidence at all of a eutectic formation. This eutectic formation was characterized really by a small dimple or blemish in the rod and spring, and not by any massive melting or any apparent flow of liquid metal, or anything that would lead us to believe that it is a condition of concern in the over-all look of coolant accident analysis.

I believe that the differences why we saw one result and why in these results summarizing the IN report -- No. 1, we were looking really under a perhaps more representative situation, and the reason we didn't see the eutectic is perhaps --

and I'm speaking in my opinion because we really don't have a detailed sequence of events. In my opinion, because of the formation of an oxide between the zirconium and the inconel during the heat-up phase of the test, that is. Explanation of the oxide, of course, is that and similar of what would occur during the actual operation of a fuel rod under normal conditions and which would then be present during the loss of coolant accident situation and would tend to keep base metals apart. If the base metals are apart, there is no way the eutectic can form.

On the other hand, in the tests reported in the IN report, there is or there was, as the authors described, a fairly large quantity of molten aluminum present, which, in some unknown way, contributed to the formation of some inconel zirconium eutectic. I think really the basic difference is that we didn't have the presence of molten aluminum in our test, and I think very importantly, we don't expect the presence of molten aluminum in our reactors during normal operation or during any kind of loss of coolant accident.

MR. BRIGGS: I believe that's all the questions I had that would deal with metal-water reactions. Thank you.

I would like to have some discussion of the Figure 10, I believe it is, in the additional testimony of the Applicant from July 13, 1971. This figure shows the peak clad temperature versus after break for a double ended break. I think probably Figure 6 will also enter into the discussion, and Figure 1 of the additional information on the emergency core cooling analysis that was submitted on August 16, 1971.

The curve of peak clad temperature versus time has some wiggles in it that play a fairly important role in determining whether the temperature will go above 2300 degrees, the maximum temperature, and would like to have some information about the occurrences in the blowdown and in the reflood. That cause particular breaks.

The first break that occurs is very shortly after the blowdown/begins again at which point the temperature goes from just above 700 degrees Fahrenheit to just above 1500 degrees Fahrenheit.

Mr. Moore, could you tell what happens during that period? That is the period from one to three seconds, with, let's say, a tenth of a second to three seconds.

end

MR. MOORE: The initial increase is associated with the assumption that from a tenth of a second on, we have gone through DNB at the hot spot. So we have a much lower heat transfer coefficient at the rod surface than we would have during normal operations.

MR. BRIGGS: What is it that causes the temperature then to turn down and to go down to about 1300 degrees Fahrenheit?

MR. MOORE: That decrease in temperature is associated and now referring to Figure 6. It is associated with the relatively low quality situation in the core and the flow effect, the peak in core flow at about five seconds.

MR. BRIGGS: The temperature then goes back up almost to 1600 degrees. What occurs at that point?

MR. MOORE: That is because the quality of the core is approaching one and the heat transfer is proportional, inversely proportional to the quality. So we are losing heat transfer effectiveness in that period of time, and also the core flow is decreasing as the system continues to blow down.

MR. BRIGGS: The temperature then turns down again, and what is the cause for the increase in core flow during the period from 9 seconds to 12 seconds?

MR. MOORE: This is the continued discharge now of the primary system. Primarily the source of water being the hot legs and the water still remaining in the steam generator and in the upper head, which is now discharging backwards through the core and up the downcomer and out the break.

MR. BRIGGS: The end of blowdown comes at about 16 and 17 seconds; is that right?

MR. MOORE: Yes.

MR. BRIGGS: At this point the temperature begins to rise, and rises rather uniformly until about 30 seconds. If one looks at Figure 1 of the August testimony, the first even shown there begins at about 29 seconds. What is going on in the period between 16 or 17 seconds and 29 seconds?

MR. MOORE: During that period of time, from 16 seconds on, we are injecting the remainder of the accumulator water, and filling the lower plenum of the vessel. We have not yet reached the bottom of the core. So the assumption is conservatively made here that there is no heat transfer taking pla[illegible] during this time. This is our adiabatic heat-up period. What is happening, we are just filling the lower part of the vessel approaching the core.

MR. BRIGGS: Beginning at 29 seconds, there is some small decrease in the rate of temperature rise, and this seems to be associated with the flooding rate. What goes on beginning at 29 seconds?

MR. MOORE: At 29 seconds we reach the bottom of the core and we are starting to flood into the core now. There is a very small amount of heat transfer that occurs during that

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initial flooding period prior to the greater heat transfer associated with entrainment. That is indicated on Figure 1.

MR. BRIGGS: Figure 1 shows a flooding rate of about almost eight inches per second persisting for about three seconds, I believe it is, beginning at 29 seconds and ending at 4 seconds and ending at 33 seconds. What is happening during this time? What is being flooded during this time?

MR. MOORE: We are flooding the lower part of the fuel assemblies and we are not generating any steam. We are actually heating up the water as it is coming in. The heat source is quite low at the bottom part of the core, and the water is subcooled. So we are heating it up. When we reach a level of about 20 inches, we start to get significant steam generation, and entrainment. That's why you see the very rapid reduction in flooding rate that occurs when we reach about the 20-inch level in the core. We are generating now a large amount of steam which now must pass through the system and out through the break.

Therefore, the flooding rate is retarded considerably. The fact that the flooding rate is reduced down to a very low volume there, because during this period of time until 40.5 seconds we are still discharging water from the accumulators. So the assumption is made in the intact loops that the lines are plugged. So the only venting path is through the broken loop. So the flooding rate is quite small.

At the end of 40½ seconds, the loops are now assumed to be opened and also serve as venting paths. You can see the associated increase in flooding rate.

MR. BRIGGS: At 39 seconds, the rate of temperature rise at the point of peak clad temperature decreases to zero and the rate of temperature rise stays at zero for about five seconds. Can you tell me what happened at that point? It is just before the accumulator empties. This is shown on Figure 10.

MR. MOORE: This is just consistent with the rather sharp increase of heat transfer coefficient as shown on Figure 1, a film coefficient of 10, which results in a fairly rapid limitation of the increase in clad temperature. But we are still adding heat through decay heat and do not have sufficient heat transfer to transfer all the decay heat away until further out the transient. I wouldn't put too much emphasis on the exact slope of that curve. It could have been the way it was plotted. There is a break there.

MR. BRIGGS: That's one of the things that puzzles me. I see that the heat transfer coefficient during the period from 39 seconds to 41 seconds does in fact rise from a value of about four to a value of about ten. Then it holds at ten and the heat transfer coefficient continues to go on up, and the temperature also continues to go on up. It would seem to me to be inconsistent that there should be this effect, and yet the effect is pretty important because that zero slope on the temperature line did not occur, then the peak temperature would go well above 2300 degrees.

Can you tell me at all why it is not obvious that the heat transfer coefficients and the temperatures are closely related?

MR. MOORE: Yes. Let me explain. The one factor that doesn't appear on these particular curves is the heat source itself. The heat source is primarily the residual heat generation in the fuel. This is decaying in time. So what is happening here is the heat transfer from the surface is increasing but it is still not sufficient with the temperature gradient from the cladding to the coolant. That heat transfer coefficient is still not sufficient to remove all the decay heat. So the clad is continuing to heat up.

Then we reach a point in time when two things have happened where we reach the peak temperature. One, the file coefficient has continued to increase as shown in Figure 1, L3Wt2

and also the heat release, the residual heat rate of power generation has decreased to the point where now the film coefficient with the temperature gradient of the cladding is sufficient to overcome the heat generation. We are starting to remove heat from the cladding.

MR. BRIGGS: Let us go back to 39 seconds. The period from 39 seconds to about 45 seconds, that is. In the period from 39 seconds to 41 seconds, the heat transfer coefficient goes from four to ten. It holds at ten for a few seconds. During that time the temperature holds constant.

We say that a temperature held constant during that time because the heat transfer coefficient now was high, as I understand it.

MR. MOORE: Higher, right.

MR. BRIGGS: Yes. It is higher, yes. But now, without knowing anything more about the situation, I would have thought if the heat transfer coefficient stayed constant, that the temperature might well stay constant for a while. If the heat transfer coefficient dropped off, the temperature would rise. If the heat transfer coefficient increased, the temperature would fall. But if one looks at Figure 1, he sees that the heat transfer coefficient increases and the temperature also increases. That looks to me like it makes this leveling off in temperature somewhat suspect.

I heard the reply that you gave but I didn't quite understand why the temperatures behaved as they did in the period from--let's say in the period beginning at about 46 seconds. Why is it that with rising heat transfer coefficient at 48 seconds, the temperature goes up rather than going down?

MR. MOORE: I would have to look at the detailed print-out of the analysis in this case to see to what extent that slight dip is real. But the general trend is, I believe, explained in the sense that we got three things going on here. We have residual heat levels decaying. We have heat transfer increasing somewhat, and we have zirc-water reaction, energy being added to the cladding. As temperatures increase at an increasing rate, according to parabolic rate equation. So the two heat sources which are temperature--the one is temperature dependent, the one is time dependent, and the heat transfer coefficient which is time dependent, all interacting. So that is why you can get these trends where the heat transfer co-efficient itself can be increasing and the clad temperature can still be increasing because we are adding energy from zirc-water and the residual heat has not decayed sufficiently.

MR. BRIGGS: I think it would be helpful to the Board if you would look at the time. From 39 seconds to 50 seconds, let's say, and explain why it is that the temperature does not continue to rise during that period, why it levels off, and why it rises following that time even though the heat transfer coefficient rises, also.

As you point out, you have to look at the details of the calculation and it probably would not be profitable to follow this along at this time.

MR. MOORE: I will check that.

MR. BRIGGS: There was considerable discussion last week of flow redistribution in the core. I am not sure that my notes properly indicated all of the things that were said. I understood you to say that during the reflood period, you, I believe, decreased the flow or made some compensation in the hot channel for flow redistribution; is that right?

MR. MOORE: Yes. Let me explain. During the reflood phase of the transient, we calculate--the primary cariable of interest is the flooding rate. This is the main determinant of the heat transfer that takes place during reflood. So we calculate the flooding rate on the basis of an assumption that the amount of entrainment of water that occurs during reflood, from the total core which must be now discharged through the system and back out the break, that that total core discharge is based on having all of the assemblies as hot assemblies. That gives us the highest amount of entrainment, gives us the largest mass flow to discharge through the loop, gives us the largest pressure drop with respect to driving head from the downcomer, and therefore minimizes the flooding rate. That is a conservatism that is put in the analysis in a sense to compensate for any possible flow redistribution that may occur between a hot assembly and an adjacent assembly. We have assumed that all assemblies are hot assemblies in getting a low flooding rate.

MR. BRIGGS: So the effect there, then, is to assume that the entire core contains the elements at the peak heat rates, and one gets a flooding rate and a pressure drop that corresponds to this. I thought I understood one of the Staff witnesses to say that one did not consider flow redistribution during the reflood stage, but that the flow redistribution was considered during the blowdown stage by taking a core flow that was eight-tenths of the calculated flow.

Do you do this or did you hear this testimony and understand it the same way?

MR. MOORE: Yes. Now we are talking about blowdown.

MR. BRIGGS: At this time this is about blowdown.

MR. MOORE: Yes, we did do that.

MR. BRIGGS: Is there something that is indicated in the Westinghouse evaluation model, in the interim criteria?

MR. MOORE: Yes.

MR. BRIGGS: Which item is it?

MR. MOORE: I don't have my copy of the criteria.

MR. BRIGGS: I find an item like that under the Relap.

MR. MOORE: I do too. I don't see it specifically under the Westinghouse, but the same requirement is met.

MR. BRIGGS: Mr. Novak has a suggestion. Possibly that could be helpful.

MR. NOVAK: Since it was a suggestion of the Westinghouse analysis that did not make any exception to it. That's why it wasn't pointed out specifically in the Westinghouse evaluation model.

MR. MOORE: That's correct. As Mr. Novak indicated, the specific items indicated in the interim criteria are noted as the exception. Our model as we described to them earlier had that factor in it.

MR. BRIGGS: I believe it was indicated in previous discussion that you have examined the question of flow redistribution through the core by use of the THINC code, is that right?

MR. MOORE: Yes, during blowdown.

MR. BRIGGS: Now this is during blowdown?

MR. MOORE: Yes.

MR. BRIGGS: I see. But you have not examined flow redistribution in the core during the reflood period, is that right?

MR. MOORE: Not with the THINC code, that's correct.

The situation is quite a bit different in the reflood conditions than under blowdown conditions.

MR. BRIGGS: What have you done about examining the redistribution of flow in the core during the reflood period?

MR. MOORE: Well, we have looked at the conditions that occur during reflood and have noticed from the FLECHT results that the conditions in the core during reflood are primarily one of steam with entrained water being carried up the core. The pressure drop under the reflood conditions is primarily one of elevation rather than friction. We have noted that one can expect, because of this fact, a thermal siphon effect, which I believe I discussed in earlier testimony, because the frictional losses are very small and it's mainly elevation. As we generate more steam in the hotter assemblies the effect is one of colder assemblies feeding water into the hotter assembly to generate even more steam from a thermal siphon standpoint.

As this mixture rises in the core there may be some effects of expansion of steam which may want to cause the steam to redistribute to colder assemblies. But the contribution to the total pressure drop of the steam is very small, because again it's still an elevation, primarily an elevation factor. And the water drop will tend to continue them further up the channel. This is the kind of behavior you see in the FLECHT assembly, albeit recognizing the limited radial geometry.

But this is the kind of observation made. There is also a chimney effect that should come into play in the hotter assemblies as we heat the steam up and the water droplets enter there, they will tend to accelerate in the axial direction, and again because of the elevation effects will tend to draw steam or water in from adjacent assemblies. It's a difficult situation to try to analyze in detail.

It's our judgment that the conservatisms associated with assuming and determining flooding rate, that you assume you have got the maximum amount of entrainment and mass flow at the system, that this should compensate for any of these other effects that we have discussed.

MR. BRIGGS: What is the steam velocity at the top of the core during reflood, maximum velocity?

MR. MOORE: I would say 50, 60 feet per second, but I am not sure. I would have to confirm that number.

MR. BRIGGS: Is there an easy way to confirm it here?

MR. MOORE: Not immediately. If I can refer to notes or check back at home I'd get a number.

MR. BRIGGS: Considering flow blockage I believe in some of the discussion you indicated that some information was available on cooling of rods, rod bundles,where there was 100 per cent blockage of a group of channels, is that right?

MR. MOORE: Yes.

MR. BRIGGS: What was the mechanism for cooling of the rods that were surrounded by the blocked channels when blockage was a 100 per cent?

MR. MOORE: It was mainly the turbulence set up immediately downstream of the blockage area which gave us a disbursed flow situation downstream of the blockage and gave us effective heat transfer. This is indicated in the results of one of the FLECHT tests.

MR. BRIGGS: If there was a 100 per cent blockage what was the source of this turbulence? How did the steam get through the channels?

MR. MOORE: Well, it was coming from adjacent channels just next to it.

MR. BRIGGS: How many rods were involved in the region of 100 per cent blockage?

MR. MOORE: I'm just going to check that.

One test with four channels and one test with sixteen channels.

MR. BRIGGS: When you say sixteen channels, those were sixteen channels that were adjacent to one another that were blocked and then there were channels outside the sixteen channels where flow could occur?

MR. MOORE: That's correct. Refering to Figure 339 in the WCAP 7665 it shows the geometry of the blockage.

MR. BRIGGS: In the FLECHT tests where you had those regrettable negative heat transfer coefficients, how was the heat flow from the steam into the fuel rod or into the FLECHT rod calculated? What was used as the basis for calculation of the heat flow, the negative heat flow?

MR. MOORE: I believe the calculation was one where you had the temperature of the cladding, the power that went into the cladding, and it showed that there was a mismatch in terms of calculating heat flow, assuming it was coming from the cladding to the coolant. So that the heat input to the cladding was just the difference between what the temperature went up to, how it increased in time, versus how much power we were putting in.

MR. BRIGGS: This was a calculation then based on the inside clad temperature and the rate at which it increased? I suppose it must be the rate at which it increased, is that right?

MR. MOORE: Yes, knowing the power also that should have been transferred out of the rod.

MR. BRIGGS: Could you tell us more about the importance of the redistribution of the flow during the blowdown, the calculations that were made by the THINC code? During what period of blowdown are we concerned with in these calculations?

MR. MOORE: Essentially through the entire period of blowdown we use the flow as calculated by the SATAN code in developing the heat transfer at the rod surface. So we want to know what the flow is throughout the blowdown transient.

PROFESSIONAL QUALIFICATIONS
WALTER STEIN
SUPERINTENDENT
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

My name is Walter Stein. My business address is 4 Irving Place, New York, New York 10003.

I graduated from Queens College with a degree of Bachelor of Science in Chemistry in 1959 and from Columbia University with a degree of Bachelor of Science in Chemical Engineering, also in 1959. I was employed by Consolidated Edison upon graduation and spent approximately two and a half years in the various generating stations as a staff Chemical Engineer. During that time I attended a seminar at Columbia receiving a Certificate for "Proficiency in Radiochemical Techniques for Nuclear Power Plants".

From December 1961 until October 1968, I was employed at Indian Point Station in various assignments in the fields of chemistry, chemical engineering and radiation safety, eventually becoming Station Chemist. In October 1968, I was transferred to my present address to perform staff duties to the Chief Chemical Engineer and the Manager of Nuclear Power Generation. At present, I am the Superintendent of the Chemical Bureau responsible for all chemistry and chemical engineering for Power Generation.

I am a member of the Company's Nuclear Facilities Safety Committee and the following technical societies:

1. American Society for Testing and Materials
2. American Institute of Chemical Engineers
3. American Chemical Society
4. ASME Research Committee on Boiler Feedwater Studies
5. Intersociety Committee on Manual of Methods for Air Sampling and Analysis
6. Edison Engineering Society

MR. BRIGGS: Well, what is flowing? Is it water or steam or a mixture of the two or what is it that's flowing during the period?

MR. MOORE: It's primarily during most of blowdown a mixture of the steam and water in the core itself. I would characterize it as that.

MR. BRIGGS: And this is coming into the top of the core and going out the bottom or coming into the bottom and going out the top? Just what is happening?

MR. MOORE: Yes. Looking at Figure 6 for the cold leg break you can see that over the prominent part of the blowdown up to the sixteen and a half seconds the flow is negative through the core.

Read the scale on the right.

MR. BRIGGS: And so this is downflow from the top of the core out the bottom of the core?

MR.MOORE: That's correct.

MR. BRIGGS: I'm afraid most of the questions I had to ask concerning this don't really apply because I was considering the THINC CODE as being useful for calculating flow redistribution during the reflood period also.

And you indicate that you have not done that?

MR. MOORE: I want to explain as I did earlier, I believe, that the situation is different in the reflood case and that we don't have a homogeneous mixture. We have entrained water and slip is important between the steam and the water. These things would not be appropriately modeled in a THINC calculation. That's the difficulty.

MR. BRIGGS: Could you tell me what experimental work Westinghouse has in progress now or expects to do in the future concerning the resolution of the questions of the emergency core cooling system?

MR. MOORE: Yes. The areas that are on going actively are primarily directed for resolving some of the uncertainties and what is in our opinion too conservative assumptions that have to be made with the interim criteria. For example, the line-plugging assumption that's made during reflood. We are undergoing some tests of mixing of steam and water in piping configurations that are simulating the injection accumulator water into a pipe with flowing steam in order to determine just what the situation is, hopefully to find that we really don't have this line plugging situation. Also to determine possible benefits due to condensation of steam and the water is injected, the cold water is injected into the accumulators, which should improve our reflooding situation and give us increased flow and therefore reduce the temperatures.

There are programs being discussed now, some of these on an industry-wide basis, in conjunction with the AEC, larger scale tests now directed toward quantifying what, if any, accumulator bypass we might get during blowdown.

We have to make this extreme assumption that all the water is lost during blowdown physically. Physically this just doesn't seem to be the case for the geometry of a reactor, and so we are considering running some fairly large-scale downcomer simulation tests to determine to what extent, if any, there is bypass. These are some examples of the kind of work that's being considered at this point, mainly directed toward improving the interim model and reducing what we consider assumptions that are too extreme.

MR. BRIGGS: In the question that was asked by the Board previously concerning the entrainment of accumulator water in steam in the unbroken loops and carryover of that entrainment into the broken loop and out the loop,you indicated that you thought the steam would be condensed and that the changes in direction and velocity would take the entrainment out of the steam, if it were present. How much of the steam would be condensed depends in a large measure on the ratio of the amount of steam that's produced to the amount of accumulator water that's being injected. In other words, the steam would be condensed at a temperature like 280 degrees, I suppose, and the accumulator water comes in at 110 degrees, I suppose, and the accumulator water comes in at 110 degrees and the steam that's being condensed is superheated to about 500 degrees, what is the ratio of pounds of accumulator water being injected per second to pounds of steam that's being produced per second in the reactor core? What fraction of the accumulator water is evaporated, in other words, during the final periods of accumulator injection this would be?

MR. MOORE: I don't have those specific numbers here. The accumulator water mass is much larger than the steam mass. It's not a question of -- there is not enough steam to evaporate the accumulator water. I don't have the exact ratios. I can get those.

MR. BRIGGS: No. The question was just the reverse of that. Is there enough accumulator water to condense the steam?

MR. MOORE: No, not entirely.

MR. BRIGGS: Would it condense a large fraction of the steam, do you suppose?

MR. MOORE: I would think so, but this is a function of the kind of mixing you get, the effectiveness of mixing up the water with the steam, and that is part of these steam-water tests are directed toward.

MR. BRIGGS: Are these steam water tests being conducted now or are they planned for the future?

MR. MOORE: Test assemblies are being built. Actual tests have not been run yet.

MR. BRIGGS: Is the test apparatus a model of a reactor configuration?

MR. MOORE: It's a model of the piping configuration associated with accumulator injection and reactant cooler loop.

MR. BRIGGS: Does it include reactor vessel with core barrel and that sort of arrangement?

MR.MOORE: No.

MR. BRIGGS: What scale is the equipment? Is it very small or is it Indian Point 2-scaled?

MR.MOORE: No, no. It's smaller than that. I believe the piping, maximum piping is something like eight to ten inches in diameter.

MR. BRIGGS: About eight to ten-inch piping?

MR. MOORE: Right.

MR. BRIGGS: And the Indian Point 2 piping is what size?

MR. MOORE: Twenty-nine inches.

MR. BRIGGS: So it would be one-third to one-fourth scale then?

MR. MOORE: Approximately, yes.

MR. BRIGGS: Do you have any schedule of completing that work? Can you give us some idea of when one could expect it to be completed, whether it would be by the end of the year or next summer or a year from now?

MR. MOORE: No. As schedules go, and as Mr. Jensch has warned us in the past on schedules, it's sometime next summer, middle of next year.

MR. BRIGGS: Do you have in process any more tests on flow blockage?

MR. MOORE: Not on flow blockage, no, sir.

MR. BRIGGS: Do you consider that the tests that have been run to date provide satisfactory indication of what can be expected during flow blockage and what blockage can be expected, is that right?

MR. MOORE: Yes, that's correct.

MR. BRIGGS: In reading the July 13th document I believe it indicates that there is water in the vessel at the end of blowdown. It says that all of the water injected by the accumulators is expelled during blowdown. But I have the impression that there remains water in the vessel in the annulus between the core barrel and the vessel wall. Is it correct or is there no water in the vessel at the end of blowdown?

end

MR. MOORE: No, there is essentially no water in the vessel at the end of blowdown. The SATAN code tends to predict that almost all the water is discharged, plus we throw away the accumulator water. I think we indicated last week there were a few cubic feet of water that when you get all through and threw the accumulator water away at the end of blowdown you had a few cubic feet in the bottom of the vessel where the bottom holds a 1000 cubic feet. That's why I say it's essentially no water.

MR. BRIGGS: In the figure on the August testimony, after the accumulators have been emptied there is a steady core reflood rate shown. Is that the reflood rate that's provided by the injection systems?

MR. MOORE: Let me explain. At the end of accumulator injection we have the downcomer not quite filled with water. There was confusion in earlier testimony on that, but I can confirm we have a downcomer not quite filled with water and we are flooding into the bottom of the core at this relatively low flooding rate and evaporating steam or water to steam and entraining water. The pumping systems are pumping in, of course, during this time, and they are effectively keeping up with the evaporation and entrainment rate within the core itself. And a little bit extra. So the accumulator height or downcomer height, excuse me, is increasing very slightly during this time as the water from the pumps is making up.

MR. BRIGGS: Then according to your calculations let's say the only water that's lost from the system during the reflood period is the water that is injected into the broken loop -- when I guess that would be all, because as I understand it, the entrainment that's in steam that leaves the core is evaporated and the steam is superheated in the steam generator, so that the only water that would be lost from the system would be that that's injected into the broken leg during the reflood portion, is that right?

MR. MOORE: That's correct.

MR. BRIGGS: And the slow reflood rate, the steady rate that's indicated there, that's accomplished during the injection system. What is the total flow of water provided by the injection system?

MR. MOORE: It's down to 360 pounds a second.

MR. BRIGGS: I believe the information that's been provided by the Staff it's indicated that there is full flow of the injection system in 25 seconds and in information that's provided by the Applicant, the full flow occurs 34 seconds after the time in which the need for water injection is indicated. Could you and possibly Mr. Novak resolve the discrepancy, if my numbers are correct?

MR. MOORE: Yes. I think that has been resolved in testimony either maybe both by the Staff and our Staff. Is the

34 second number was a mistake in the safety analysis report in that the starting time of the diesels was not correct. It was not the design value, and that made the difference of 9 seconds, I believe, between 25 and 34.

MR. BRIGGS: The numbers that have been used in your calculations of the reflooding, you have used the 25-second delay, is that right?

MR. MOORE: That's correct.

MR. BRIGGS: And the Staff uses 25-second delay time?

MR. NOVAK: Well, we reviewed the analysis based on 25 seconds.

MR. BRIGGS: Now what is the delay time in starting the diesels?

MR. NOVAK: Ten seconds is the maximum assumed delay time.

MR. BRIGGS: And the Westinghouse number, 34 seconds you had used some different time for --

MR. MOORE: Yes, 19, I believe, in the FSAR.

MR. BRIGGS: Nineteen seconds is incredible?

MR. NOVAK: Perhaps Mr. Kniel might want to respond to that.

CHAIRMAN JENSCH: That would be helpful, I think.

MR. KNIEL: I am refreshing my memory. I did the work on answering this particular question.

I did discuss it with the Division of Reactor Standards people who have data on starting times for diesels, and they informed me that ten seconds was a reasonably long starting time for a diesel generator. So that the ten-second number that's used, normally used by Westinghouse, and as used in the Staff analysis leading to the 25-second delay for full flow, is consistent with the experience that's been had with diesels that have operated.

I get the impression that the 19-second number came in as sort of a total kind of ɪaximum kind of time that you could have by virtue of the fact that a criteria was used that if it didn't start in 20 seconds it didn't start, period. So that that's how the 19-second number crept in there, I think. But that's just speculation on my part.

I know that there was a criteria that Westinghouse established that if it didn't start in 20 seconds, that was a failed diesel, so on the assumed single failure that that meant that the diesel had to start in 19 seconds.

So that is how the 19-second number got in there. I repeat that on the basis of the information that the Staff has on the diesels that have operated 10 seconds seems a reasonably long period, conservative, for starting period.

MR. BRIGGS: In calculation of the peak clad temperature, then the draw down of temperature during the double-ended pipe rupture, how many diesels are required to operate to give the reflood flow that's used?

MR. MOORE: One diesel.

MR. BRIGGS: One diesel. One diesel out of how many?

MR. MOORE: One out of two diesels. Three, excuse me. One out of three diesels.

MR. BRIGGS: One diesel out of three diesels?

MR. MOORE: I'd have to check that. I am speaking from memory. There is a definition of minimum safeguards. It's assumed, assuming various combinations for various failures. We have taken or we do this analysis with a minimum flow on that basis.

MR. BRIGGS: And you could give us reference to a point --

MR. MOORE: Yes, it's in the FSAR.

MR. BRIGGS: -- where that is in the FSAR? Fine.

Would it be possible for the Staff to indicate to us what tests are now in progress by the AEC Laboratorties to resolve the questions of the emergency core cooling system and what kind of progress is being made, what kind of schedule is being used for these tests? I realize that you provided us with a document that tells what the water reactor safety program is, but we learned the other day that part of that safety program which had to do with flow redistribution was not funded and no indication that there was a plan to fund it. So the Board would like to have some information on the important tests that are in progress now and/or are planned and what the schedule is and what the status is on the important tests.

CHAIRMAN JENSCH: If we could also get enumeration of those tests which were planned and may be started and have been stopped in the last year or two related to water safety reactors, particularly the ECCS and any other problems related to reactor safety.

MR. BRIGGS: For instance, there was some discussion the other day about whether the problems are resolved, are in hand, or we don't know much about the answers. And one example that one might take is the flow blockage problem. Is there a program within the AEC in which further information is being developed on flow blockage in pile and out of pile, or does the AEC concur with Mr. Moore's estimate that, well, Westinghouse, let's say, has no program for investigating flow blockage and presumably considers this to be well in hand, or that there are programs to make it well in hand?

CHAIRMAN JENSCH: The Board will give further consideration to further statements of concern, but at this time we will take a fifteen minute recess and at this time we will recess to reconvene in this room at 5:20.

(Brief recess.)

CHAIRMAN JENSCH: Please come to order.

MR. MOORE: Mr. Chairman, could I refer to the diesels, page 6.2-37 of the FSAR? It indicates that two out of three diesel generators are required for minimum safeguards operation.

MR. BRIGGS: Could someone tell us what these are?

MR. KARMAN: I will get to that later. I just left them there.

MR. BRIGGS: Mr. Moore was worried.

MR. KARMAN: I don't blame him.

MR. BRIGGS: Concerning requests for information on the safety program, the information provided by the Commission could also there be included in that information an estimate of what fraction of the Commission's safety program funds are being spent on light-water reactor safety.

A question to Mr. Novak. I believe the Staff testimony indicates that -- let's say that the situation of a double ended pipe rupture for Indian Point 2 had been calculated by use of RELAP 3 and THETA-1B about a year ago, and that the agreements with SATAN CODE was resumable. Also that some calculations had been made comparing the SATAN CODE and the other codes used with RELAP 3 for a Turkey Point reactor. It is inferred from that that if one were t recall Indian Point 2 by use of the RELAP code and the THETA code, that one would come out with a temperature that is lower than has been calculated by Westinghouse for the peak clad temperature.

Is the Turkey Point plant so like the Indian Point 2 plant that there is just no question that the comparison would result in a lower temperature calculated by use of the

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Commission's codes than the temperature of the peak clad temperature than by the use of the Westinghouse codes?

MR. NOVAK: In my estimation, yes. The difference that we had observed in comparing the Westinghouse codes versus the AEC codes, I think the primary difference that we have observed is the BLODWIN Code. Here we are comparing the SATAN to the Westinghouse code versus the RELAP code, which is the AEC code. The general observation one makes when comparing this is that the RELAP code does predict higher core flows during blowdown. I think this is the general characteristic we had observed. I would suspect that this characteristic of higher flow during the blowdown would carry over between Turkey Point 3 and Indian Point 2. The Westinghouse analysis is similar in terms of the number of modes that they use for Turkey versus Indian Point 2.

The RELAP work that we would have done on Indian Point 2 would have been a similar description than what we did for Turkey. In thinking of this problem, I can't suggest a way where we would expect a slip of peak clad temperatures.

MR. BRIGGS: Has the Commission's comparison been limited to the Turkey Point reactor since the interim criteria were adopted, or have there been other comparisons made?

MR. NOVAK: With respect to Westinghouse plans?

MR. BRIGGS: Yes.

MR. NOVAK: Since the establishment of the interim policy statement, I would say the only analysis has been the Turkey Point analysis.

MR. BRIGGS: Was this made during the time that the interim policy statement was being formulated, or was the comparison made after the interim policy statement was issued?

MR.NOVAK: It was made as near as possible, and we could make, in accordance with the interim policy statement, using the RELAP code. What I am saying, we were trying to apply the AEC evaluation model to the Turkey Point plant which then has about, as close as we can, similar restrictions on the analytical techniques.

MR. BRIGGS: I believe in the cross-examination there were questions asked about what would happen if the containment pressure in the Indian Point 2 containment were lower than is used in the calculation. I don't believe you gave a clear answer as to whether this would likely result in higher temperature or lower temperature. Is it not possible to state whether the temperature would be, the peak clad temperature would be higher or lower in the event that the containment pressure were lower? Have no calculations been done by the Commission Staff on any plans to evaluate this?

MR. NOVAK: Nothing specifically, I don't know of any that were done by the Staff. I think, in our generic review, in our review as a Task Force, we did have sensitivity studies with pressure that one could use for the blowdown portion of the accident. I'm not sure whether we had specific sensitivity studies at that time for the reflood portion. There is, in effect -- the effect, of course, during blowdown, is to lengthen the time to reach the blowdown. This, then, if you follow the interim policy statement, requires a greater portion of the accumulator water that must be fairly discharged on the floor. It also permits one to start the adiabatic heat-up portion slightly further on and probably doesn't have a significant effect. It would be a part of the analysis. I am trying to put the pieces together.

As I look at the break spectrum, we get a sensitivity to how important it is for the amount of water that is discharged from the accumulators, arbitrarily discharged. As we note in the sensitivity study, there are smaller breaks and we arbitrarily discharge greater amounts of the accumulator water but the net effect on the accident is that the peak clad temperature is left as a function of break size. So around the containment pressures we are analyzing today, it is not that sensitive. I think one has to take large steps in containment pressure before you would see a significant difference in the blowdown response and the reflect response of Indian Point 2.

MR. BRIGGS: Has Westinghouse made any calculations on the effect of the containment pressure and the peak clad temperature?

end

MR. MOORE: Yes. I have the figure here for at least the effect during blowdown. If you had a 2 p.s.i. lower pressure to define the end of blowdown -- in other words, you have extended the blowdown. That is worth ten to twenty degrees Fahrenheit peak temperature. 2 p.s.i. is a larger difference in pressure.

MR. BRIGGS: Does it raise the temperature or lower the temperature?

MR. MOORE: Excuse me. Raise the temperature.

MR. BRIGGS: So that was 10 to 20 degrees Fahrenheit increase in temperature?

MR. MOORE: Yes, for 2 p.s.i., which is a large percentage of difference in pressure.

CHAIRMAN JENSCH: If I understand that answer, did you say if the containment pressure is lower by 2 p.s.i., that you get an increase in clad temperature of 10 to 20 degrees Fahrenheit?

MR. MOORE: Yes, in defining the end of blowdown. Remember, we take 90 per cent of the pressure rise which in Indian Point would be pressure at the end of blowdown of 50.3 p.s.i.a. to define end of blowdown. That is the point that stops any further accumulator bypass. If that pressure were 48.3, which is another 5 per cent or so, I guess, reduction in pressure, which is large, that would only be worth 10 to 20 degrees increase in peak clad temperature.

CHAIRMAN JENSCH: Thank you.

MR. BRIGGS: There was some discussion of the experimental confirmation of the THETA-1B Code. The opinion was offered that one could run no experiments to give confirmation of that code. Is that really right, that it is not possible to use electrically heated rods and things like that to give an experimental verification of the temperature rise that would occur?

MR. NOVAK: I think when Mr. Lawler responded to that question, he was trying to respond to the truest sense, that the THETA-1 Code is the code used to analyze a single fuel rod. He pointed out that in his judgment it would be impossible to perform an experiment of a single fuel rod since you would not have a critical mass. I think the answer is, yes, you can establish many experimental programs which can be used to confirm the heat transfer that you are calculating using in the THETA-1 Code, single-rod experiments. They would be ideal. I'm sure in a general sense this confirmation has been done.

MR. BRIGGS: It might be that the question that had been asked was a little more along the line, I suppose, is there an experiment that you can run in which you have blowdown and then reflooding occurs, and you finally get a temperature of an electrically heated rod, and you have previously calculated that temperature for this integral experiment, if you wish. Is it not possible to get experimental confirmation of the whole series of calculations in this way?

MR. NOVAK: Certainly one of the highlight experiments are additional semi-scale experiments, what we refer to as loop one. Previous semi-scale experiments have not gone deeply into the heat transfer. The simulated core was a nine-inch-long core. The entrance effects really do not permit one to take credit for the heat transfer. This was noted. The plan loop one and a half tests now will have a five-foot core. Certainly from that kind of experiment that has a blowdown and which has a reflood portion, will permit you to make a best estimate calculation. So you will have a test of the THETA Code and all blowdown codes, in fact. This is the purpose of that experiment.

Here we are getting our best opportunity to go in and check it during blowdown.

end

MR. BRIGGS: I assume that you will tell about the status of those tests in the information that you provide later. Do you have any information now on the status on the tests?

MR. NOVAK: There are discussions that are underway today that --

MR. MOORE: Tomorrow.

MR. NOVAK: Tomorrow, yes, between the Idaho Nuclear people and the AEC people, the Regulatory Staff, to resolve comments on the proposed tests. The equipment is in construction and in fabrication. The discussions now pertain to preanalysis of the tests, the kinds of experiments that could be performed, and in what order. Hopefully some of these tests will be undertaken before the end of the year.

MR. BRIGGS: Mr. Trosten, your schedule for test operation of the Indian Point 2 Plant shows operation at 90 per cent of power level. We have talked primarily about 50 per cent of power level. Our full power, that is. I should remember the motion better, I suppose, but what is the relationship of the 90 per cent power of permission to run tests at 50 per cent power?

MR. TROSTEN: The chart is depicted in Figure 1 of our testimony, Mr. Briggs, primarily for the purpose of showing the full sequence of activities. Because certain aspects of the testimony are best understood by reference to that chart -- however, the motion before the Board at the present time deals just with testing at up to the 50 per cent level, and therefore, for purposes of considering activities as would be authorized if the motion were to be granted in full, one should just look on Figure 1 up to the end of the line depicted by point C. The other parts of the chart, categories D and E, would be the subject of a subsequent motion we would expect for authorization to operate at 90 per cent of full power and thereafter full power operation.

MR. BRIGGS: Mr. Moore has given us some information about the maximum clad temperature that would occur for 50 per cent power. I wonder if it would be possible to think some more about that, and to indicate as well as one can, how badly the emergency core cooling system might function. That is how long it might be delayed in functioning, and that sort of thing, without the maximum clad temperature exceeding 2300 degrees. I don't know how seriously the performance could be decreased without exceeding that temperature. I think it would be useful to the Board to have the information.

MR. MOORE: Excuse me. This is at 50 per cent power?

MR. BRIGGS: Yes.

There is one, I think, final question that I have to ask that had been asked a few days ago. To what extent has it been possible to test the emergency core cooling system in the Indian Point 2 Plant to demonstrate that the components will function at the times and in the sequence required?

MR. TROSTEN: Mr. Prestele will respond to your question.

MR. PRESTELE: The pre-startup test program for the emergency core cooling system, Mr. Briggs, was comprised of a number of elements. First of all, it's determination that the various components, pumps, valves, and so on, would function in the manner prescribed by design. I think to your question, the answer is that an over-all integrated test of this system has been performed which has allowed us to achieve a degree of confidence that not only will these components function as they are designed to function, but that they will come into play in sequence prescribed by design at a time specified by design. This has been done starting with a simulated loss of power situation and a manual fast insertion signal. All of the results in the time required by design specification have been observed to occur.

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MR. BRIGGS: What is this manual fast insertion signal?

MR. PRESTELE: I'm sorry. Manual safety injection signal?

MR. BRIGGS: Manual safety injection signal, how does one accomplish this?

MR. PRESTELE: There are, of course, a number of parameters which, when sensed, will cause an automatic safety injection. In some instances it requires a combination of events. For example, a combination of low level in the pressurizer, low pressure in the pressurizer will cause an automatic safety injection. In addition to that, in addition to these various automatic means of achieving safety injections, this can also be done manually by simply actuating a switch which has the same effect as any of these automatic actions which will result.

MR. BRIGGS: Was any consideration given as going so far as to blowdown system in some way to cause these actions to occur?

MR. PRESTELE: No, it was not.

MR. BRIGGS: Would such a test be possible?

MR. PRESTELE: I suspect that it would be possible. I believe that it's not necessary, however, in order to demonstrate the satisfactory operation of the system. The overall integrated response of the system has been determined up to and including the operation of the circuit breaker, the electrical circuit breakers, which would bring into operation specifically the standard injection pumps, heat removal pumps and so on.

MR. BRIGGS: The pumps didn't actually operate and pump water into the system?

MR. PRESTELE: The pumps had been operated as part of performance tests of the pumps in their respective systems.

In the matter of determining overall response of the safety injection system we did not operate the pumps but rather observed the full sequence of events which are supposed to occur up to and including the operation of the breakers associated with those pumps. But we did not actually run the pumps as part of the integrated test.

MR. BRIGGS: You didn't see the valves opened and that sort of thing, is that it?

MR. PRESTELE: Yes, we saw the valves opened.

MR. BRIGGS: But the pumps were not operating?

MR. PRESTELE: The pumps did not operate, that's correct.

MR. BRIGGS: When you say you think it might be possible to blow down the system to conduct a test could you suggest how that might be done?

MR. PRESTELE: I couldn't offhand, Mr. Briggs. My recollection of this subject in the discussion stage, however, was that there were disadvantages and uncertainties that would arise as a result of a full scale test of this nature, and in view of the fact that we believed that we derived sufficient confidence regarding the operability of all aspects of the safety injection system, just simply made it in your judgment unnecessary to go to that extent.

MR. BRIGGS: Can you tell me what some of the disadvantages were?

MR. PRESTELE: I can't recall, Mr. Briggs. This goes back some time in our discussions. I think Mr. Cahill might want to respond to that.

MR. CAHILL: I don't recall them, Mr. Briggs, but I can imagine some of them now. The blowdown would, of necessity, be very slow because it would have to go through existing piping and not designed for a tremendous and rapid blowdown simulating an accident, and of course we would not get the simulation of the hot water spilling in containment, which gives rise to the containment pressure signal. So it would still be a simulated test, and not reproducing simultaneously each of the effects of a loss of coolant accident.

MR. BRIGGS: So you tested the components individually and you have tested the control systems and the activation of motor starters and things like that in the simulated test that you have done?

MR. PRESTELE: Yes, sir.

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DR. GEYER: I would like to address a question to the Staff or the Applicant or both. It is can the Staff or Applicant provide a complete energy balance including changes in energy storage, temperature and pressures for the hot channel or bundle for a few selected time increments during the critical phase of reflooding?

MR. MOORE: Do I understand a complete energy balance--

DR. GEYER: For either a hot channel or the hot bundle.

MR. MOORE: Could you elaborate on that? You are talking about the energy in the coolant and coming out of the fuel or what now?

DR. GEYER: Well, water is coming into the bottom of this channel. Steam and water mixture going out of the top. Some heat is coming in, a lot of heat is going out. Heat is being generated by decay of products. Heat is being released from storage in the rods. So if you look at this channel, there is heat coming into it and going out of it in a variety of ways and some is being stored or taken from storage, and what I am asking for is a balance of all these energies.

MR. MOORE: At certain times during transient?

DR. GEYER: At certain times during reflood transient.

end

MR. MOORE: During reflood.

DR. GEYER: During reflood.

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MR. MOORE: Yes. I can't do that right now. That's a lot of information.

DR. GEYER: Could you please provide it at your convenience.

MR. MOORE: Yes.

DR. GEYER: That concludes the present experssion of concern, at least by the Board, respecting emergency core cooling systems.

In reference to any possible further recross-examination by the Intervenor Citizen's Committee for the Protection of the Environment, the Board will be available for any oral deposition that the Citizen's Committee might desire to undertake, and that would be held in Washington, D. C. We feel that such a location for interrogatores would not lessen the direction by the Commission that the hearing be held in the vicinity of the reactor, since this is a deposition only which would thereafter need to be presented in open public hearing, which would reconvene in the vicinity of the reactor and here at the Springvale Inn in particular.

But we will request the attorney for the Applicant to ascertain what is programmed by the Citizen's Committe in that respect and whether as an alternative to the deposition whether interrogatories could be prepared and submitted for answer, and likewise presentation is desired by the Citizen's Committee at a subsequent hearing session of this proceeding.

The Board will be available to receive that

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information late tomorrow afternoon at the Germantown office of the Atomic Energy Commission and we will make plans for Friday's deposition, if one is required, and it would be suggested that it be held in the small annex hearing room adjacent to the public proceedings branch under the office of the Secretary of the Atomic Energy Commission which is on the first floor of the Atomic Energy Commission Office at 1717 H Street, Washington, D. C.

Will that be agreeable?

MR. TROSTEN: Yes, Mr. Chairman.

I have two points that I would like to ask the Board about. First, I would like to ask the Board to rule that in the event the Citizen's Committe does not wish to follow the deposition route that may be directed to submit any written interrogatories on Friday.

Applicant is prepared to respond to any written interrogatories within one week, this being an alternative originally suggested by the Board, which is entirely satisfactory to the Applicant if the deposition mechanism does not prove to be satisfactory.

CHAIRMAN JENSCH: I just wonder how realistic a statement of interrogatories by Friday is, if the technical assistant for the Citizen's Committee is not going to be available till Friday, whether Monday might not be a more realistic date, that they could have worked on it over the weekend if necessary.

MR. TROSTEN: Well, I suppose between Friday and Monday is not a tremendous difference. The only point I would make, though, Mr. Chairman is this. I hve offered to Mr. Roisman in my telephone conversation with him today the typing services of actually getting the typing done of things that had to be typed, and I really don't see any reason why he can't have his interrogatories by Friday, and I don't think he sees any reason actually. So I would say that Friday, if you are asking the question whether Friday is reasonable in terms of , what the Citizen's Committee is able to do, I would say yes, it is entirely reasonable, and I don't think inconsistent with what Mr. Roisman said.

CHAIRMAN JENSCH: Well, I appreciate your statement. I think if it depends upon a technical assistant maybe Mr. Roisman is unable to express a position in that regard, as a matter of courtesy to the Citizen's Committee, and the recognition that his technical assistant is in one location and Mr. Roisman in another, that maybe Monday is a better date.

MR. TROSTEN: The other point I wanted to ask about, Mr. Chairman, is whether the Chair would rule that we could have the answers to the interrogatories, if that is the route chosen, or the deposition or portions thereof, if that is the mechanism used, entered into evidence by stipulation of the parties rather than necessarily through the mechanism of an

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offer at the public hearing.

CHAIRMAN JENSCH: Well, let's see what the mechanism is and what the suggestion is from the other party before we make any ruling in that regard.

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: There is one other matter. The Board would request the Applicant to procure, if possible, in the absence of the attorney for the State of New York agency which is appearing in this proceeding, a copy of the 1967 order by the New York agency that has to do with water quality standards and then the order adopted in 1969 which I understand has been described as upgrading those 1967 criteria. And if the factors warranting that upgrading could be indicated, whether they were derived from a public hearing or some consideration that may not be reflected in the 1969 order itself, and finally, as a third item, if it is available as a public document, the response by the Environmental Protection Agency, which was received by the New York, I believe, Department of Conservation, either in October or November of 1971.

So that might be available directly from the Environmental Protection Agency, which I believe makes public all of its releases on considerations of water quality standards.

MR. TROSTEN: Yes. We will endeavor to consult with the New York State representatives to furnish this information

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to the Board.

CHAIRMAN JENSCH: Thank you.

Is there any other matter that we could consider before we recess?

The Staff I believe has a matter.

MR. KARMAN: Mr. Chairman, I placed on your desk and the desk of the other Board members and the other parties an updating of the index of relevant correspondence to this hearing which was submitted as a joint exhibit between the Applicant and the Staff when the hearing first commenced last December. And almost a year has gone by and we naturally felt that it was necessary to update this index with correspondence attached to it.

CHAIRMAN JENSCH: Do you plan to do this every year as we go along?

(Discussion off the record.)

MR. KARMAN: I offer this as an updated supplement to that joint exhibit.

CHAIRMAN JENSCH: Is there any objection?

MR. TROSTEN: No objection.

MR. MACBETH: No objection.

CHAIRMAN JENSCH: Hearing no objection that supplement can be as an addition to the joint exhibit identified by Staff counsel?

Is there any other matter that we can contribute before we recess?

MR. TROSTEN: Yes, Mr. Chairman. I would like to ask if we could take just a five-minute recess so that Staff counsel and Staff witnesses could look over certain proposed transcript corrections for the hearing session for yesterday.

Looking them over, Mr. Chairman, looking over the transcript, we observed a considerable number of errors in the transcript which we feel it would be useful to have corrected immediately. We have discussed this with the reporter and he is prepared to make these corrections immediately. I thought we could just agree to that and it could be done if we could take a five-minute recess.

CHAIRMAN JENSCH: We won't be in formal recess, but if you will talk with him about it we will be at ease.

We can go on the record at least to say that we have no further questions of Mr. Moore, and thank you. You are temporarily excused, subject to call for further examination.

MR. MOORE: Thank you.

MR. TROSTEN: Mr. Chairman, may I make two observations while Mr. Novak is looking at the transcript?

CHAIRMAN JENSCH: Yes.

MR. TROSTEN: First, I would just like to note that Applicant intends to file a written motion as soon as practical after this recess to close the record on the radiological safety hearing, subject to certain matters remaining open.

I refer particularly to the receipt of further evidence in connection with interrogatories or depositions that presumably such certain additional information dealing with the fire situation. I make the point merely that we intended to file a written motion which will set forth the particular items that Applicant would consider would be accepted from the general safety composing the record on the radiological issues.

CHAIRMAN JENSCH: Yes. And in connection with that will you tell us what the purpose of the motion is? I don't quite understand separating the subject matters so precisely. If something should come up by December, for instance, that you had another fire, which we hope you do not, but which would affect safety, is it your thought that the order entered terminating inquiry on radiological matters, that it couldn't be reopened? The Board certainly wouldn't construe that. They will take up the radiological safety matter at any time as long as this proceeding is pending.

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: And I don't understand the advantage that you are seeking to gain by the motion. I think it's at least an endeavor, and I think you can draw a chart with the angles and so forth that would work out very well, but as a practical matter if something comes up on safety, this Board is going to take a look at it whenever it is brought to the attention of the Board or whether the Board at some time desires that further matter should have inquiry.

MR. TROSTEN: All right, Mr. Chairman. I appreciate your comments and we will set forth the reasons in support of our motion.

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CHAIRMAN JENSCH: Good. Very well.

MR. TROSTEN: I also would mention to the Board that we will endeavor to consult with Mr. Roisman with regard to the matter of proposed findings and conclusions and transcript corrections in order to work out a schedule for submission of these matters to the Board as well as of course the briefing schedules, and so forth, consistent with the pace of the hearing with the present record and with the stipulation that was agreed to by Applicant and the Citizens Committee for the protection of the environment.

CHAIRMAN JENSCH: That will be very helpful. I think the Board is very much concerned with the scope of the issues that will be under consideration for any testing consideration, and I suppose matters can be clearly set forth as I understand the Citizens Committee position, they will oppose this.

MR. TROSTEN: That is correct, sir.

CHAIRMAN JENSCH: And the question arises whether this in effect brings into issue all of the matters that will be proposed for any system power operation at 20 per cent or higher.

MR. TROSTEN: Yes, sir.

We will be consulting with respect to those matters.

I might mention that the stipulation contemplated that there would be findings and conclusions filed with regard to the motion, and then also contemplated that there would be findings and conclusions, that is, proposed findings and conclusions filed with respect to the full term, full power operating license, but we will address all those matters in our consultations and submit proposed findings and conclusions to the Board.

CHAIRMAN JENSCH: Very well. That will be helpful.

One other matter that the Board has considered, maybe this could be done at the December session.

If time permits the Board would like to have whatever may be properly described as an oral argument based on the record and based upon the motions before the Board at the conclusion of the evidentiary presentation of the session starting on December 14th.

So we may have the benefit of the views of the parties not only through the proposed findings which will be submitted and the briefs in support thereof, but also an oral discussion

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that may reflect in part both the proposed findings and the brief.

And sometimes we find that an oral presentation is very helpful when we start digging into the proposed findings.

MR. TROSTEN: Yes, sir. This would deal with, I take it, the proposed findings and conclusions, the briefs then before the Board, and all pending motions?

CHAIRMAN JENSCH: Yes.

MR. TROSTEN: Yes, thank you.

That was all I had to offer at this time, Mr. Chairman.

If the transcript corrections are satisfactory to the Staff--

MR. KARMAN: The transcript corrections are satisfactory.

MR. TROSTEN: I suggest that I could do it either way, Mr. Chairman. I can show them to you--

CHAIRMAN JENSCH: May we take a look at them for a few minutes?

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: Are these statements related solely to statements by witnesses?

MR. TROSTEN: No, sir. I believe the answer to your question, Mr. Jensch, is that these relate to--I don't think they relate just to statements by witnesses, but I can check this in about two minutes if you give me a minute, sir.

CHAIRMAN JEANSCH: Let me ask you a further question, sir. Does it relate to any statements by the Board?

MR. TROSTEN: If you will give me a minute, Mr. Chairman, I will check both of those.

Mr. Chairman, with the exception of the following these are all corrections to testimony by witnesses: Statement made by me on 3879, a statement made by Chairman Jensch at 3894--

CHAIRMAN JENSCH: What was the change proposed?

MR. TROSTEN: Show it to Mr. Jensch.

CHAIRMAN JENSCH: Very well. Proceed.

MR. TROSTEN: Yes. I believe there is one by Chairman Jensch on 3866, too.

CHAIRMAN JENSCH: Where was the other one?

MR. TROSTEN: The one I was referring to before, Chairman Jensch, was 3894. Do you see one there, sir, on 3866 correcting the statement by you?

CHAIRMAN JENSCH: Yes.

MR. TROSTEN: Yes. Another statement by Chairman Jensch at 3896.

CHAIRMAN JENSCH: Yes, I saw that one.

MR. TROSTEN: And one by Dr. Geyer at 3899. With those exceptions they are all corrections of statements by

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witnesses.

DR. GEYER: Yes.

CHAIRMAN JENSCH: Very well. Then the parties are agreed to the proposed corrections?

MR. KARMAN: Yes, Mr. Chairman.

CHAIRMAN JENSCH: The Board accepts the proposals and the transcript may be corrected accordingly.

MR. TROSTEN: Thank you, Mr. Chairman.

The reporter, I understand, will take this and issue a new version.

CHAIRMAN JENSCH: Very well.

Is there any other matter to be taken up before the recess? Any other suggestions?

At this time let us recess to reconvene in this room at 9:00 a.m. on Tuesday, December 14, 1971.

(Hearing recessed.)

Regulatory Docket File