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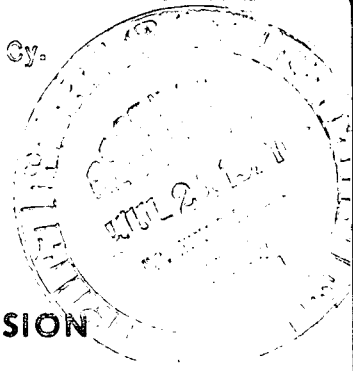

UNITED STATES ATOMIC ENERGY COMMISSION

IN THE MATTER OF:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

(Indian Point Station, Unit No. 2)

Docket No. 50-247

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Date - July 14, 1971 **Pages.** 1077-1251

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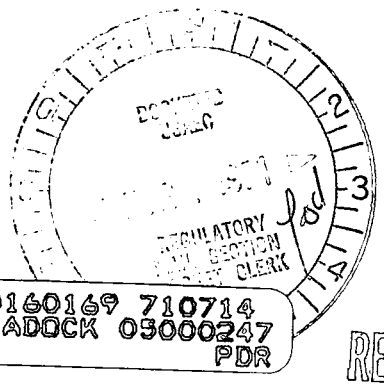

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UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

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

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

Wednesday, July 14, 1971

The above-entitled matter came on for hearing, pursuant to notice, at 9:30 a.m.

BEFORE:

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

DR. JOHN C. GEYER, Member.

MR. R. B. BRIGGS, Member.

APPEARANCES:

(As heretofore noted.)

C O N T E N T S

P R O C E E D I N G S

CHAIRMAN JENSCH: Please come to order.

Before we proceed this morning, attention should be called to the fact that there was a request made by the Westchester County Association for the entry of a statement on behalf of that association by way of a limited appearance in this proceeding. A letter was received from Mr. Daniel J. O'Brien, managing director of the Westchester County Association, requesting permission for Daniel J. O'Brien to enter a statement in this proceeding.

It appears that copies were served upon all parties to the proceeding, and if there is no objection, his statement may be included in the record as if read.

Is there any objection by the Applicant?

MR. TROSTEN: No objection, Mr. Chairman.

CHAIRMAN JENSCH: Regulatory Staff?

MR. KARMAN: No objection, Mr. Chairman.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No objection, Mr. Chairman.

CHAIRMAN JENSCH: Intervenor, Citizens' Committee?

MR. ROISMAN: No objection.

CHAIRMAN JENSCH: Very well. It will be handed to the reporter and the statement by Daniel J. O'Brien will be physically incorporated or copied into the transcript as if read.

LIMITED APPEARANCE OF DANIEL J. O'BRIEN, MANAGING DIRECTOR, THE WESTCHESTER COUNTY ASSOCIATION, INC., ON BEHALF OF THE WESTCHESTER COUNTY ASSOCIATION, INC.

Mr. Chairman, members of the Atomic Safety and Licensing Board, all other officials, ladies and gentlemen.

I am Daniel J. O'Brien, Managing Director of the Westchester County Association, Inc., and I'm here today representing our officers, directors, and more than 500 members, in the matter of Consolidated Edison Company of New York, Inc. and the requisite activation of Indian Point Station Unit No. 2.

Our interest in this matter is extensive, indeed. Our membership numbers many leaders of Westchester business, representing all areas of the county. Thus we have an abiding interest in Westchester County's business climate which consists largely of the advantages and features that attract the type of business that is good for the orderly growth of Westchester and that preserves and conserves the find residential characteristics of our county. But the attraction of new business is only one phase of our activities. An even more important phase is the development of services that keep current Westchester business in Westchester. And this embraces not alone the interests of employees of each company, but the welfare of all their families as well. And here electrical power becomes an all-inclusive necessity, bearing

directly on employment, social life, and general well-being of the public.

We claim no expertise in the subject of power generation, but frequently, in dramatizing the rapid and sustained rate in growth of activity in Westchester, we use as one important index the consumption of electrical energy in terms of kilowatt hours consumed. And here we are struck by two unusually meaningful statistics:

(1) Consumption of electrical energy for residential use in 1940 totaled 124,589,000 kilowatt hours, but in 1970 8,208,000,000 kilowatt hours -- 65 times as much as 1950.

(2) Industrial use in 1940 took 198,600,000 kilowatt hours. But in 1970, 17,000,600,000 kilowatt hours, 88 times as much electrical energy as 1940.

We submit that these are growth figures of extraordinary magnitude, and to progress in the enlargement of generating capabilities in consonance with such rapidly growing demands in Westchester must have called for great skill, courage, and sustained effort all during these 30 intervening years. I shudder to think of where we would be today had the same kind of roadblocks been thrown in the path of progress during that period as are being employed today in the name of environment.

We submit, Mr. Chairman, most respectfully, that

the time has come to face realities and clear the road to progress in the development of necessary capacity of generation; within, of course, the guidelines that appropriate governmental agencies consider essential to public health and welfare.

We believe the necessary action now is the activation of the Consolidated Edison Company Indian Point Station Unit No. 2.

Growth in consumption of electrical energy in Westchester will continue increasingly in the foreseeable future. Let us encourage our suppliers to move forward with plans and construction. This matter is not one simply of creating facilities for increased generation of electrical energy, but even more importantly, to do so in a matter that yields earnings high enough to attract the enormous capital required from investors for the funding of these improvements.

Thank you, Mr. Chairman.

CHAIRMAN JENSCH: Attention should also be directed to the fact that during the course of the recess, Congressman Dow of New York, expressed certain concerns respecting this reactor, and he directed a letter to the Chairman of the Atomic Energy Commission, who responded to the expressions of concern, and I believe that Congressman Dow has not communicated further in reference to his concern, but notation should now be made on the record that receipt was had of his communication to Chairman Seaborg of the Atomic Energy Commission, and also that a reply was directed to him answering his expressions of concern as well as arranging for a conference between Congressman Dow and Chairman Seaborg.

If there is nothing further, shall we continue --

MR. KARMAN: Mr. Chairman, I have one preliminary matter.

With respect to the printout on the Oak Ridge safety reports which we discussed yesterday, we may find some difficulty in getting sufficient copies within a reasonable time to have those physically incorporated into the transcript as requested by the Chairman yesterday. I wonder whether it would be possible to have that listed as an exhibit, so that this need not be done. It is rather bulky, and it may take some time to get sufficient copies to have it actually, physically incorporated.

CHAIRMAN YORE: Very well, will you propose the

next exhibit then? The next exhibit number on behalf of the staff -- do you have the transcript before you?

MR. KARMAN: I believe it is Staff Exhibit No. 3, Mr. Chairman.

CHAIRMAN JENSCH: Very well. Will you identify the document and make a formal offer?

MR. KARMAN: This is a printout of Project Numbers associated with water reactor safety programs, which was printed by the Oak Ridge Nuclear Safety Information Center at Oak Ridge. It is difficult for me to give the number of pages here.

CHAIRMAN JENSCH: Well, it purports to reflect --

MR. KARMAN: Project Code 101-0785 through Project Code 108-0904.

CHAIRMAN JENSCH: And purports to reflect abstracts of results of contract research work undertaken under the direction of the Atomic Energy Commission.

MR. KARMAN: Yes, sir.

CHAIRMAN JENSCH: Very well.

That document having been described by the Regulatory Staff counsel and proposed for identification as Staff Exhibit No. 3, having been identified and having been offered, is there objection on behalf of the Applicant?

MR. TROSTEN: Mr. Chairman, we have no objection to its receipt in evidence, subject to a later motion to strike. We have not had an opportunity to review all of the

contents of thsi document as yet. It may be that there is some material in there which is so completely beyond the scope of the issues in this proceeding that we would move to strike it.

CHAIRMAN JENSCH: Very well.

The State of New York?

MR. SCINTO: No objection, Mr. Chairman.

CHAIRMAN JENSCH: Intervenors, Citizens' Committee?

MR. ROISMAN: Subject to the usual reservation, no objection.

CHAIRMAN JENSCH: Very well.

Staff Exhibit No. 3 is received in evidence subject to these reservations and motions to strike.

(The document referred to was marked Staff Exhibit No. 3 for identification, and was received in evidence.)

MR. TROSTEN: Mr. Chairman, I would like to make a suggestion to the Board concerning the conduct of the proposed in camera session for discussion of Applicant's security. I would suggest to the Board that at the conclusion of today's public hearing that the Board adjourn to another room here in the facility and that in camera session be conducted immediately after the public session.

I have discussed this with counsel for the

Regulatory Staff and they have advised me that a room could be made available here in the facility on rather short notice.

CHAIRMAN JENSCH: Well, the Board has not had an opportunity to consider the matter since your suggestion in this regard yesterday. We will give consideration to it in the course of the day.

I believe that you have indicated generally the reason for your request for an in camera session. I don't know that we have had much discussion about that from the other parties. Do you desire to add anything further to your support for the request that you made yesterday?

MR. TROSTEN: I don't think I can add anything more specifically, Mr. Chairman. I would be pleased at a recess in this hearing to meet with you and counsel for the other parties to discuss it in further detail. Perhaps this would be an acceptable approach to you.

CHAIRMAN JENSCH: Does the Regulatory Staff care to comment in this regard?

MR. KARMAN: We would have no objection to having a discussion of this. We have no objection to having an in camera session to ascertain really whether or not an in camera session is required.

CHAIRMAN JENSCH: Yes. As I understand the in camera session, or the so-called parallel procedure which is

somewhat similar to what you request for security of the nation and proprietary rights; I don't know that your request comes within either category.

MR. TROSTEN: Mr. Chairman, we are relying upon the general provisions in the Commission's regulations which allow for in camera sessions if the public interest so requires. There have been of course in camera sessions held by Boards as the Chairman is well aware, although these sessions happen tohave involved matters of proprietary information.

The Commission's rules contemplate that matters pertaining to plant security shall be treated on a confidential basis. For example, there is a provision in the regulations dealing with information on divulging of material, which provides that such information will not be revealed. We are prepared to discuss this with the Chairman in a recess if you so desire.

MR. KNOTTS: Perhaps it would be helpful if we referred to Section 2.790(d) of the Commission's rules of practice which, if I may excerpt from it, says that, "correspondence and reports from the AEC which identify a licensee's or applicant's..." -- skipping over some matter -- "detailed security measures for the physical protection of a licensed facility, shall be deemed to be commercial or financial information within the meaning of Section 9.584,"

et cetera, "and shall be subject to disclosure," et cetera, "in accordance with Part 9."

MR. TROSTEN: This is the provision which I was referring to a moment ago.

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CHAIRMAN JENSCH: The point that was omitted is the one -- I wonder whether the part you read qualifies or is related to the part omitted. For instance, it says "correspondence and reports to or from AEC which identify licensee's or applicant's control and accounting procedures for safeguarding licensed special nuclear material or detailed security measures for the physical protection of the licensed facility."

I don't know whether that alternative is related to the special nuclear material, "shall be deemed to be commercial or financial information" and so forth. We can give consideration to that matter at a time after the Board has given some consideration to this request that you have. I don't know that we need to have any other discussion of it other than what has been indicated on the record now.

The State of New York? Do you desire to speak to this matter?

MR. SCINTO: We have no objection to participatin in an in camera session, Mr. Chairman.

CHAIRMAN JENSCH: Intervenor Citizens Committee?

MR. ROISMAN: As we stated yesterday, Mr. Chairman, we didn't have any objection to it, we thought it was sort of an admission against interest that the matter of security was subject to some doubt, since the Applicants are afraid to have the problem discussed in the open.

But we would bow to the Applicants' interest here if

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he felt the only way to protect the facility was to keep the discussion secret.

MR. TROSTEN: Needless to say, Mr. Chairman, we do not regard this in any way as an admission against interest, but merely as a further evidence of our desire to protect the public by safeguarding these security measures.

CHAIRMAN JENSCH: I think Applicant's counsel mentioned that if you announce where you keep the keys to the back door, people might have access to the location of that key, and security might not be as effective as it otherwise might be.

I thought that seemed to point up the necessity for keeping thekey under the rug pretty carefully.

In any event, the Board has not given consideration to this matter and we will at some time during the day.

MR. TROSTEN: Thank you, Mr. Chairman. The only other preliminary matter I wish to raise concerns the time for further consideration of foundation for the proposed cross-examination of the Staff on comparison of spray systems and also perhaps with respect to the B&W document proposed to be induced by Mr. Roisman yesterday.

I have discussed this with Mr. Roisman this morning, and we are agreed, subject to the Board's views, that this matter should be deferred until the opening of business tomorrow morning, at which time Applicants would be prepared to submit a memorandum to the Board on the subject.

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CHAIRMAN JENSCH: Well, it is the view of the Board that the subject matter to consider what the constituents are of a containment spray solution is inherently a part of the whole safety consideration of the plant and foundation for a comparison of solutions does not seem to be a part -- the foundation evidence to which reference was made yesterday was in reference to the Babcock and Wilcox report, and as to that, until the Intervenor desires to offer foundation evidence, the matter is not before the Board.

MR. TROSTEN: That is correct, Mr. Chairman, excepting that we would, in the first instance, like to see clarification, if you will, of the Board's determination mailed yesterday. We would like to submit a further statement to the Board with respect to your determination yesterday.

It is further significant to note that Mr. Roisman, I understand, intends to cross-examine the Staff for the purpose of showing that one spray system is superior to another spray system and we intend to object to that cross-examination and it seems to me that it would be preferable to defer this thing until the beginning of the session tomorrow morning, at which time we would be prepared not only to submit a memorandum to the Board with regard to that particular question involving the cross-examination as opposed to the introduction of the document, but also offer further argument on this matter generally.

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CHAIRMAN JENSCH: Well, the time that this subject comes before the Board I think can be arranged for the convenience of the attorneys and parties here and the Board has no objection to that.

I think there may be a question of semantics involved. In other words, in an endeavor to speak to whether another spray is better than another may be one phraseology of the problem of whether the existing and proposed spray for this plant is as good as it should be and, of course, consideration of factual matters will necessarily involve some comparison.

Whether you ascribe that one is better than the other or one is not as good as it should be, I think gets into a question of semantics.

MR. TROSTEN: I think it gets into a question of semantics, Mr. Chairman, but I think the distinction, as far as the purpose for which Mr. Roisman is seeking to adduce evidence is quite important to us, and because that distinction is quite important to us, we wish to submit a further statement to the Board on this subject.

CHAIRMAN JENSCH: The Board will be glad to receive it.

MR. KARMAN: Mr. Chairman, I just would like at this time for the record to indicate the Staff's exception to the Board's ruling with respect to the comparison of sprays and reiterate the position we took yesterday on this subject.

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CHAIRMAN JENSCH: It will be noted. I think it should be noted, of course, that the Staff Safety Evaluation compares a lot of other systems with other plants and the Board has had some difficulty in the analysis, in that you consider the metal components of another system, but you don't want to consider what is inside the piping, and the distinction becomes quite nebulous.

But those are matters we will consider when we renew consideration of the matter.

Are we ready to proceed with cross-examination? We had not finished with Mr. Wiesemann. Would you return to the stand, please?

MR. ROISMAN: Just one preliminary matter, Mr. Chairman.

Yesterday we offered into evidence and was accepted several documents. Most of those, but not all of them are available to the members of the Board because they have already in effect been filed in this proceeding.

We have tried within the limits of our financial resources and finding copies of things to get at least two additional copies of those documents which we suspect may not be readily available. I would just like to hand them up to the Board now.

They are not all of the documents that were admitted into evidence, or even all of the documents that are not already in this proceeding, but they were all we were able to

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get our hands on.

CHAIRMAN JENSCH: Very well. Unless there is objection to your procedure, we will -- we are receiving and have been handed a collection of documents. These, as I understand it, contain two copies each of several of which you have selected. Is that correct.

MR. ROISMAN: That is right, Mr. Chairman.

CHAIRMAN JENSCH: I wonder if these should not be turned over to the Reporter, one copy at least.

MR. ROISMAN: She already has one copy of those. I had started with three.

CHAIRMAN JENSCH: We will turn these over -- is there any objection by the parties -- we will turn them over to the technical members of the Board. Is there any objection to this procedure, the Applicant?

MR. TROSTEN: No, Mr. Chairman.

CHAIRMAN JENSCH: State of New York?

MR. SCINTO: No.

CHAIRMAN JENSCH: Regulatory Staff?

MR. KARMAN: No.

CHAIRMAN JENSCH: Very well. Mr. Wiesemann, will you now return to the stand, please.

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Whereupon,

ROBERT A. WIESEMANN

returned to the stand as a witness and, having been previously duly sworn, was examined and testified as follows:

MR. SCINTO: Perhaps I could bring up one preliminary matter, Mr. Chairman.

CHAIRMAN JENSCH: Proceed.

MR. SCINTO: At the close of the session yesterday evening, the Chairman inquired about the availability of Mr. Sherwood Davies testifying on Saturday of this week. I made such inquiry, and it appears that Mr. Davies will not be able to be in attendance on Saturday of this week.

We have had a number of phone calls last night and it really appears the earliest we can have him available to testify is Tuesday, the 20th.

CHAIRMAN JENSCH: Very well. We appreciate your making that inquiry. The Board feels, in view of the discussions that have been had during the day yesterday, it may be advisable to take a few days to review this almost overwhelming submittal of documents yesterday, both on behalf of the Applicant and the Staff.

We don't make any criticism of the late submittal by the Applicant and the Staff, but there are many matters that will require considerable review and we will endeavor to complete that review over the weekend.

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If we do not do that, it will necessarily mean when we reconvene for the much-heralded ECCS session there may be some matters that are reflected in the documents presented to the Board yesterday that will warrant further inquiry over and beyond that which we will endeavor to undertake at a session beginning on July 20th.

MR. TROSTEN: Mr. Chairman, I didn't interpret your remarks as being a criticism of the Applicant, but I would like to note that the only document we submitted yesterday which had not previously been submitted to the Board -- most on July 6th and one the Friday of last week or Thursday of last week -- were these two documents on the emergency core cooling system performance which we did not anticipate would be taken up by the Board at this particular session of the hearing.

We understood that.

CHAIRMAN JENSCH: Yes, I believe there were some further answers by the Applicant to questions from the Board and those matters will require some extensive review, maybe partly by way of clarification and partly by way of expansion on the matter.

But we can't compartmentalize your submittal with the Staff's; we will have to consider them both together and, therefore, we will undertake to do as much reviewing as we can on Friday and Saturday of this week and Monday of next week and reconvene on July 20th to accommodate Mr. Davies and such

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other review as we can undertake at that time.

MR. SCINTO: Mr. Chairman, I just wanted to indicate that the State of New York thanks the Board for its courtesy in accommodating our witness.

CHAIRMAN JENSCH: Well, let me hand it back to you, we appreciate your calling in Mr. Davies.

Let's go ahead with the cross-examination now.

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BY MR. SCINTO:

Q Mr. Wiesemann, yesterday during cross-examination you discussed the single failure concept and you indicated that in some special cases analysis was made of simultaneous failure of more than one component. I also believe I heard you say that in order to have an accident in the facility there had to be multiple failures. Was this correct?

A Yes, that is correct.

Q Consequently in the analysis in the FSAR, the analysis that the staff makes, then, is it not true that an analysis of any accident having offsite consequences would have to be based on a series of or multiple failures. Is this not correct?

A That is the effect of the way in which the review is conducted, yes.

Q Could you briefly describe, in a specific accident, let's take a loss of coolant accident, from the event, which is hypothesized to bring on the accident, the rupture of the pipe; could you briefly describe the systems incorporated into this facility which are assumed either to fail or to operate in degraded fashion in order to result in the offsite consequences which I believe, the largest offsite consequences described in the FSAR, amounting I believe to 180 rem two hour thyroid dose at the site boundary?

A Actually I would have to start before you reach

the point of double ended pipe break, because some failures have to occur in order to reach that point. Because the initial event that would probably occur if you were to have a loss of coolant accident would be a small leak in the reactor coolant system. That leak would ordinarily be detected by redundant leak detection systems within the containment, plus indications which are available as to the reservoir of water in the reactor coolant system. So that these systems which warn of the fact that there is a leak would have to fail. Or the operating staff would have to continuously ignore the indications of leakage which would incidentally be a violation of the technical specifications once the leak had reached a magnitude specified in the technical specifications for unidentified leakage from the reactor coolant syst em.

If this were to occur in all of these -- and all of these failures did occur, then the first occurrence would be a lowering of the level of pressure in the reactor coolant system. This is accompanied by a signal from the pressurizer level and pressurizer pressure in which, because of the failure analysis we assume that only one of three channels is available to provide the signal, which there is an assumption of two failures at that point, without defeating the system. The lowering of the pressure -- if this accident grew to be the big double ended break, which I doubt would actually occur, the accumulator system, at the same time we

were getting the safety injection signal, the accumulator system would discharge its water into the reactor coolant system, because of the lowering of the pressure in the system and the level in the system. The safety injection signal from the pressurizer level and pressure would start the safeguard systems which include the safety injection system itself, containment isolation, and all of the other safety systems which are needed automatically in the event that loss of outside power has occurred. The diesels would automatically start to provide backup power.

We incidentally assume failure of all offsite power even though there are redundant sources of offsite power available to supply electric power for operating the emergency equipment. We assume that for some reason that power is not available and rely on only that equipment which is connected to the diesel generators, emergency diesel generators. And there we assume that one of the diesel generators fails to operate and still have sufficient electric power to run all of the essential safeguards and take care of other plant requirements that are associated with safety.

The other systems which are required in this connection with the reactor -- with the emergency core cooling system are the component cooling system and service water systems which serve to discharge the heat removed from the system to the ultimate heat sink. These systems, each of these

systems, are designed to tolerate single failures, so that we can have a failure of your choice in any one of the systems, so that a failure of a pump or valve in the service water system, a failure of a pump or valve in the emergency core cooling system, safety injection system, high head system or low head system, as the case may be, without jeopardizing the function of the emergency core cooling system in this particular accident.

The containment is protected in over-pressure by a combination of sprays and recirculation fan coolers. There are six of the fan coolers and two spray systems and one spray system alone will take all of the heat out as would the fan cooler system by itself with the failure of one of the fan coolers.

So we have a double redundancy in this regard. And the fact that we could lose one total system plus have a failure in the other system and still be able to keep the pressure within safe limits for the containment. The spray system itself is redundant in that there are two separate spray trains provided, so that this handles the iodine removal requirements for the accident and can tolerate single failure in either of these. In the course of the accident we reach a point ultimately where we are faced with a situation of removing heat for an extended period of time, but at a much lower level of heat than would be required to be removed

in the short period of time immediately after the accident.

For those situations we are able to tolerate failures of passive elements, extra redundancy in piping and valves have been installed. And in this particular plant, unlike some of the other plants, this plant has given double redundancy in that the low head recirculation system that is used for this purpose is duplicated. There is a complete system inside the containment and that system is backed up by another system outside of the containment. So that -- most plants, other plants being built before and after Indian Point have only the system that is outside of the containment. And these systems are able to, these long term systems are able to tolerate the failure of passive elements, as I say, like a pipe break which would result in discharge of the recirculated water rather than recirculation back to the reactor coolant system.

Now, if you combine all of these -- I haven't ever made a tabulation of all of the failures that could be tolerated before you actually get into trouble, but in many instances these are quite numerous as you can see by virtue of the fact that when you pile up the single failure that is built in to tolerate the single failure, I find that each system, you have to have the initiating failure, which may not necessarily be the loss of coolant accident, as I indicated there have to be some failurs occur in order to let

the plant get that way, because history of this type of thing has indicated for -- particularly for the kinds of materials and the technology employed in the reactor coolant system and presurized water reactor that leaks occur before breaks occur, and this has been illustrated by evidence of various events that have occurred where leaks have occurred in systems.

The fact is that knowing that leaks occur before breaks, and having a leak detection system that warns the operator that leaks are occurring, and his ability to be able to determine by going into the containment and inspecting it at appropriate times the condition of the reactor coolant system to determine where, identify where the source of the leak is, he is able to make the decision to shut the plant down before you would ever get to a situation that would result in a massive break of this kind. But you have to have a failure of all of that before you even begin to be concerned about the possibility of a rupture.

Then it is highly unlikely that the rupture would ever reach the point where it would reach such a large break as a double ended break of the pipe because of the ductile nature of the piping. The leak would open up and what would actually happen is that the plant would have to be shut down manually, because of the inability to keep the water level at its normal water level. The water level would go down gradually and finally reach the point where the equipment which

is provided to keep the normal reservoir of water in the reactor coolant system would be unable to keep up with the leak rate and the water level would begin to drop below the level where the operator is -- where the operator normally keeps the water level, and he would immediately recognize that there is something wrong here and he would just simply shut the plant down and investigate, and thereby foreclose the possibility of having a large break.

Q But you nontheless do design against that large break?

A Yes, sir.

Q With a system of safety first which you described here, which require rather extensive sequences of failure to arrive at those consequences?

A That is correct. I think that is what I referred to when I used the staff term of multiple barriers. It is a philosophy that has been developed in the nuclear Navy program and has been carried through ever since that time in the design of nuclear facilities.

MR. SCINTO: That is all I have. No further questions of Mr. Wiesemann.

CHAIRMAN JENSCH: Does the staff have any questions?

MR. KARMAN: No questions, Mr. Chairman.

CHAIRMAN JENSCH: The Applicant?

MR. TROSTEN: I have no questions of Mr. Wiesemann

at this time, Mr. Chairman.

CHAIRMAN JENSCH: When do you think you will?

MR. TROSTEN: I have no present plans to offer redirect examination of Mr. Wiesemann, Mr. Chairman. I am simply reserving the right to do so in the later course of the hearing.

CHAIRMAN JENSCH: Well, it is a question of semantics again. If you exercise the right to call him. we will give consideration to it at that time.

Very well, Mr. Wiesemann, you are temporarily excused, subject to further call.

(Witness temporarily excused.)

CHAIRMAN JENSCH: Mr. Wiesemann, I take it, will be here tomorrow and thereafter?

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

CHAIRMAN JENSCH: Is there some further examination at this time of witnesses by Citizens' Defense Committee?

MR. ROISMAN: Yes, Mr. Chairman. The next witness that we would like to call is Mr. Karl Kniel from the Staff.

CHAIRMAN JENSCH: Mr. Karl Kniel, having been sworn previously, need not be sworn again. Will you resume the witness stand, Mr. Kniel?

Whereupon,

KARL KNIEL

resumed the stand on behalf of the Regulatory Staff and,

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

MR. SCINTO: Is Mr. Kniel being called as Mr. Roisman's witness or is he being called as the staff witness, and Mr. Roisman is cross-examining him?

MR. ROISMAN: I am cross-examining him. If Mr. KNiel would like to be our witness, we would be delighted to work with him.

CROSS-EXAMINATION

BY MR. ROISMAN:

Q Mr. Kniel, did you spend the night reading the transcript as I urged you to do when I saw you last evening at 10:30 when we all picked up our transcripts?

A I did review portions of the transcript yesterday evening.

Q First, Mr. Kniel, just to keep the record straight at this point, could you tell me what your responsibilities have been with respect to the Indian Point No. 2 plant?

A My position is Senior Project Leader in the Division of Reactor Licensing of the Atomic Energy Commission. My responsibilities have been the technical review of the Indian Point 2 facility and coordination of technical review by other persons in the Regulatory Group and consultants to the Regulatory Group.

Q Mr. Kniel, as in the cross-examination yesterday,

the issue, the question I would like to explore with you is how judgments are made by, in this case the staff, in determining what contingencies should be planned for with regard to the plant safety systems. My concerns -- and I will express them at the beginning so we will all know where I am trying to go -- is to find out whether or not all contingencies that can be covered are planned for and all contingencies that can't be covered are called incredible, or whether we work from the other end; first find whether or not the contingency is incredible or not, and then find out if there is a design safety ssystem to meet it.

To start that off, I wonder if you would tell me what you view, in essence, as the statement of Mr. Wiesemann -- from Mr. Wiesemann of yesterday -- with regard to these questions. In other words, how do you view Mr. Wiesemann's statement in terms of how Applicant approaches the question of deciding which consequences might occur and should be planned for, and which consequences might not?

And, if you would, if you formally use such words as "possible,""probable," "likely," "unlikely," "credible," or "incredible," would you use them in an appropriate way, and then I will ask you to tell me what you mean by those words.

A Well, the Atomic Energy Commission conducts its

review independent of what the Applicant does. The Atomic Energy Commission has published a series of criteria called The General Design Criteria which reflect the judgment of the technical staff as to what considerations should be given to design of nuclear plants.

Q But when you do your analysis, do you look at which the Applicant submits to you in doing your analsyis, I mean at more than merely the bare bones description of the components of the plant? Do you look at their description of certain accidents that might occur, and their safety contingencies to cover them, and what events they consider possible and what events they consider impossible in terms of evaluating, what they think the plant performance is?

A Well, we do look at what they have considered, but primarily we make our own judgment of what should be considered and we review their work that has been done in response to what we believe should be considered.

Q In that context, when you receive something from the Applicant, for instance, let's say with regard to the consequences of a loss of coolant accident, the credit to be given for the filters or the credit to be given for the containment spray system or the credit to be given for the plate-out, if you find that the assumptions that are used by the Applicant differ from your assumptions, do you question

the applicants about those assumptions to find out how they concluded either that a certain system would be more effective or less effective? Or do you just ignore what they do and proceed ahead with your own assumptions, whether they agree or disagree with what the applicant's are?

A We actually do both. In many cases we make our own evaluation independent of what the applicant does. We don't ignore what the applicant does and we certainly question him on what he has done and what his feelings are and what his technical work has been in certain specific areas.

And in the particular area you mention, the spray system, that is evaluated independently in terms of meeting Part 100 requirements.

Q When you say "meeting part 100 requirements," you mean in terms of total radioactive releases in the event of a major accident? YOu didn't mean there were requirements in Part 100 that specified the precise details or the performance criteria for the spray system?

A No. Part 100, I interpret Part 100 as a site criteria. It is a calculation made to specific formula, if you like, as given in Part 100 and to see if that site meets this criteria. And these criteria are applied to all reactors, so that there is some consistency in the siting of reactors.

So, in applying Part 100, we do our own work independently of what the applicant does.

Q In the course of receiving analysis of the plant's operations from the Applicant, do you find that there are instances in which the Applicant categorizes certain events as being improbable or impossible, or incredible, and therefore does not have any design built into the plant to compensate for the occurrence of those events?

A We certainly review the applicant's input in this respect. Again, the criteria of what should be considered as credible, or incredible, are our own and are reflected in the General Design Criteria.

Q Excuse me, Mr. Kniel. That wasn't the question I asked you. I had asked if when they submit material to you if you find that in that material certain consequences of the operations of the plant are not, there is no design to compensate for that consequence occurring, and the reason for that is the applicant's conclusion that the event is improbable, impossible, incredible, highly unlikely, or what-have-you?

A We would certainly consider that event and make our own judgment as to --

Q I am asking you --

CHAIRMAN JENSCH: Excuse me. Let him finish, please.

THE WITNESS: We make our own judgment as to what category that fits in, that particular event.

BY MR. ROISMAN:

Q But do they make those judgments when they submit it to you? In other words, does the material you receive from them have those judgments in it? I understand that you make your own, but do their materials have those judgments in there?

A Well, they may be implied in there, certainly.

Q And you make similar judgments which may not come up with the -- which may not have the same result as theirs? In other words, they may say a certain event couldn't possibly occur, and therefore there isn't any consideration of what would happen if it did occur. And you might, in your analysis, assume that that event could occur, and do an analysis to see what the consequences would be and perhaps come back to them with some questions about your analysis, asking them to explain the event, something of that nature. Is that correct?

A Yes, that is correct. We certainly use the applicant's own efforts in trying to decide whether an event should be considered as credible or incredible and should be designed against or not designed against. In the final analysis, it is our own judgment as to which procedure to follow.

Q Now, in your analysis, what factors enter into your judgment as to whether a particular event should be labeled credible or incredible? Let me ask you first of all:

Am I right in assuming -- let's try to get a common word here -- that the practical consequences of determining that a particular event is incredible is that there is not analysis with respect to the operation of the plant to find out what the consequences will be if the incredible event occurs, and if an event is determined to be credible, then we will find that the staff and the applicant or at least one of them, has analyzed the event and, in the FSAR or supporting documents, has indicated what the consequences of that event will be?

In other words, I am trying to find out what hinges on whether a particular event is identified as being credible or incredible? Have I correctly stated it, or perhaps you would like to state it in your own words?

A I think you have essentially correctly stated it.

A credible event is something we design against to prevent a public hazard. An incredible event is something we do not design against.

Q All right.

Let me go back to the earlier question, then. Can you tell me what are the standards that the staff used in deciding whether to classify an event as credible or incredible?

A Well, the staff has been at this business for a long time and I would say probably the major output of the staff--and of course, the major output of all of the work that has

gone into all of the applications, and all of the work in nuclear power plant design -- has been used to make these judgments over a long period of time. And these judgments are reflected in the general design criteria which, as pointed out yesterday, have been in the darft stages for a long period of time, also they have been revised several times, and I believe they have now been issued as a part of the Commission's regulations, Appendix A to Part 50.

Q Now, let's see if I get this first standard right.

The long experience of members of the staff helps them make judgments. Is that it?

A Well, the staff is following the general design criteria. In other words, the staff as individuals has made contributions to the general design criteria, or may make future contributions in terms of revising the general design criteria. So it has been a methodically built-up process. It is not something that is made on every plant. Certain new features or new things may come up in connection with individual plant reviews, but basically, the staff reviews the plant in terms of does it meet the general design criteria, and the general design criteria reflect the credibility or incredibility of certain events.

Q In formulating these general design criteria or the new answers thereto that the staff may apply in a special case, is probability, mathematical probability analysis used,

for instance of the type we discussed yesterday, where the applicants did an analysis of the probability of an airplane hitting the reactor.

A It is used in a limited sense, and it is desirable to use it more. As was pointed out yesterday, the technique has not really been fully developed, especially if you go to things which have very little probability of occurrence. I believe there was a case discussed yesterday of the probability of an airplane crashing in any given spot, let's say, and that analysis was made for Con Edison. It reflects certain knowledge about operational mathematics, operational considerations which lends itself a little bit more to determining these kinds of probabilities.

When you are talking about equipment failures, component failures, it is a little more difficult, but certainly the staff makes strong attempts to try to come up with numbers in terms of probability and tries to associate these numbers with credibility or incredibility. However, there is a reluctance to have a simple number represent credibility or incredibility. Until those numbers can be refined to the point where they are very reliable, the judgment of a lot of people and the concern of a lot of people on all of the input that goes into making a low probability number, I thin, is a better substitute. There is an additional consideration: Things like that, on component failures, which

makes it difficult to make this kind of analysis. I would say the nuclear industry is not particularly keen on the statistical approach to finding component failures. The approach has always been that we don't want to accumulate that kind of history.

Q Mr. Kniel, in the example that was just used yesterday, the airplane crashing into the reactor building, I believe that the probability was one in 11 million, if I remember correctly, of that event occurring; assuming now that the statistics meet the criteria of being reliable statistics, and that it was a fairly reliable mathematical probability, would you say that that was an incredible event or a credible event?

A I think our review implies it is an incredible event.

Q You mean because your review does not include the possibility of that occurring?

A That is correct.

Q This analysis was done, I believe, in either June or July of this year. When you made your analysis or when the staff made its analysis of that event occurring, was a mathematic probability study done, another one other than this, or was this one available in an earlier version, or was it done on some other basis?

A Well, the staff has looked at the probability of

airplane crashes, principally with respect to locations near airports. The staff has published a certain amount of work they have done in connection with the Shoreham Nuclear Plant and the work there is published as part of the safety evaluations of the Shoreham plant. The staff has been careful in that evaluation not to come up with absolute numbers of probability, because we feel that kind of number is still a bit speculative and we have gone to comparative probability -- As was pointed out here yesterday, using this technique on a comparative basis is more satisfactory, given the present body of knowledge, than using it on an absolute basis.

However, from what I know of that analysis, we certainly think that the number that was calculated in this particular document with respect to the crash probability at Indian Point is not wildly incorrect; it is in the ballpark, so to speak.

Q That is an interesting use of terms.

Maybe I am mistaken, but do I remember that in the Shoreham case one of the analyses that was used as a comparative analysis was an airplane crashing into Shea Stadium, and that -- I am not sure that I remember that that is true, I don't know whether it was merely a subconscious use of the phrase by you, but when you compare the possibility of an airplane accident at Shoreham, was it compared with the possibility of an airplane crash at Shea Stadium as a

way of getting a comparative analysis?

A Not to my knowledge, it wasn't. I think the probability of a crash into Shea Stadium would be significantly higher than it would be at Shoreham.

Q How do you conduct one of these comparative analyses. Can we take a hypothetical here? Let's assume that the possibility of probability of a plane crashing into the plant is as the applicant's analysis suggests, 1 in 11 million, and the possibility of an airplane crashing into Shea Stadium is 1 in 10,000. Can you discuss with me how you would use those -- assuming the statistics are, let's say, equally reliable -- how you would go about doing a comparative analysis?

A Well, I wasn't a participant in this particular study, but I think I recallwhat kind of approahc was used in the case of the Shoreham study. The statistics on crash frequency or crash probability near airports were compiled from the available numbers. And these were plotted, and it shows that as you move away from the airport, the probability of a crash decreases substantially. And it furthermore shows that the kind of decrease to a kind of background level at several miles. I use the word "several miles." I don't know -- four, five, six, seven, something like that. So that the comparative analysis indicated that when you are several miles away, that you are essentially kind of like a background, any place in the noAtheast would be subject to

the -- roughly the same kind of probability.

Q Is that the type of comparative analysis that you use? In other words, if the likelihood of the event occurring reaches the point of being as likely as other events which we live with every day, that are similar to it, then you figure that this plant is not adding a risk to man's environment that is substantially larger than other risks?

I mean, if there are 10,000 risks that we run every day, of a plane crashing in any one of 10,000 places in New England, the addition of one more with the same level of risk, bringing it to 10,001 places is considered not very great? Is thathow the comparative analysis works?

A No, I don't quite understand how you formulated that particular question from what I said before.

Q When you said you went to background and then you determined after five or six miles from the airport, the likelihood of an accident occurring is about the same as "the background," that is about the same as the the plane hitting any spot 5 or 6 miles or more from airports anywhere in New England --

A That was used to evaluate the situation of the proximity of an airport.

Q I understand. I see how you get the figure. The statistics, that, at six miles, let's say, it is 1 in 10,000, whatever it is, changes. What I don't understand is

how you apply to that statistic the qualitative word "credible" or "incredible."

END##

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A That is a question of judgment. It is a question of judgment of a lot of people. It is a consensus of an awful lot of people involved. We don't like to hang our hat on a number, because the numbers can't be determined that accurately.

But it is the consensus of the Staff that normally a reactor facility does not have to be hardened against an airplane crash. It does not have to be designed to sustain the crash of a civil air transport.

In other words, that is reflected in its general design criteria. The general design criteria do not require the plant to be designed to meet an airplane crash into the plant.

Q You mean any plant or one that is a certain distance from airports?

A Well, in general it does not require that. For plants located near airports, we have made other requirements, we have required this kind of additional hardening at Three Mile Island, for example. We haven't required it at Shoreham. We are coming out with some specific criteria in this respect, the AEC, which will be published in the next few months hopefully.

Q Now, in other words I am concerned here with the practical results of Staff analysis, rather than the theoretical concerns. It makes a practical difference to the Staff, the location of the reactor, vis-a-vis a particular airport. And

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the reason that it makes a practical difference is in part that the closer you get to the airport, the greater the chance is that there will be an accident where a plane could strike the reactor and you decide whether you want to design the reactor building to withstand that possible plane crash.

What I am trying to find out is how do you draw the line, how do you decide whether it is five miles, or closer, or four miles or closer, or whether it is the one-in-ten-thousand probability that you required design to be done for, but the one-in-one-hundred-thousand probability you don't require to be designed for.

You tell me, you used the word judgment, but I assume it is not gut reaction, you don't all sit in the room and say how many feel we ought to do it, how many feel we should not. I am trying to find out what factors entered into that judgment. Not just experience, you told me about that, but how do you apply that experience? I mean your kinds of judgments are very technical judgments and I assume there must be technical steps you go through.

A Well, there are technical steps we go through. If you make a mathematical analysis of a probability of occurrence of a certain event, you find that you have to assume or provide somehow the probabilities for certain other events that led up to this.

In other words, the calculation has certain

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components in it. So the final answer is never as good -- it is only as good as what goes into the individual components of the answer.

Now, most of our analysis is done more in a qualitative sense. In other words, we look at the individual components, and we determine what the probability is for these individual components. This is used to bring out the final judgment as to whether the event should be considered or should not be considered as a credible or incredible event.

Now, there are a lot of different people with different specialties involved and the input is on a certainly industrywide basis. A lot of our input is from the Applicants, from national laboratories, and elsewhere.

Q Input in terms of helping you formulate the more reliable statistics, or input in terms of getting judgments?

A Both.

Q All right. In terms of getting the judgments, do you go to someone and ask him, Harry, what do you think about this, and he says, well, my judgment is, or does he sit down and do something? Does he do -- I am trying to find out how the judgment gets formulated.

It does not happen instantly, someone does not come to you, if I gave you the probability analysis that was done with regard to whether an airplane could or couldn't strike this reactor building, I assume that you would take

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some time to find out whether it appeared that the statistics that were in there had a reliable basis or not. If it said they called up a friend of theirs who flies a lot and asked him how many times he had flown near this reactor, you would count the statistics.

If they said they called the FAA and got the flight statistics for a period of two week, you would give the statistics, but not a great deal of weight, because two weeks is not a very long period of time. If they said they had analyzed the ten-year activity in this area, and had also gotten some projections from the FAA about the ten-year activity subsequent to this, then you are beginning to come to a more reliable statistic about physically how many planes are in the air within a certain distance from this plant on their way to airports nearby or just passing over at substantial altitudes.

Once you finished developing this, in other words, getting facts about the figures and the statistics, what more analysis do you do in reaching your judgment about whether you would say that one-in-eleven-million predicted probability of a crash of an airplane into this reactor is credible or incredible and whether you will make the Applicant harden this reactor building against the possibility, or leave it alone.

A I think the decision in this particular case was based principally on statistical information. But in

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other cases the information that is used is the design of the components, the codes and standards used in the design of the components, the testing that is done during the manufacture of the component, the testing that is done, preoperational testing, the in-service testing, and surveillance.

Those things enter into whether we can rely on something or how well we can rely on it and what the probability of a failure is.

Q In this particular case -- I think I asked you this before but let's get it again -- you say that the one-in-eleven-million chance of the crash would be incredible and, therefore, that it wouldn't be designed for; is that correct?

A I don't think I really have to say that. It is certainly implied since in our evaluation we didn't consider hardening of the facility as a requirement. We certainly, you can certainly conclude yourself from that that we don't consider it a credible event.

Q If a statistical study were done and it showed there was a one-in-five chance of an airplane crashing into this reactor building, would that be considered credible or incredible and that it should be designed for?

A In my opinion that would be credible. But I think it kind of points up what we are trying to get away from, we are trying to get the benefit of a more rigorous mathematical approach to these probabilities, especially in more complicated

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systems, where it is more difficult to make judgments or in a sequence of events where it is difficult to make judgments.

We are not trying to rely on numbers completely. We are trying to rely on a detailed qualitative breakdown of what goes on. And this is done and redone over a long period of time. It is not done by individuals looking at a reactor. It is done over a long period of time for the Staff and it is changed constantly too as things change.

Q For instance, in the airplane example, your qualitative analysis, in a way it is beyond the Applicant's control whether a plane will or will not crash into this building and it has nothing to do, the Applicants could design this building in terms of the quality of design at the highest level, and if Boeing designs a lousy 707 and it plows into the reactor building someday, you may say it is not the Applicant's fault, nor would you be in a position, I assume, as nuclear experts, to evaluate the quality of the design of 707s, or of the personnel who run the FAA's air controller center for the New York area, to figure out the chances in terms of putting judgments on those statistics.

Is that correct?

A Well, I don't think we are quite as helpless as you kind of imply. We have to operate on what we know and we have to project on what we know. We know that aircraft reliability meets certain standards, that there is a federal agency to enforce those standards, that there is every prospect that for

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an industry that has to live on customers, that there are minimum standards of quality in aircraft which will be continued. So I think we can project that the aircraft quality certainly won't decrease or won't decrease significantly and we can forecast the needs for hardenability of reactor facilities on the basis of projecting that the quality of transport aircraft manufactured will continue at the present level.

Q I didn't want to get into an argument with you about those assumptions, but let me say that I truly hope that your analysis in the nuclear area is based on a more reliable basis than what you suggest to me in terms of the aircraft industry and I urge you, at the earliest convenience, if this is truly entering into the analysis on aircraft, to contact Mr. Ralph Nadar and to read the record on the analysis of the Electra prop jets, which were designed and approved by the FAA and were subject to several crashes before they were redesigned and reapproved by the FAA.

I don't want to get into an argument on that; I realize that is not your area of expertise. I hope when you analyze nuclear stuff that you don't also assume that the mere fact that the Applicants have the customers and public to serve will be adequate protection, because sometimes those goals don't always get achieved.

That is what we are here to find out, whether or not they have been achieved.

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A I think you misinterpreted what I said a little bit. I said you implied that maybe some time in the future they are going to design a lousy airplane and the probability for crashes will go way up. I am just saying I don't think that will happen. The present statistics aren't going to change too much.

Q I don't know whether they have already designed a lousy one.

A Well, I think in the sense that to calculate this probability, the present statistics are not going to change this much. That doesn't mean some future aircraft may not have as good a performance as, let's say, some of the present aircraft.

Of course, it is all relative, I mean, how you regard what the performance of the aircraft has been. I am just saying it is not going to deteriorate further. I may add one other thing, and that is I think the aircraft people have expressed an interest in the nuclear way of looking at it.

In other words, I have heard or have read certain discussions where they don't want to tolerate the crash of an aircraft anymore. They want to design completely against it in terms of the nuclear approach. The nuclear approach has always been that a public hazard is an intolerable condition and can't be accepted, and I think the aircraft people are

thinking more along those lines. They don't want to accept the crash of an aircraft as something that will happen.

Q I am all for that, great. Let me go back to this question of comparative analysis again.

I wonder if you could give me an example of a situation in which you would use -- if you would use for me -- the comparative analysis approach with regard to mathematical probabilities?

A I don't have any particular examples I could give you at this time.

Q How do you know that it has ever been used? Did someone tell you it has been used, comparative analysis has been used for mathematical probabilities? If you would like some time to check your notes or something, I will be glad to excuse you and you can come back.

I have some other questions to ask you on other subjects and you can come back to the witness stand tomorrow --

CHAIRMAN JENSCH: Well, this might be a convenient time now, if he desires to do it, it is the proximate time of our recess.

Let us recess to reconvene at eleven o'clock.

(Recess.)

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CHAIRMAN JENSCH: Please come to order.

Mr. Roisman, will you proceed with your examination, please.

BY MR. ROISMAN:

Q Mr. Kniel, just before the break we were talking about the question of comparative analysis. Let me ask the question again: Can you give me some example of an area in which comparative analysis is used as you indicated it might be used with respect to mathematical probabilities?

I might say that if you wish, you can use a simplistic example. I am not concerned with the particular substance of it, but rather the mechanism by which the comparative analysis works when you use that in evaluating and determining whether to say a certain event is credible or incredible?

A The gist of my testimony was intended to indicate that this method has been used to some extent and it is desirable to use it in lieu of doing a complete probabilistic analysis. I am not a particularly qualified person in this area. I think the Staff will continue to promote their interests in this area and they are continuing to promote their interest in this area.

The only particular example that I am aware of at the moment is the one I already mentioned to you, the one we published in the Safety Evaluation, I guess it is in the appendix to the Safety Evaluation, for the Shoreham construction

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permit. And that is a comparative analysis of crash statistics near an airport.

Q What is compared? You compare what statistics to what other statistics?

A I don't understand your question.

Q You said it is a comparative analysis. What is being compared?

A A comparative analysis, I thought the words comparative analysis referred to making estimates of probability for different situations and then comparing it. And basically estimates have been made of probabilities for crashes at various distances from airports and then they were compared versus distance, in other words, what the probability versus distance is. That is the comparison.

Q You mean it is a comparison between the probability at a particular distance, not a comparison between the probability at distance A and the probability at distance B?

A I didn't understand that.

Q All right. You are trying to decide at some point, if we put a reactor in the middle of the plane runway at LaGuardia, I assume some design ought to be built into the plant to compensate for the possibility that a planemight strike the plant.

That is at ground zero. I assume if LaGuardia were the only airport in the world and we located our plant 50 miles

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from it, then you might say, well, the chances of an airplane going into LaGuardia is, you know, perhaps this one-in-eleven-million figure and you wouldn't design for it.

When you make judgments, there must be a gray area there, someplace in which the plant is not actually on the runway and is also not 50 miles away, where you would still require hardening, as you tell me you have done in the Three Mile Run plant.

I am trying to find out if that is a number, which I gather from what you tell me it is not, in other words, it is not a one-in-ten-thousand we always say that is credible and in one-in-ten-thousand it becomes incredible, but is it something that includes numbers and judgments and so forth.

I want to find out how you draw that line. You have drawn certain lines in analyzing this plant.

A I understand the question. Presumably the AEC is going to have to drawn that line when they come out with the criteria for airports, for design of reactors near airports. So far the indications are that at four and three-quarter miles, the line is somewhere inside four and three-quarter miles.

I believe the Shoreham facility is four and three-quarter miles from the airport. So the line is somewhere inside of that.

Now, it is possible the AEC may decide to draw some

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kind of a shaded line, where there may be some intermediate positions. But the question of how you draw that line I think again is a question of all of the judgments that go into this.

Do you draw a distinct line, do you draw several lines requiring several different gradations of protection? That is a question of judgment and we exercise that judgment in terms of the criteria that the AEC publishes for the building of nuclear power plants.

They are reflected in those criteria.

Q Let's look at the criteria for a second, if we can.

First of all, am I right in assuming that the judgment has been made -- I don't know whether it appears exactly in this form in the design criteria -- but the judgment has been made that the possibility of a loss of coolant accident from a double-ended pipe break is credible, and the design should be built into this plant in order to compensate for that possibility?

In other words, the judgment has been reached that it is credible. Is that correct?

A Yes, that is correct.

Q And am I equally correct in assuming that the possibility that there will be a major meltdown of the core of this plant as a result of a loss of coolant accident or anything else has been determined to be incredible and, therefore, that possibility has not been designed for. Is that correct?

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A Yes, that is correct.

Q Is there a painless way in which you can tell me in detail, not in conclusory terms, how you go about reaching the judgment that one occurrence is incredible and the other is credible?

Now, if mathematical probability enters into it at all -- I am not asking you to tell me the details of these two events, in other words, to tell me well, we have designed this little shear bolt so it will shear in the event the pressure reaches a certain point and so forth, but rather how do you evaluate the possibility of failures and so forth.

If that evaluation is part of the design criteria in Appendix A, I would like you to go behind the design criteria, if you can, and tell me how that got formulated.

MR. KARMAN: Mr. Chairman, at this time I am not sure that our witness is in a position to go beyond or behind the design criteria, which are Commission regulations. The Staff of the Atomic Energy Commission is bound by those regulations and evaluate their plants on the basis of those regulations.

I don't think that the question leading to the position where the witness is asked to go behind or beyond the design criteria is an allowable question. We object to that.

MR. ROISMAN: Mr. Chairman, the witnessed testified

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earlier that the Staff participated in the preparation of these design criteria. I am not trying to attack their validity, at least not at this point. I am trying to find out how these judgments were made.

THE WITNESS: That is a pretty big order.

MR. KARMAN: Wait.

CHAIRMAN JENSCH: The objection is overruled.

THE WITNESS: Well, as I said, the criteria were developed by the Staff over a long period of time by a lot of people using the available technology. I don't have any kind of recording of all of those criteria, or a capability to recall all of the information that went into it.

I was never a party to the formation of all of those criteria. I may have participated in portions of them, only in a sort of way.

BY MR. ROISMAN:

Q I didn't mean the specifics; I want to know how.

A You are asking me what are the bases for all of the criteria, and how were they formulated?

Q No, I am asking you the second only. How were they formulated?

In other words, you have used the word judgment and I am trying to get behind the word judgment. In other words, is judgment the combined experience of the men who worked on it, is that what you mean by judgment?

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If so, is that a statistical experience? In other words, experience that they have had based upon performance of reactors, or was it schooling, in other words, were they all Ph.D.s; they all had nuclear engineering degrees? What went into the judgment? How did the judgment get formulated?

A I think the design criteria are a distillation of the knowledge of the, the nuclear knowledge that we have on the part of industry, on the part of the national laboratories, on the part of the Staff.

Q But earlier you testified that with regard to much of this, we don't have enough statistical knowledge in order to do the kinds of mathematical probabilities which you say would be a good idea if we could move in that direction, but at present there are weaknesses in the statistics.

If you don't have the statistical knowledge, what kinds of "nuclear knowledge" did you have?

A Well, you don't have the statistical knowledge in the absolute sense. I mean in other words if you are asking for a quantitative definition, we frequently don't have that kind of thing; we can't define it very accurately in an exact quantitative sense.

It is not necessary to define it that accurately. Supposing, for example, that the probability for an occurrence is ten to the minus twentieth or one to the minus tenth. Those numbers are equally small, in general we would consider them

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incredible. So that it is not necessary in many cases to be exact about the answer.

Q What about ten to the minus five?

A Now, you are asking me to draw the line again.

Q Yes. But you had to draw the line, somebody did.

CHAIRMAN JENSCH: Wait a minute. One at a time, please.

MR. ROISMAN: I am sorry, go ahead, Mr. Kniel.

THE WITNESS: I think the lines we have drawn are clear in some cases.

For instance, we have drawn the line in the case of a loss of coolant accident, that a double-ended break is credible. The fracture of the vessel, failure of the vessel is incredible. I think there is a good example of where we have drawn a line, as you want to put it.

BY MR. ROISMAN:

Q What I am trying to find out is -- Maybe one way of looking at it is how close is the rupture of the vessel to the line in which you would say credible instead of incredible?

In other words, there is an imaginary line, I assume that these two events are not precisely just on one side of the line and one just on the other. I am after the imaginary line and how it is set.

A Well, it is set by the people who know about vessel

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failures, the knowledge of people who have made this decision on vessel failure, what kind of knowledge they use, that is what you are asking me.

All right. They look at statistics on certain vessel failures, and there is a limited amount of data on certain vessel failures, they look at those. They look at how the vessels were designed.

They look at how the nuclear vessels are designed, what the nuclear codes are, whatthe additional in-service, the additional nondestructive testing is in the fabrication, what the additional margins of design are for the vessel, what the in-service conditions for the vessels are, what kind of leak detection systems you have, what kind of in-service inspection systems you have.

And they use that information to determine what the credibility of vessel failure is in a nuclear plant.

Q Now, those various component elements that go into the analysis, like the codes that are used, or the leak detection systems, as I understand it in a sense those are not really concepts which approach an absolute.

The codes are good now but they could be better. I think the agency now has out a general design criteria, proposed rule-making, on code inspection for vessels, if I remember correctly. I don't remember the exact title of it, it has something to do with various inspection techniques.

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But it is an upgrading, the ASME Codes were upgraded during the period '67 to '70 and I think there is a higher grade of code.

So these codes and the electric detection systems and the fabrication techniques that are used can get better than the ones that, in fact, are in existence now.

How is the judgment made as to whether they are "good enough" at a given point, how, without statistics? How do you know that the ASME Code of 1965, which I think is the one that generally covers the fabrication of the vessel in this plant, although this plant I believe is going to conform to the later ASME Codes on inspection, how do you know that the '65 Code was good enough. Or if it is not you personally, how is the judgment made about that?

A Well, it is not made personally, but the judgment was made at the construction permit stage that the provisions for manufacturing the vessel and design of the vessel were adequate in terms of an incredibility of vessel failure.

Q Not where, how?

A How? Well, it was made from a knowledge of the people who are more familiar with this technology, they made the judgment based on the known technology, the things I referred to before.

The design of the vessel, the requirements for fabrication methods of the vessel, the requirements for

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nondestructive testing at various stages of the vessel, requirements for testing of the vessel prior to installation, the requirements for testing, pre-service testing the vessel. And the requirements for in-service testing of the vessel.

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Q But how was it possible to know that those various component elements, that those were good enough?

For instance the Applicant has submitted answers to the questions here from both the Board and ourselves indicating that in the technical specifications in-service testing of certain parts of the reactor vessel will be undertaken in ten years if certain equipment, which is not now designed, has been designed and the Applicant believes that will be possible within the ten-year period.

In other words, it is an evolving technology. Presumably that technology is not evolving in the face of a conclusion that has already been made that enough is enough, and we don't need any more.

How do you make a judgment that the present state of whatever it may be, inspection criteria, is good neough so that you can conclude that/only if that amount of inspection is done, it is incredible, when you add all of the other elements in, that there will be a rupture of the reactor vessel?

A Well, in terms of an in-service inspection program, for this plant, it meets the requirements of Section 11 of the ASME Code, which has just been recently adopted.

The technical specifications provide for that program. There is a comment in the Remarks column to the effect that certain methods for remote examination will have to be

DB-2

developed to implement all of those requirements. That is just a statement of the present situation.

The requirements are still there. It is just a statement of the present fact.

Q Do you take the ASME code as given, that is, the staff does not do independent analysis of those code standards to decide whether they are adequate?

ASME says that is what is to be done and that is what is to be done?

A Well, Section 11 of the Code --

CHAIRMAN JENSCH: Would you try to answer it yes or not and then explain, if you can? Does the staff determine the adequacy of the Code, as I understand the question.

THE WITNESS: Yes, that is true. The staff determines the adequacy of the Code.

What I was about to say was the staff participated in developing the Code. Staff members made strong participation, major contributions to the development of that Code.

BY MR. ROISMAN:

Q I understand.

A Because the AEC has taken the position that it is desirable to use industry standard Codes as part of their regulations and they have incorporated in the regulations references to industry codes, industry-developed codes. They are actually now being developed by the AEC and industry. That is, the AEC as individuals participate in the development

DB-3

of those codes.

Q I understand that. But you were telling me that in a given situation the Staff doesn't accept on faith the Code. I mean it may have been that everything the Staff thought should be a code for inspection of reactor vessels was adopted by the ASME, and therefore it would be possible for you to accept Section 11, not because the ASME had done it, but because it was in effect your position and the ASME adopted it?

A That is correct.

Q I assume it is also possible you could have had some recommendations that they didn't accept eventually. I mean the Applicants participated in this, independent people participated in it, and maybe some of your suggestions were rejected.

What I am asking is if some were rejected, is it the Staff position that in evaluating a particular reactor,you would go or could go behind the ASME Code and in effect say they didn't accept our position, but we are going to demand that the applicants do so or else we are going to oppose the issuance of a license or we are going to require that a rupture of the reactor vessel be considered credible, and therefore there has to be some design to compensate for it in the reactor?

A Certainly we have taken that position in the past

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I think in some cases.

Q So when you go behind the Code, how do you decide whether the COde, a particular code, is good enough? In other words -- and I am pleased to hear this -- you don't accept it merely because it comes from the ASME.

What factors enter into your judgment that a code is good enough, even though it is constantly evolving and may in the future be a stiffer or more stringent code?

A I would say in answer to your question that historically the Staff has been in a position probably of reviewing codes. Here is the code, is it good enough for our purposes, in other words. But present developments, we are participating in the development of those codes.

Now the primary reason for having the codes in the first place is to have an acccepted standard by which the appropriate components can be designed, so that the industry isn't particularly enthusiastic about developing codes that don't reflect the position of the Staff in the codes themselves.

So in the more newly developed codes, and in the revisions to the codes, as they are coming off from year to year, the Staff in-put is a very strong in-put to that code, because the code doesn't have a particular function if the Staff doesn't approve of the code. So I don't think there is much area left where the staff reviews the code later.

Q Then perhaps you can answer it in the context of

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when the Staff presents their recommendations to the people who are formulating the code.

How does the Staff determine how much is required for purposes of the code?

A Well, it determines it on the basis of detailed technical knowledge of what is involved in any particular part of the code.

Q Is that knowledge based upon statistical experience, that demonstrates that certain levels of inspection or certain levels of design criteria are necessary in order to prevent failure from occurring more frequently than would be acceptable?

A Well, if the statistical experience is available, it would reflect that. In general there isn't that much statistical experience available. And it reflects more a knowledge of what the technical phenonema are that are involved in designing a particular part of the vessel or piping or whatever it is.

Q You mean a theoretical knowledge?

A A theoretical knowledge, which incorporates the empirical information.

In many cases empirical or experimental correlations are used to define certain safe conditions.

Q By experimental, you mean something from which you would not gather statistics? In other words, you would not take statistics by subjecting outside of the reactor,

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but equivalent to the reactor conditions, pieces of metal to be used in the reactor, subjecting them to certain load stuations and then come up with statistics about when they fail?

Do you call that statistical experience or not? I am just trying to find out.

A Well, that is certainly statistical experience also. More experiments are conducted to get results which have a certain statistical significance. I am sort of differentiating between that and statistics on components fnnctioning.

Q I understand. Is there not more statistical experiece gathered? If i understand your earlier testimony, it is that the statistical experience is a better thing to have but you don't have it in nearly as many instances as you would like.

Why is there not more of that statistical experience, whether from experiments or from actual operation of plants?

A Well, there haven't been that many plants operating. One of the problems with getting statistical information in connection with component failure is that we are constantly improving the design of the components. So that it is invalid; in other words, as I said b efore, there is a reluctance to be satisfied in the nuclear industry with anything less than very high quality performance.

So that there is an immediate effort made to improve

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any failure of any kind in terms of redesign or additional metallurgy or what-have-you, so that that type of failure won't occur again.

In other words, we are not really in the business of accummulating statistical experiments on components which aren't quite satisfactory or which are not near perfect.

Q Do you do design improvements on components that haven't failed?

A Based on any new information or experimental evidence, yes.

Q Can you give me an example?

A We don't do the design work.

Q I understand that.

A But we certainly incorporate or suggest that revised features be incorporated in the codes, where any new information is developed which would indicate that the safety of plants would be improved by the application of new requirements.

Q In other words, you would use the improvement of safety as a standard for requiring higher design of components is that correct?

A Yes. This is a moving technology, and in any technology in which you don't have continuous development, that is a dead technology, it is going to be over in a matter of a year or two or three, or whatever.

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So I think in a technology in which you are working, there is a constant development and certainly in the nuclear industry, that developments always reflect safety.

I mean, it is hard to get away from it. It has reflected it ever since it was born. There has been a reluctance to accept any kind of failure because of the potential hazards involved.

So any dvvelopment in the nuclear industry is safety-related. As long as it is a live industry, there will be continuing developments and presumab ly that development will add to the safety of the plants.

Q But if I understand correctly, there is no development technology taking place in the area of coping with the results of a rupture of the reactor vessel. Is that correct?

A I am not totally familiar with all of the development programs that are being done everywhere.

Q In your knowledge. You can come back if you wish on another day and tell us whether you have heard of something.

A I think any work that is being done in this area is on a lower priority than it might be on other areas.

Q Earlier you mentioned the facdt that at the time that this plant was designed the rupture of the reactor vessel was considered incredible.

When the construction permit was granted for this

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plant, was there provision in the PSAR for the construction of something called the crucible?

A Yes, there was.

Q What was the function of the crucible? What was it there for?

A Well, it was there as a potential measure to accummulate any molten fuel that may have possibly melted through the reactor vessel.

Q Would that be called a rupture of the reactor vessel, if that molten fuel leaked through?

A I don't know what you want to call it.

CHAIRMAN JENSCH: Excuse me. What was it for then?

THE WITNESS: I beg your pardon?

CHAIRMAN JENSCH: Can you tell us what it was for then?

THE WITNESS: What was the crucible there for?

CHAIRMAN JENSCH: Yes.

THE WITNESS: In the design, in the analysis of the loss of coolant accident for the Indian Point plant at the construction permit stage, the analysis indicated that there was some fuel melting and this some fuel melting would have resulted or possibly would have resulted in some of the fuel accummulating at the bottom of the vessel. Certain provisions were made to cool the vessel from the outside.

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However, it was felt that it was not a sure thing that if the fuel, some of the fuel did spill into the bottom of the vessel, that the vessel would preserve its integrity. Therefore a pit crucible was installed to accommodate any fuel that would melt, could potentially melt through the vessel.

BY MR. ROISMAN:

Q So at that time it was considered credible, if I have the term correct, that therre could be fuel that would come through the ractor vessel?

A Yes, the analysis did indicate there was some fuel melting. I have forgotten exactly how much it was, but I think it is indicated in the Safety Evaluation.

Q Right. Now I understand that sometime between then and now the Staff has made the judgment that that possibility is incredible, is that correct?

A Yes, that is right. The performance of the emergency core cooling system was changed very significantly subsequent to the issuance of the construction permit and the analysis indicated it would preclude melting of the fuel. And therefore the Applicant, with the concurrence of the staff and the ACRS, removed the pit crucible from the design.

Q Now was the addition of the accummulators that we talked about yesterday part of the improvement of the ECCS performance that made the event now incredible, rather than credible?

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A Yes, that is correct.

Q To your knowledge, was that a critical or the critical, the most important, or whatever, factor?

A I would say it was a very important change to the emergency core cooling system.

Q Now, I take it in deciding that that was so, a judgment had to be made about the performance of the accumulators, I mean this goes back to our question of how you get to the point of saying whether something is credible or incredible. And you analyze the function of various components.

A judgment had to be made about the performance of the accumulators in order to determine that they would perform with a sufficiently high level of reliability, that you could then conclude that there would be, that you had gone over the line from credible to incredible in terms of this meltdown of the core.

Is that right, some kind of judgment was made like that?

A Yes. That is correct.

Q Was there any experience, that is either experimental experience at the time that the judgment was made -- I am not talking about at this point, but at the time the judgment was made, some time between 1965 and 1970 -- was there experience with the operation of accumulators on other nuclear power plants upon which it was concluded that statistically

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you could show that accumulators' chance of failure was so slight that they ought to be considered as it being incredible that they would not function, at least up to the level that was necessary to prevent this meeting of fuel.

A There is no statistical experience on the performance of accumulators. We have never had a loss of coolant in a plant that has them.

Q What about experimental experience with accumulators, again before the time -- wait, perhaps I should ask one question to get something clear.

At what time was the judgment made by the Staff that the design of the plant had changed from 1965 at the construction permit stage such that it was no longer credible to have a major or any meltdown of the fuel that would require the use of a crucible?

I don't mean the day and month necessarily, but in what year?

A I am not sure, but I think it was like 1968.

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Q At that time was there experimental experience with theoperation of accumulators upon which a judgment could be based that they had a sufficiently high reliability factor that you could therefore make this melting of fuel an incredible rather than a credible event?

A Well, certainly a judgment was made, yes.

Q Was it based on experimental data? We have taken care of the fact it wasn't based on operating experiments.

A It has more to do with the performance of the accumulator rather than reliability. Of course you can separate the two a little bit. It was evaluated both as to performance and reliability, which now prevented fuel clad melting.

Q Upon what basis?

A It was made on the basif of analytical results of the performance of the revised emergency core cooling system, which included the accumulators.

Q Does "analytical results" mean mathematical as opposed to empirical?

A That is correct.

Q In the period between 1968 and 1971 were any non-mathematical but empirical type tests run to attempt to verify the validity of the mathematical models?

A Well, the analysis of the performance of the emergency core cooling system during the loss of coolant accident

requires not just, you know, one direct experiment, but all sorts of supporting correlations of different types of analyses for different phases of the accident.

Q Right. I am focusing on the function of accumulators. That, we have established, is a major change that occurred from the 1965 design to the present design. It was a major factor in the staff's judgment that a melting of the fuel through the reactor vessel was no longer credible, and could be classified as incredible, and need not be designed for any longer. So, focusing on the question as it relates to the experiments with regard to the performance of the accumulators, were there any experiences between 1968 and now designed to find out whether the mathematical projections for the manner in which the accumulators would operate, perform, function and so forth, was accurate?

A Yes. There have been quite a few experiments performed in this period of time that relate to the loss of coolant accident and the performance of any kind of emergency core cooling system.

Q The accumulators in particular?

A I think there have been some experimental data that reflect on that subject, yes.

Q Have any of those tests indicated that the mathematical projections with regard to the accumulator needed to have any of their assumptions changed, that the mathematical

models were inaccurate, or possibly inaccurate, and that that experimental data required modification -- to your knowledge?

A Well, I am not qualified, really, to testify to the answer to that question, since that, if you are including recent data, that data has been reviewed by the task force on emergency core cooling, of the AEC, and they are prepared to, they would be prepared to answer that question at a subsequent session.

Q All I am asking from you in effect is have you looked at those interim policy guides and do those interim policy guides require modification in the mathematical models that were used in '68 and subsequently upon which the conclusions of the staff was based that the melting of the fuel through the reactor vessel was incredible, and modifications in those mathematical models occurred in these new interim policy guides?

A Not exactly, because the analytical models have been revised many times since that 1968 occurrence, so that the revisions that are being requested or as outlined in the staff, or the AEC policy statement, are really revisions to new methods of analysis that are used now, rather than in '68.

Q In other words, not only are there revisions being made in terms of the newer mathematical models, but those mathematical models themselves were revisions, and we assume

improvements upon the earlier mathematical models that were used in the 1968 period, and upon which the original judgment was based that this meltdown was now incredible? Is that your answer?

A That is correct.

Q From this development with regard to that one area, can you tell me what in your opinion is the staff position with regard to how valuable experimental data is with regard to the complicated systems like the loss of coolant accident and so forth, compared to the mathematical models? I mean, if I understand your testimony correctly, in 1965 it was deemed credible that there could be a melting of fuel that would go through the reactor vessel and a design was put into the reactor to compensate for that.

In 1968, on the basis of neither experimental data nor performance or operation at other reactors, it was concluded through mathematical analysis that it was now incredible that that could happen through the impositon of, among other things, something call accumulators.

In 1970 and '71, experimental data indicated that at least some modification was required in that mathematical analysis, not, mind you, that the staff has changed its position at this time and suggested that what was incredible is now again credible, but merely they had to modify; it is not as incredible as it was before perhaps, something

of that nature. What influence does that have on the staff's conclusions that they can rely upon the mathematical models without the verification of experiments, or has the staff considered that?

A Well, let's go back to the first part of your question a little bit.

The first part of your question addressed itself to why the pit crucible was put there in the first place; my answer to that question was I said the calculations indicated there might be a small amount of fuel melting and that that fuel might fall to the bottom of the vessel, and the vessel might not be able to be sufficiently cooled, and therefore the pit crucible was installed.

I didn't say it was totally credible that you would have a melt-through through the vessel. So I would like to correct that part of it.

With respect to the latter part of the question, all mathematical models that are used are certainly not purely hteoretical models. They incorporate the results of experimental knowledge; they reflect all experimental knowledge. They are based on experimental knowledge.

So that it is not that mathematical models that were used before were drawn up independent of what was known; they were all based on the best information known at that time, all the experimental knowledge on heat transfer coefficients,

pressure drops, things like that. So the improvement in that knowledge, plus the improvement in mathematical techniques, has enabled better calculations to be made.

Q I understand that the burden of the question, as I explained at the beginning, the place where I am going is to find out how you know whether or not the knowledge you have at a given moment is good enough. I mean, if I walked up to you now and said, Mr. Kniel, I have devised this plastic cup and while it may look like an ordinary plastic cup to you, I I can assure you if you will merely install this inside of the reactor vessel, it will prevent any melting of the core, and here -- have the applicant installit -- let's get rid of all these emergency devices that are gumming up the works; we will make cheaper plants and electricity and everything.

You would demand more than my word that this little cup would be able to do that? At some place along the way you would feel I had given you a sufficient amount of knowledge that you could then say,"okay, Roisman has come up with a design change which warrants us removing some other safety feature, because now the possible event that we thought was not totally credible, just credible, could occur, is now incredible."

In effect that is exactly what the technical people from Westinghouse and Con Edison did, and the staff accepted that knowledge and made a change in the design of this plant in 1968. Now you tell me that the experimental knowledge

and knowledge about models and mathematical models is always improving.

I appreciate that. I am trying to find out how you know whether or not what you have got is good enough. How was the staff able in 1968 to say, "Okay, take out the crucible and let's go with the accumulators." Why didn't they instead say, "Well, we are going to run some experimental tests on the performance of these accumulators, and after we have got some experience with that, it may take two or three years, we may be able to modify our 1965 position. But until that time, leave the crucible in this plant. Maybe it won't be possible to change the design for the Indian Point No. 2 plant, but perhaps it will be available to subsequent Westing house reactors of similar or larger size."

A judgment was made not to do that. The other course of action was taken. I am trying to find out not which specific knowledge was used, but how do you know the knowledge you have got is good enough? And particularly in this case where there seems to be some suggestion that at least that knowledge, when experimental data was developed, proved to be to some extent inaccurate. Not that conclusion, that is, not that the staff changed its conclusion from incredible back to credible, but there were some assumptions that had been made that needed to be changed.

How do you do that? How do you know you have

enough information?

A Well, engineering frequently faces the question; we have empirical knowledge, because engineering is the economic application of science, it is not the application of exact knowledge. It is the application, economic application, of science.

Q Would you explain that word? Finish the sentence, but I would like you to explain that.

A Anything that is built by engineers has to be paid for, that is what I mean by "economic." Anything that is built by science, that doesn't have -- it has to be paid for, but it has to be paid for only in terms of it doesn't have to pay its way. Anything built by engineers has to pay its way.

You can't build a bridge and not pay for it; you have to have the tolls to pay for it. You can't build a reactor and not pay for it.

Q How does that factor --

A Let me continue with my answer.

Q Okay.

A So frequently engineering is faced with less than total absolute knowledge about everything. And when we face that problem of less than total, absolute knowledge about everything, which I don't think anybody has about anything, in my opinion, we use what knowledge we have and we design

with certain margins to accommodate the unknown.

And the analysis that was done, the margins that were put in on the basis that the revised analysis for the emergency core cooling system, it was deemed that it was adequate to prevent fuel clad melting.

Q Now, did this economic concept come into that?

A Well, there is no economic concept there. I am just saying that I have only tied it into the fact that you frequently have less than perfect, absolute knowledge about everything. And you design to accommodate that with adequate margin in a conservative way.

Q What does the economics have to do with it, the dollars and the cents; who pays for it?

A Presumably if you had an infinite number of dollars and cents you could develop absolute knowledge and know all of the details.

Q Or at least you certainly could get better knowledge. Is that what you are saying, if not perfect?

I share your concern in that I think perfect knowledge is probably beyond us, at least for our generation of human beings, it is probably beyond us.

But you could get much better knowledge, you mean, if more money were spent? Is that what you are suggesting?

A You can always improve the technology. Frequently it doesn't pay to improve it. Like many engineering structures

are designed with not a detailed analysis of everything. Safety factors are put in to accommodate certain imperfect designs.

In other words, a person builds a road, he doesn't calculate what the stresses are on all parts of the road to see that it won't fall apart. He bases it certainly on experience and on certain safety factors he puts in. He adds material at the expense of additional design.

Q Well, now, you indicated that frequently you have a situation in which in effect the cost is not warranted?

A No, I didn't say that. What I said was the cost relates to imperfect knowledge. Engineering is always the application of imperfect knowledge. The only reason I brought the cost in was to -- the reason we have imperfect knowledge. You asked me why don't we have perfect knowledge; well, we don't have perfect knowledge because of the cost element. But since we do understand the phenomena, sometimes in a more limited way than we want to, we can accommodate for those phenomena in terms of additional safety factors, in terms of additional margin. And that is how we arrive at the conclusion that it is acceptable.

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Q In the context of the accumulator question, how were you able to arrive at the conclusion that the addition of the accumulators was a sufficient additional safety feature that you didn't have to take any further account of the melting?

Again, I don't mean the details, I mean this system of analysis?

A We reviewed the analysis provided by the Applicant and we determined that there were sufficient, there was sufficient margin in the analysis so that there wouldn't be any clad melting.

That is sufficient margin to accommodate any unknown features at that time.

Q Mr. Wiesemann spoke yesterday about the single failure analysis which is included in the design of criteria in Appendix A of Part 50. Can you explain to me how the conclusion is reached or how it was reached that the single failure criteria, rather than the double failure or triple failure criteria, was the criteria that should be used?

A Well, I don't think I could give you all of the background information that was used to arrive at that criteria.

Q I mean the types of, rather than the specifics?

A I can just give you, I think, in my opinion, a suitable basis for a single failure criteria is that you assume a random failure, in other words, a single random

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failure. If you are looking for random events, they usually don't happen simultaneously, they happen on at a time. So I think that would be the simplest explanation I have that relates to the single failure criteria.

All of the background that went into deciding that the single failure criteria should be applied as a part of the design criteria, I can't provide you with that. But that was certainly a major effort on the part of the people involved.

Q This idea that random events usually only happen one at a time, what is that based on? Is that a statistical analysis that random events usually happen only one at a time.

A It is just based on, I think, most of our experience. I think in the case that the Chairman pointed out yesterday is an interesting one, where you only get one blowout at a time. It didn't particularly apply to the accumulators, because they don't wear and tear like tires, tires wear down, but certainly you have four tires, and unless you have a massive kind of accident, you will get a single failure.

At the same time I think your own experience will indicate for the most part that the kind of failures you have experienced in machines that you have are probably, you know, one failure at a time, or if there is more than one failure, they were progressive failures.

In other words, where one component deteriorated and led to a subsequent failure of another component and this

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subject is also addressed in the design criteria.

Q Is the roll of dice random events? Would that qualify as random events?

A Yes, if the dice are not biased.

Q Yes, they are assuming these are legit dice.

Can you tell me what the probability is that you will roll two sixes in a row?

A I can't tell you offhand. My knowledge of probability is fairly poor.

Q All right. I will help you along a little bit on it. As you know there are six sides on each dice. You have two dice. And we will assume, to make it very simplistic, the only six we are talking about is rolling two threes. There is also four-two and five-one, but that is more complicated.

So the first time you roll the dice, the chances of getting three on each of the dice is what, it is one in six on each dice, and that is a one in thirty-six on two dice or one in twelve?

A For the two dice simultaneously, I guess it would be one in thirty-six.

Q And doing it twice in a row?

A I guess that would be -- I don't know really.

Q It is not multiplied, is it, they are random events, not connected?

A That is true, they are random.

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Q Okay. So it is one in thirty-six plus one in thirty-six? I see people shaking their heads.

A That could be right.

Q Do you want to get help? Does the Staff have a statistician -- this is a very complicated probability.

MR. KARMAN: It is your question, Mr. Roisman.

MR. ROISMAN: It is your witness.

CHAIRMAN JENSCH: It is anybody's answer, though. We seem to have some technical men -- Mr. Wiesemann, I think, has a figure. Let's take his.

MR. WIESEMANN: No, I was just recalling that a good lawyer never asks a question unless he knows the answer.

CHAIRMAN JENSCH: Is your background legal or engineering?

MR. WIESEMANN: A little bit has rubbed off.

MR. ROISMAN: Which way?

MR. WIESEMANN: Both ways, probably.

BY MR. ROISMAN:

Q Mr. Kniel, I think it is correct that it is not one in thirty-six twice, which would give us a better probability of rolling them twice that way than in doing the other. I think you will find it is one in seventy-two possibility of having that event occur.

The question I want to ask you is would you, just using our statistical discussion before, would you say that

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that is a credible or an incredible event?

A The probability, as you point out, if it is one in seventy-two, I would say it is a credible event.

Q Now, you told me the determination of the single failure analysis is based upon the fact that random events usually happen one at a time and not two of them.

Now, we have this situation with these random events with dice and we have what you call a credible probability that it would occur. Can I assume from that that more than merely the statistical probabilities of the occurrence of random events enters into a judgment about the single failure analysis?

In other words, it is not merely the fact that there is a statistical probability that random events will not occur simultaneously?

A I just offered that as my own view as to what might support single failure analysis. The randomness of events.

Q I don't want you to get an inflated head, but your own view is pretty important, Mr. Kniel, you are not just a casual guy on the street.

You have testified here earlier. You are one of the senior staff people from the AEC involved with evaluating this plant and I assume you made contributions to the development of the design criteria, so your opinions and judgment, when we talked earlier about the judgment of engineers entering into decisions about whether events are credible or incredible,

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I assume that you were talking about yourself as one of those people. So I think your opinion is very important insofar as it relates to this.

So if your opinion as to what the basis is for these design criteria is an important consideration, what in your opinion would be other bases for the single failure analysis, other than the random events concept?

In other words, I am trying to find out -- we are still looking for the line, this imaginary line, that made the single failure rather than the double failure the criterion?

A Well, I can't rehearse for you all of the effort that went into deciding that.

Q The kinds of knowledge, Mr. Kniel, not the specifics.

A I am not particularly familiar with all of the kinds of knowledge that went into deciding that the single failure analysis should be the appropriate one.

Q You accept it, though, when you do analyses, you assume the single failure analysis is valid. Is that correct?

A That is correct. If it is called for by the general design criteria, I apply it to reviewing the plant.

Q But insofar as you personally know, the validity of it is not known to you, personal knowledge is not there, it is because it is the design criteria promulgated by the AEC, by perhaps yourself and other members of the Staff and other

ln7

AEC personnel. And that is the reason why you accept the single failure analysis, when you do your analysis of a specific plant.

A That is correct.

Q Mr. Kniel, I believe that you have always been identified as the individual from the Staff who can talk about the question of risk-benefit. Yesterday you read into the record what the Board accepted as a substitute answer for a question that was asked on January 19, 1971, on page 487 of the transcript.

Were you the Staff individual who provided the original answer to that question which appeared attached to a letter dated April 15, 1971, and submitted or directed to the members of the Board and signed by Mr. Myron Karman and what has been accepted in evidence as Exhibit F of the Intervenor Citizens Committee for the Protection of the Environment?

Were you the one that prepared the original answer also?

A Yes. I don't recall whether the words -- well, I know where the answer is there. I don't recall that all of the words were written by me specifically.

CHAIRMAN JENSCH: I wonder if a copy of that letter could be tendered to the witness to refresh his memory.

THE WITNESS: That won't really help me.

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CHAIRMAN JENSCH: Take a look at it anyway, if you will. (Roisman handing to witness.)

THE WITNESS: I am aware of this answer. Your question is did I write every word in here? I don't remember whether I did or not.

BY MR. ROISMAN:

Q Do you know who did?

A Who wrote every word in there? No, I don't have an accounting for who contributed every part of that answer.

MR. KARMAN: Mr. Chairman, may I at this time -- possibly we may be able to assist.

Mr. Knotts?

MR. KNOTTS: Mr. Chairman --

MR. ROISMAN: Is this testimony or just comments?

MR. KARMAN: Let's find out.

MR. KNOTTS: In an effort to be helpful to the discussion, I ordinarily would not wish to interrupt Mr. Roisman's cross-examination, but as is the custom with the Staff, or any such organization, it frequently happens that groups participate in preparing an answer.

In this instance, as I recall the way the answer was prepared, I discussed, I myself discussed that answer with Mr. Kniel and other members of the Staff, and in large measure I was responsible for writing the words, each and every word.

MR. ROISMAN: Well, Mr. Chairman, that raises

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somewhat of a problem. I am not normally in favor of calling lawyers as witnesses.

MR. KARMAN: We are prepared if you so desire, Mr. Roisman.

MR. ROISMAN: Perhaps it would be helpful if Mr. Knotts would at least take the stand and let us know who was responsible for the portionsof the original answer, who he consulted with, where he got his information and what the basis of that was, in order to find out who we ought to call to talk about that in substance.

I couldn't tell from Mr. Knotts' comments just now whether or not he wrote the critical paragraphs here which are primarily the next to the last and the last paragraph of the original answer, which in their original form indicated that some risk-benefit analysis is done by the AEC Staff on a case-by-case basis.

It is that point which is deleted from the substituted answer Mr. Kniel read into the record yesterday.

MR. KNOTTS: I am not trying to get Mr. Kniel off the stand or for that matter keep myself from explaining something, but I think Mr. Kniel can account for the phrase that you have in mind, why that change has been made.

MR. ROISMAN: Okay. Why don't I pursue it with Mr. Kniel and see if it is possible.

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BY MR. ROISMAN:

Q Mr. Kniel, I am going to ask if you would read the other answer please, so that -- I will give a copy to you so you can read it into the record.

Would you please identify it as you read it. It is attached to Exhibit F. And read the question and the answer.

MR. TROSTEN: Mr. Chairman --

THE WITNESS: I have some procedural difficulty with reading something you provide me with.

MR. TROSTEN: Mr. Chairman, I would like to have it clear that in reading this testimony the only thing that Mr. Kniel is doing is reading from a document which was sent by the AEC Staff to Mr. Roisman with copies furnished to other parties.

I assume Mr. Roisman --

MR. ROISMAN: And sent to the Board.

MR. TROSTEN: And sent to the Board as well. I assume by asking Mr. Kniel to read this excerpt from this letter that Mr. Roisman is not attempting to demonstrate in any way that this is Mr. Kniel's testimony, by virtue of the fact that he happens to be reading this now.

MR. ROISMAN: I specifically asked him to read the front page to indicate what it was he was reading from.

MR. TROSTEN: Thank you.

end 7

CHAIRMAN JENSCH: Proceed.

MR. ROISMAN: If the staff wants to give you a copy of that, Mr. Kniel, that is fine; or if Mr. Karman wants to look at it to make sure it is a true and correct copy of what was sent to the Board and which I received a carbon, that is fine.

CHAIRMAN JENSCH: I think if you so assert, Mr. Karman will accept that statement.

Proceed, please, Mr. Kniel.

THE WITNESS: All right.

I have a document here which was provided by Mr. Roisman. The heading is United States Atomic Energy Commission, dated April 15. It is addressed to Sanuel W. Jensch, Dr. John C. Geyer, and Mr. R. B. Briggs, in connection with Indian Point Nuclear Generating Unit No. 2. It is indicated that these are responses to AEC Regulatory Staff -- by the AEC Regulatory Staff to the questions asked by the Atomic Safety and Licensing Board at a hearing session on January 19.

The particular item I have been asked to read is in response to a question which appears in the transcript on page 487. I read the answer as follows:

"The fundamental-risk-benefit decisions with respect to industrial development of nuclear power have been made by Congress in the Atomic Energy Act of 1954 as amended. Under the Act power reactors may be constructed

and operated subject to licensing and regulatory requirements to protect the health and safety of the public and the common defense and security.

"The Commission's rules and regulations and guides, including standards and requirements which represent an accommodation of risks and benefits in implementation of the responsibility conferred on the Commission by the Act. An example is the General Design Criteria for Nuclear Power Plants (10 CFR Part 50, Appendix A), e.g., Criterion 17, Electrical Power Systems.

"In addition, the policies and practices of the regulatory staff as developed over the years in consultation with other expert bodies including the Advisory Committee on Reactor Safeguards, embodied additional risk-benefit decisions which are implemented in such publications as the General Design Criteria, Appendix A of 10 CFR Part 50.

Finally certain decisions which involve the assessment of the cost versis benefit or risk are made on a case by case basis. An example would be the requirement for installation of equipment which is necessary for public health and safety viewed against plant lifetime, but need not be installed immediately because delay incident to such installation outweighs the small incremental benefit which would be obtained by postpoining plant operation until the back-up equipment is installed. An example would be the Regulatory

Staff's decision in consultation with the ACRS, to require the installation at a later time of back-up equipment to prevent hydrogen buildup in the containment following a loss of coolant accident. This backup system will be in addition to redundant flame recombiners which will be available for initial operation."

That completes the reading of the answer as requested.

BY MR. ROISMAN:

Q Thank you, Mr. Kniel.

Are there any parts of this answer which in your opinion are inaccurate?

A Well, the part that you referred to is somewhat ambiguous.

Q Would you like -- you mean the part about the case by case basis, the last paragraph?

A Yes.

Q Would you like to elaborate or make it less ambiguous -- or would you, please?

A Yes.

I would replace that sentence with one as follows: "Certain decisions which involve an engineering judgment as to safety are made on a case by case basis."

Q An engineering judgment. Does that term relate back to our earlier discussion where we talked about whether engineering is, I believe you said, an economic science?

A I said it is the economic application of science.

Q Right.

In the context of this sentence as you just rephrased it, does that mean that some cost consideration enters into the economic, into the engineering judgment that is made on a case by case basis?

A No. We don't evaluate things on a cost basis.

Q I don't mean only dollars and cents cost. Cost in terms of delay or cost in terms of inconvenience, other kinds of costs as well?

A I don't quite understand the question.

Q Are any of those, do any of those kinds of costs enter into judgements on a case to case basis?

A I have never used the cost, myself, as a factor for my judgement.

Q When the decision was made with regard to this particular plant to require the installation at a later time of backup equipment to prevent hydrogen buildup in the cntainment following a loss of coolant accident, on what basis was that made? Am I correct in assuming there is another system to be added here?

A That is correct, but in this case it is already installed; it is not going to be installed in the future. It is already installed.

Q Talking about the flame recombiners?

A Yes.

Q I am sorry, the sentence in this answer said this backup system will be in addition to redundant flame recombiners which will be available for initial operation.

A Oh, this is a venting, purging system.

Q Yes, that was my understanding.

Am I correct in assuming with respect to this particular plant, at some subsequent time a purging system will be installed? In other words, there is a requirement that ti will be installed for this plant?

A That is correct.

Q But it was decided that it need not be installed now. Is that right?

A That is correct, because we have a redundant flame recombiner system.

In other words, the flame recombiner system in itself is redundant, two such systems.

Q Right.

You mean there are two of those units installed in the plant?

A That is correct.

Q Why is it necessary to have an additional backup system?

A Well, it was a judgment arrived at by the staff with the AECRS that a redundant backup system would be required

for this plant.

Q Why not require it for operation in the year 1961, assuming the plant operates in 1971?

A Well, the probability of requiring it goes up as time goes on, so that by running the plant for, I have forgotten even what the requirement is for installing it, what the date of the requirement for installing it is --

Q My recollection is it is a couple of years.

A Since I have forgotten, I can't testify as to what the date was.

Anyhow, the gist of my answer is that the probability for requiring that backup system during a two-year period is sufficiently small so that compared with the 40-year system, that we can allow that extra time.

Q You mean that the likelihood that there will be a need to use the hydrogen purge system is sufficient low for the first couple of years?

A Not necessarily in the first couple of years, but in a couple of years, as opposed to a 40-year operation of the whole plant.

Q Is this another instance, or would it be appropriate to say that you concluded it is incredible that there will be a need for its use and therefore it is not necessary to have it in that early few years -- whatever it is -- one or two?

A We haven't proposed anything is incredible. We have provided for maintaining the hydrogen concentrations in the containment with a redundant system.

Q But the redundant system will remain and in addition there will be a backup system. But the backup system, you tell me, won't have to be installed for a period of time, a couple of years. And thatyou consider that that is safe to do it that way?

A That is right.

Q And your judgement is based upon a conclusion that -- that is what I am trying to find out -- a conclusion that it is incredible that there will be any need for a backup system within the first couple of years, although it is credible there will be a need for the backup system at some indefinite time?

A No, our judgment is based on the fact that for operating without such a system for 38 years isn't desirable; operating without such an additional system for two years is acceptable.

Q Why?

A Because the probability goes up with the length of time you operate.

Q Probability goes up from what to what?

A Well, for two years it is some number -- this is again relative probability -- for 38 years it is 16 times as

high. Not 16 necessarily --

Q You really have me troubled. Mr. Larson said 19. Mr. Wieseman knew the answer to that.

A Nineteen times as high.

Q So that in this case the factor 19 is a measure of the difference between credible and incredible?

A No. It is not. It is a measure of the difference between running without it and running with it. There is a factor of 19 difference in probability.

Q Right.

A But we don't know where that is on the absolute probability scale.

Q Right.

A We just know that the two probabilities differ by a factor of 19.

Q If there were a 100 percent certainty that before the end of 40 years you would have to use the backup system, if there were -- I understand that obviously there is not -- if there were a 100 percent certainty you would have to use it, would you then conclude that the factor of 19 was sufficient to warrant not using it in the first couple of years?

A No.

Q If it were 99 percent certain that you would have to use the system in 40 years, would you then conclude that the factor of 19 was sufficient not to use it in the first two

years?

A If it was 99 percent certain --

Q That you would have to use the backup system sometime in the 40 year period?

A No.

Q All right.

I am not going to take you all of the way through. Tell me where the breaking point is?

A Well, theproblem is in identifying where the breaking point is. That is your problem, that what you would like us to say --

Q It is true, because you have done it, I assume?

A We certainly would like to have a formula, look at a number, say, fine, here is a number, here is an additional number, and basically it would be very nice for an event to be labeled with a certain probability. An event has a certain probility -- "X", let's say. And event "B" -- it certainly would be desirable ti know whether that probability "X" is a go -- no-go situation, so to speak, is it credible or incredible? We don't have numbers like that.

We only have a qualitative effect of a number like that. We discussed that before. You asked me whether 10^{-10} or 10^{-20}, was this probability incredible. I said, yes. The implication in our safety evaluation is if the 10^{-7} probability, that was calculated by Con Edison for the aircraft accident, is correct, that implication is again a 10^{-7} would be

incredible, if that number is correct.

What I am saying here in terms of whether or not you can allow a two-year period between -- whether or not you can allow a two-year period for non-installation of this particular backup system is that the probability, without the backup system, of unacceptable consequences without the backup system, for the two-year period and the probability for unacceptable consequences with the backup system are very small numbers.

So the factor of 19 difference doesn't really have too much significance. In other words, it is very improbable that we will require that system at all.

Q But you don't know what those numbers are?

A No, I don't know what those numbers are. I just know that they are very small.

Q you know they are very small, because you have some partial statistics that show you it will have to end up within a range? Can you give me the range?

A We don't have partial statistics and we don't have an indication of exactly how to determine those numbers. It is a judgment that those numbers are very small. When they -- whether they are 10^{-8}, 10^{-10}, or 10^{-12}, I don't know.

Q You don't have any statistics on which you base the conclusions? In other words, I can understand, you know, to some extent I can understand when you do an analysis and you

come up with a conclusion in which you say that it is our judgment that a certain event will or will not occur. And this judgment is based upon the judgments, and some other people had judgements and so forth, and everything is judgments, and the statistics aren't here. But when you say you have got no statistics, and you have got only judgments, but you come up with a conclusion that while you can't tell me what the statistic is, you fell confident it is a small one, that I find more difficult to understand.

I wish you would try to explain to me how you can come up with a low probability, a figure, without having any figures thatyou look at in order to be sure you are within that range?

A All right.

Let's try to tackle that problem here. The probability of requiring this particular backup system relates to several probabilities that go before it. Item one is the probability of having a loss of coolant accident, which is a small number. I don't know what it is, maybe 10^{-3}, 10^{-4}, 10^{-5}, I don't know -- a small number. The probability of then having a failure of the emergency coor cooling system to operate satisfactorily is again another small number, because to get the kind of hydrogen into the containment to require the recombiners, you would have to have a significant failure in the emergency core cooling system. Now you have got the

multiple of two very small numbers.

In addition to that, you have to multiply it by the probability of failure of a single flame recombiner followed by another failure of another recombiner. Those are also small numbers. So you have the products of four small numbers. In my judgment, that is a pretty small number.

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Q But you don't know, you can't tell me what those other small numbers are?

A I can't tell you exactly what those small numbers are.

Q Do those small numbers have statistics upon which you base your --

A No, they don't have statistics. We don't have statistics on what the probability of a loss of coolant accident is. We don't have statistics on what the probability for emergency core cooling system failure.

We don't have statistics on the probability of failure of flame recombiners.

Q Then how do you know those numbers are small?

A I don't know personally --

Q Are you going to give me a list of other numbers you believe are also small?

A I don't know personally those number are small. It is the judgment of the Staff and the industry and everybody involved in deciding what the credibility of some of those things are that those numbers are small.

Q I am sure it is the judgment of the industry, but how did the Staff get to that judgment?

A Well, we arrived at that judgment from a knowledge of the basic phenomena involved. What is the possibility of a --

Q You don't mean statistical possibility, is that right?

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A Well, certainly there is a certain amount of statistical probability when you are talking about, let's say, the loss of coolant accident. You are talking about failure of a pipe of some kind.

Q But has that statistical analysis been done?

I am not asking if it could be, but has it been?

A Not to my knowledge, but I am sure the people who evaluate probabilities could give you some rough idea of what the probability for pipe failure is, depending on its design and everything else.

Q You mean somebody who has done it already for the Staff, or if there were a probability here and he could get the data, it could be done?

A Well, I don't know what the Staff has done in terms of probability analysis for pipe failure, for instance. So I am not personally familiar with it.

Q My guess is that we are going to break for lunch in the not-too-distant future.

Would you check with the other Staff people here before you come back on the stand after lunch and see if you can find out for me whether there are any statistics or any substantial amount of statistics that underlie or would be a basis for your conclusion that there are small numbers that make up the probabilities for the various events that have to lead to this.

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Let me ask you just one additional question on this particular subject. Would the probability that there would be an event in which the backup system would be needed for this plant, for the hydrogen purging, would that probability be lower if the plant did not begin operating until after the backup system were installed?

A Probability for needing it?

Q Yes, for an event occurring in which it would be needed?

A Oh, for an event occurring in which it would be needed?

Q Right. In other words, the event's occurrence.

A Certainly it would be more favorable to have it installed before the plant operated. But you are talking about the difference between extremely small numbers.

Q I understand that.

CHAIRMAN JENSCH: The numbers are getting a little larger as we miss our lunch hour. If this is a convenient time to interrupt --

MR. ROISMAN: Let me just ask one more question on it, Mr. Chairman.

CHAIRMAN JENSCH: Proceed.

BY MR. ROISMAN:

Q But your statement is that, to put it in conclusion terms, that the plant would be safer but not safer in a way

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that is relevant, if we waited before the plant were permitted to operate until after the backup system to the redundant flame recombiners were installed.

A That is correct. I would say it would not be safer in a way that is relevant.

Q Okay. I wanted to understand that.

Thank you, I will see you after lunch.

CHAIRMAN JENSCH: Just one item before we recess. The Board has been giving some consideration to the security matter which we discussed this morning.

The Board is reluctant to have any sessions that are not fully public. We are going to suggest this procedure, that -- I do this, I should say, with due recognition of the suggestions from technical associates here -- if the questions proceed somewhat along this line, do you hide the key for the door, that might be an acceptable question without infringement of the security measures, but when you say where do you hide the key, then you get into an element of confidentiality that should be preserved.

So the Board would suggest this, that we endeavor to limit our inquiries to the first of those two types of questions and if we find or if the questioning seems to involve the second type, then we will propose another procedure for that second type of question, either to have it come in in written form where the confidentiality would be preserved, or

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we will try to develop something like a parallel procedure program envisioned by the rules of the Commission.

MR. TROSTEN: Mr. Chairman, if that is your intention, may I suggest that we have a discussion among counsel and the Board at the bench, so we can determine in advance what the questions are, so we would not have to interrupt the procedure in the midst of it to have that type of discussion? I think that in itself could present a problem, Mr. Chairman.

CHAIRMAN JENSCH: Well, I appreciate that problem. I agree with you, it could be a problem. But I think insofar as you folks can confer about questions, do that.

We would rather that there not be any discussion of this on the public record. That does not mean, however, that you should not, if you feel to protect the interests of your client, you should object.

We will not regard it as annoying or anything. If you feel it is getting into questions of where do you hide the key, do object. Maybe this won't work, but we are inclined not to have any hearings or proceedings that aren't fully public.

MR. TROSTEN: All right, Mr. Chairman.

CHAIRMAN JENSCH: That may not be possible.

MR. TROSTEN: We will endeavor to meet with Mr. Roisman during the recess to discuss this matter further.

CHAIRMAN JENSCH: If that doesn't seem to be

sufficiently fruitful, from your point of view, do something else.

MR. TROSTEN: May I ask Mr. Roisman concerning his intentions with respect to this afternoon's session from a time point of view.

CHAIRMAN JENSCH: Is this something you can take up with him?

MR. TROSTEN: Yes, I can.

CHAIRMAN JENSCH: At this time, let's recess to reconvene in this room this afternoon at two o'clock.

(Whereupon, at 12:40 p.m., the hearing was recessed, to reconvene at 2:00 p.m., this same day.)

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AFTERNOON SESSION

(2:00 p.m.)

CHAIRMAN JENSCH: Please come to order. We have been delayed a moment or two in reconvening in view of the conference here at the bench among the attorneys.

Mr. Kniel, will you resume the stand, please?

Whereupon,

KARL KNIEL

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

CHAIRMAN JENSCH: Do you have further interrogation, Citizens Fund?

MR. ROISMAN: Yes, Mr. Chairman, we have a few more questions.

CHAIRMAN JENSCH: Proceed, please.

CROSS-EXAMINATION (Cont'd)

BY MR. ROISMAN:

Q Mr. Kniel, this morning we were discussing the original statement that was made in what is marked as Exhibit F of the Intervenors by the Staff in response to the question regarding risk-benefit. And you indicated that that portion of the answer which said, finally certain decisions which involve the assessment of cost versus benefit or risk made on a case-to-case basis should be changed to indicate that cost as such is not a factor and to the extent that benefit versus

ln2 risk considerations are conducted, that they are conducted not by the Staff on a case-to-case basis, but in other forms as indicated in your substituted answer yesterday.

Is that a fairly correct statement of your correction of this original answer?

A I believe that is correct, yes, sir.

Q Could you direct your attention, please, if you have a copy of the Part 50, Section 50.34(a) of 10 CFR, the section that deals with design of equipment to control releases of radioactive material in effluents.

Are you familiar with that section, Mr. Kniel? It is the as-low-as-practical standard?

A Yes, I am familiar with it.

Q To refresh your memory, I will just read to you subsection (a) of 50-34(a). "An application for a permit to construct a nuclear power reactor shall include a description of the preliminary design of equipment to be installed to maintain control over radioactive materials and gaseous and liquid effluents produced during normal reactor operations, including expected operational occurrences.

"In the case of an application filed on or after January 2, 1971, the application shall also identify the design of and the means to be employed for keeping levels of radioactive material and effluents to unrestricted areas as low as practicable.

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"The term 'as low as practicable' as used in this part means as low as is practically achievable, taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety, and in relation to the utilization of atomic energy in the public interest."

Now, Mr. Kniel, can you explain to me how that requirement which is written into the regulations would not constitute a risk-benefit consideration on the part of the Staff in making determinations about whether or not radioactive effluents from plants are kept "as low as practicable."

MR. TROSTEN: Mr. Chairman, I suggest that Mr. Roisman is asking the witness for a conclusion of law.

MR. ROISMAN: Mr. Chairman, I am not asking for anymore than of a conclusion of law that appears in the original answer. The witness in effect has opened this up, he has testified as to what happens with risk and benefit.

As I remember, in fact, his answer was originally objected to by Mr. Scinto on the grounds that it did include a conclusion of law and the Staff said no, not so, we consider this to be our view of what these concepts mean. I think the issue is open.

CHAIRMAN JENSCH: That is the way I understood the question, it was a request for an explanation rather than a conclusion. We have to recognize the witness is not a lawyer,

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but he is a senior representative of the Technical Staff and I think his interpretation and explanation can help.

The objection is overruled.

THE WITNESS: Well, in implementing that section of the regulations that you refer to, we look to the state of the art, state of the engineering art and look for equipment which represents the state of the engineering art, the state of the technology as we understand it and we review the Applicant's design in terms of does it represent the application of present technology.

We don't make any kind of a balance regarding risk-benefit. The main question that we review is does this design represent an up-to-date application of the technology to achieve the as low as practicable result.

BY MR. ROISMAN:

Q How do you apply the words in the definition of this as low as practicable, taking into account the state of technology which you have just talked to me about, how do you apply these words and the economics of improvement in relation to the benefits to the public health and safety and in relation to the utilization of atomic energy in the public interest? What do you do when you apply those portions of the regulation?

A Well, I am not sure I can really interpret those portions of the regulations at this moment.

Q Are you at all involved in the application of the

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standards, in other words, as part of your responsibility at the Atomic Energy Commission, would you be required to make a judgment as to whether or not, with respect to a particular plant, the radioactive effluents are, in fact, being kept as low as practicable or is it some other member of the Staff who is responsible for that?

A No, I am involved in that, partially.

Q Are you telling me now that you do not make the judgments, although you do do that, you do not make the judgments of what are the economics of improvements in relation to benefits to the public health and safety, in relation to the utilization of atomic energy in the public interest?

That is when you determine what is as low as practicable, you do not follow that portion of the regulations?

A Let me read that portion of the regulations myself.

Q (Handing to witness.)

A Well, with reference again to -- let me reread this portion of the 10 CFR Part 50, 50-34(a).

"The term as low as practicable as used in this part means as low as is practically achievable, taking into account the state of technology, and the economics of improvement in relation to benefits to the public health and safety, and in relation to the utilization of atomic energy in the public interest."

My primary emphasis in our review is to take account

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of the state of the technology and the state of technology reflects, I believe, the economics of the improvements. The state of technology and the economics are sort of tied in together.

Q Can you explain that a little bit more in detail? Or give me an example if you can, perhaps related to radioactive effluents.

A Well, the technology of control of radioactive effluents is related to what is desirable and what is achievable in a reasonable economic way.

Q For instance, is the control of the release of radioactive effluents on this plant, as an example, does it meet, or is there on this plant the design of the best available technology for the control of radioactive effluents? Or are there better controls, although in your opinion ones which would not be necessary for public health and safety?

A Are you talking about day-to-day effluents or are you talking of accident effluents?

Q No, I am talking about day-to-day. I assume also that provides talks about day-to-day.

A The technology of day-to-day effluent control has expanded and is moving ahead on a rapid time schedule. Our review of this plant was completed -- I am having difficulty remember when we completed it -- it was some time ago, many, many months ago, almost a year ago.

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So that the plant equipment does not necessarily reflect the very latest technology that is available or potentially available.

Q Then I have some difficulty in understanding this. If I understood your answer to me earlier on the economic, it was that the technology will not develop in areas where it is not economically feasible to do so, and, therefore, in talking about the state of technology, you will in effect have taken account of the economics, because you won't have anybody working to develop a certain type of radioactive control which would be more effective, but unnecessarily so, and, therefore, costs will be taken into account in the technology.

Now, you tell me that there are superior radioactive effluent control devises available. Can you explain to me if that is so, why there has not been an amendment to the Staff's position with regard to plants that don't have such radioactive controls?

A Well, let's go back over what you just finished saying. I didn't say that the economics of radioactive effluent control were a guiding principle as to what kind of equipment you put in there. I said they were a limiting condition, in other words, they are bound, they set bounds as to how much equipment or how much you can add to the facility for effluent control. The primary basis for review of effluent control does not reflect the present technology and the technology is

ln8

bounded to some extent by economics.

It reflects what is desirable for the public and it is bound by economics.

Now, the latter part of your question dealt with potentially improving the effluent control equipment on this plant in terms of what the advances of the technology have been within the last year or so.

And that certainly is a continuing consideration on the part of the Atomic Energy Commission Staff. We don't reconsider that on a month-to-month basis, but it is something that is continually under consideration.

At the moment we have accepted the plant as stated in the Safety Evaluation.

Q In your opinion is the radioactive releases which will come from this plant if it operates, in normal operation, are they or will they be as low as practicable, within the meaning of Section 50-34(a)?

A Well, you are asking me for my opinion?

Q That is right.

A As to whether they will be as low as practicable?

Q That is right.

A I think we have written the Safety Evaluation and we reached that conclusion in the Safety Evaluation.

Q Now, I am asking you whether it is your opinion that when this plant begins operation, at that time -- you told

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me the Safety Evaluation was completed about a year ago -- at that time, when the plant begins to operate, will the radioactive releases from the normal operation of the plant be as low as practicable?

A I am having a little trouble with -- at what time, what is going to happen at what time?

Q Let's assume the plant begins operating in January, 1972. When it begins operating, will the radioactive releases from the plant be as low as practicable, in your opinion, within the meaning of that Section 50-34(a)?

A In my opinion, this plant could be operated so that the releases are kept as low as practicable, yes.

Q Will it be? I mean in your opinion, assuming it follows the requirements that you, the Staff, is laying down and is proposing is adequate for purposes of this Atomic Safety and Licensing Board hearing?

A Well, I don't know -- it could be operated that way. I have reason to believe that it will be operated that way.

Q Is you doubt because you are not sure the Applicant will do what it is supposed to do? I am not asking you if you doubt them, but is it because you can't answer for them?

A Yes, that is it, I don't have any loss of confidence in that the Applicant can operate the plant, it is just that I think it is a question that my answer is not particular a valid one.

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I mean I think the plant can be operated that way. I believe the Applicant intends to operate the plant so the releases are kept as low as practicable. If it will be operated that way, I don't quite understand how my kind of answer to that has any significance.

Q Well, the reason I am asking you is because you have indicated to me that you are one of the people responsible for making the judgment that the REgulatory Staff's, I stress the word "Regulatory," Staff's responsibility is to determine whether or not these regulations and guides of the AEC are carried out. I am wondering whether or not it is your conclusion that this plant will meet Section 50-34(a) of these Atomic Energy Commission regulations, namely, when it begins operation, if it is January of 1972, and assuming it begins operations, will it be able to have its radioactive releases kept as low as practicable, as that section defines it?

A Inasmuch as we have already said the plant can be operated in line with the regulations, yes, the answer to the question is yes.

Q Since the date on which the Staff Safety Evaluation was completed, have there been any improvements in methods for controlling radioactive releases which were not incorporated in this plant initially? Additional holdup for gaseous wastes, different type of processing for liquid wastes, cryogenic gas traps, any technology of which you are aware?

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And I would direct your attention for instance to the technology proposed to be installed on the Palisades nuclear power plant for the control of radioactive releases. In short, do you know of any technological developments which have occurred in the last year, I guess, dealing with radioactive effluents?

A Well, the technology is moving ahead in this area, but it does not move ahead in a quantum step.

In other words, you used the words proposed to be installed. That does not agree with installed; in other words, there are always things we could do in the future that would be better developed technology. And there is certainly every possibility that the AEC may require additional steps to be taken in the future in terms of our continuing surveillance of how this plant operates.

Q Let me state the question differently. If we were going out to that plant this afternoon to install the most recent technology available; in other words, you can buy it, you can get it, it is available -- equipment for controlling the release of radioactive materials, and if we were going to install it on that plant, would it be the same equipment that is now on the plant?

If it is not, would the equipment we would be installing reduce the radioactive releases from the plant below the level at which they will be using the equipment now installed

ln12

on the plant?

A Well, the proposed installation at other plants which presumably reflects an increase in the technology has not been proved out. In other words, it is still in a developmental stage. So I can't say for sure that any new equipment would really do a lot more for you.

Q You mean there is new equipment available which it is predicted would have a better release rate, but as yet no one knows because it hasn't really been --

A I think there are certainly indications that it would perform to limit releases further. But we don't have the results of a lot -- we don't have the results of any of those systems that are functioning at the moment.

Q In the context of the definition of "as low as practicable" in 50-34(a), upon what basis would you not require the installation of these new systems?

In other words, would the reason for not installing them be that you don't know how they would perform, or that the installation of them would require some delay in the operation of the plant, or what factor would enter into that in making a judgment with regard to this particular plant?

A Well, at the time that we did our review of this plant, we felt that the equipment represented up to date versions of what is available. That statement is not altogether true at this moment.

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But we don't have a minute-to-minute or month-to-month review of systems in nuclear plants. The only answer I can give you at the moment is that we found that this plant will meet the regulations as of the time of the completion of the review.

Q Let me see if I understand this correctly, then. Part of what enters into your judgment about what is as low as practicable is the practicality of the review process. In other words, your review process on this plant was effectively completed about a year ago, and at that time what was practicable is that the systems that are no installed on the plant were the best available then. Systems that you know of now, in order to have them installed on this plant, and for you to make a judgment, would require in effect a new review, in which you would reach a new conclusion about what the term "as low as practicable" meant.

Do I understand correctly you are telling me that the fact we are not conducting a new review is influencing your decision as to what is as low as practicable for this plant?

A We certainly don't conduct reviews on a monthly basis.

Q How about yearly?

A Or a yearly basis.

We don't have any schedule for conducting a review.

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When this plant goes into operation, we will be well aware of what the effluents are from this plant and if there is any indication that the effluents don't meet the as low as practicable requirements, we will certainly so indicate to the Applicant and work towards getting better equipment installed.

Q If I understand correctly, the as low as practicable requirements are not specified effluent release rates. In other words, it isn't a certain amount of curies, that is not how as low as practicable is defined, in terms of numbers, the way the general radiation standards have been, where we had some specific numbers and the plant could not operate and exceed those numbers.

How will you make the judgment at any given moment in your continuing evaluation of the plant performance whether the effluents are being kept as low as practicable?

A All right. Could I confer a minute on this?

Q Surely.

A The reason I wanted to confer with counsel and other technical people from the AEC is to verify the fact that AEC has published a proposed rule-making on a numerical definition of what is as low as practicable. And that will be used then to implement the as low as practicable regulations.

Q I understand that. But it is a proposed rule-making, is that correct? In other words, it is not in effect now?

A It is not in effect at this moment, no.

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Q So what I am talking about are the regulations as they are now in effect. Let me ask it and perhaps give you a couple of specifics.

Is there a stack on this plant for the release of radioactive gaseous effluents?

A There is a vent, yes.

Q No, a stack, like a smokestack?

A Not that I know of.

Q If there were a stack, would the radioactive effluents that are released be lower, the doses at the site boundary, would those be lower?

A You mean if there is a stack, that is higher than the vent?

Q Yes.

A If there were a stack that is higher than the vent, it is a question of meteorology, I am not a qualified witness in that area.

MR. TROSTEN: Mr. Chairman, I would like to interrupt the cross-examination to ask Mr. Roisman a question.

Mr. Roisman, is it your intention by this continued line of questioning -- I have refrained from objecting to the questions that you have raised on the theory that you are attempting to explore the means whereby the Staff makes its determinations with regard to the safety of the facility.

However, the understandings which we have concerning

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the nature of the questions which you intend to raise in this hearing are that the Citizens Committee for the Protection of the Environment does not intend to raise the question in this hearing as to whether the releases from this facility are as low as practicable.

The continued line of questions that you are raising are raising some doubt in my mind as to whether you are adhering to that course of action. I wanted to inquire of you in this respect.

MR. ROISMAN: The purpose for asking the questions is to find out how the Staff makes its determinations about questions of safety and whether it uses the concept of risk-benefit in making its judgments.

MR. TROSTEN: On that basis I will continue to refrain from objecting to this line of questions at this time.

BY MR. ROISMAN:

Q Mr. Kniel, are you capable of determining -- I understand you have made the analysis, or participated in the analysis with regard to this plant as to whether or not the release of radioactive effluents was being kept as low as practicable.

Therefore, would it be possible for you, if you left the witness stand and spent some time at it, to come back and tell me whether or not if a stack were added to this plant, the top of which would be, say, 100 feet higher than the vent,

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whether or not the radioactive doses at the site boundary from normal releases of effluents would be lower than what they are now?

If you want time to look at that, fine. If you think another person from the Staff is capable of answering that, perhaps we ought to call him.

MR. SCINTO: I am afraid I am going to have to object to that. I think that question as a hypothetical either leaves out some information or assumes some other information. This addition of the stack, there is also a question of how much material is going up the stack as to what the doses at the site boundary are.

MR. ROISMAN: If the radioactivity released from the plant is released through a stack rather than through a vent --

MR. SCINTO: The same quantity?

MR. ROISMAN: The same quantity is released, would it be a lower dose at the site boundary. Now if you need time to look into that, I will be glad to excuse you and let you do that.

MR. KARMAN: Mr. Chairman, may we have a few moments? I just want to check something.

CHAIRMAN JENSCH: Yes.

end 10

CHAIRMAN JENSCH: If you are searching for something, maybe if you would indicate what you are looking for, someone would be able to find the reference.

MR. KNOTTS: We thought the question had already been answered.

CHAIRMAN JENSCH: Is there some recollection by anybody that this questions has been answered in any prehearing conference proceeding?

MR. KNOTTS: I wasn't sure whether it was a Board question or Mr. Roisman's.

CHAIRMAN JENSCH: I wonder if we might go ahead and if this witness finds his answer can be modified by some previous submittal, arrange to make that change.

MR. KARMAN: I am sorry, Mr. Chairman.

CHAIRMAN JENSCH: I say let the witness proceed an if he finds his answer should be modified, we will make the change.

Will you proceed with the question. Does the witness have the question in mind?

THE WITNESS: Yes, I do, sir.

CHAIRMAN JENSCH: Proceed.

THE WITNESS: We have a reference here to a previous answer to a similar type question. The answer is as follows --

BY MR. ROISMAN:

Q Can you give the reference so we can follow you?

A Yes, I will.

It is the answer to your question -- question number 5i --

MR. KARMAN: Is there a date on that?

THE WITNESS: Our response by letter is dated MAY 12. It is on page 10.

CHAIRMAN JENSCH: Will you proceed, please.

THE WITNESS: The answer is as follows: "The term 'as low as practicable,' when used in connection with 10 CFR Par 20, applies to total quantities of radioactive materials released. For Indian Point No. 2, releasing gaseous waste materials from the super-heater stack, rather than the plant vent, would not alter the total quantity of released material. Nevertheless, in theory some slight reduction in offsite concentrations and ultimately doses is possible by releasing materials from the super-heater stack; however, in view of the low dose predicted from gaseous effluents, we have concluded that the application has already met our requirements in this regard."

BY MR. ROISMAN:

Q Mr. Kniel, I don't know whether that is your answer, and maybe it is unfair for me to ask you to elaborate on it, but if you could, following the semicolon there "however, in view of the low does predicted from gaseous effluents, we have concluded that the application has already met our

requirements in this regard," -- what requirements are those? Is that the "as low as practicable" requirements or some other set of requirements that the term "our requirements" refers to?

A That would be as low as practicable requirements.

Q Then do I understand correctly that the mere availability of a lower dose is not, dot not itself result in a determination that the stack which would lead to that lower dose must be taken in order to implement the as low as practicable standard?

A When you say a lower dose, you haven't specified whether it is a significantly lower dose. There is some question whether you would achieve any lower dose that is significant. I am not qualified, really, to answer the question regarding what the doses are from the stack depending on the elevation of the release.

Q I understand that. I am just taking the data in this answer that says that the doses from the stack would be less. Now you are telling me that merely being less is not enough, it has to be less by a degree that would make a difference in terms of health or safety or something of that nature?

A Well, the answer doesn't address itself to a quantitative difference in what the doses are.

Q Assume that the difference is as small as you wish. Whatever you would consider it to be --

A On the basis that they are as small as I wish, it doesn't have any significant effect.

Q It would be small, but it wouldn't have a significant effect, is what you are saying?

A Right.

Q So that this concept of as low as practicable, as you see it, means only as low as is necessary to protect the public health and safety and that any lower than what is necessary to protect the public health and safety wouldn't be required?

A Well, I was answering the question on the premise that the differences in doses could be as low as I wanted it to be.

Q Yes, right.

A And in a practical sense, if the differences are extremely low, then there is no good reason, no practical reason, for doing something one way as doing it the other.

Q You mean because it wouldn't affect the public health and safety, is that what you mean by practical sense, the practical sense is the effect on public health and safety?

A Yes.

Q Is there a practical difference on the effect on public health and safety between releases which are 80 percent of 10 CFR Part 20 limitations, or releases which are one

percent of 10 CFR Part 20 limits?

A I am not qualified to answer that question.

Q Do you know who from the Staff is qualified? And is that person here?

A I don't know offhand. You are asking is there a practical difference between them if the releases are 80 percent versus one percent?

Q Yes, as an example, right.

A That is a question or radiation effects at these low doses and that would be a difficult question to answer.

Q What I am trying to get at is you suggested that when you use the term practical difference, you mean there will it have an effect on public health and safety. All right. I am trying to pursue that to find out whether or not your interpretation of that is the standard in Section 50.30(a), that the doses be kept as low as practicable, would in effect mean that the doses need not be any lower than 10 CFR 20 limits?

A No, that is not our interpretation. You allowed me the premise that the difference in the doses could be as low as I wished.

Q Now I am talking about the 80 percent and one percent difference. I am asking you, using the same standard, will there be an effect on public health and safety between having 80 percent or one percent. That is the standard you used to distinguish whether or not there was a practical

difference between the doses. I am trying to find out whether there is a practical difference between the 80 percent in 10 CFR Part 20 limits and one percent -- using your standard for determining what is practical, namely, will the difference effect public health adn safety?

A I can't answer the question. If the question you are posing to me is if you have 80 percent of 10 CFR 20, versus one percent of 10 CFR 20, will that make a difference to the public in terms of their health?

Q Yes.

A I am not qualified to answer that question. I mean I am not an expert on low level radiation effects and public health.

Q I understand. Do you know who is?

A Well, thereare, I imagine, self-proclaimed experts --

Q I am just talking about someone from the Staff. I assume you had to make a judgment about whether or not the radioactive releases in this plant were kept as low as practicable. Did you go to the self-proclaimed experts, Doctors Gofman, Tamplin, Sternglass -- those we might classify as self-proclaimed experts, or did you use in-house experts to help you reach the judgment that you say you reached, that is, that this plant kept its releases as low as practical. You had to have some idea of what the public

health and safety demanded.

MR. KARMAN: Possibly Mr. Grill may assist Mr. Kniel in answering this question. He has already been sworn in.

MR. ROISMAN: That is all right. I don't mind if he goes up simultaneously.

Whereupon,

RICHARD GRILL

resumed the stand on behalf of the Regulatory Staff and, having been previously duly sworn, was further examined and testified as follows:

CROSS-EXAMINATION

MR. ROISMAN: Mr. Grill, would you like me to repeat the question?

First of all, do you accept Mr. Kniel's premise, that is in determining whether or not there is a practical difference between doses, the standard to be used is whether it would effect the public health and safety?

MR. GRILL: Yes, I will agree with that.

MR. ROISMAN: Now, using that, would you tell me, is there a practical difference between an 80 percent of 10 CFR Part 20 limit or one percent of 10 CFR Part 20 limits?

MR. GRILL: In my personal opinion, no.

MR. ROISMAN: Therefore, in applying the standard to keep radioactive releases as low as practicable, under Section 50.34(a), your application of that principle would

be that if the releases were kept at 80 percent of 10 CFR Part 20 limits, that would be adequate, and it would not be necessary to require that they be kept lower than that.

MR. GRILL: No, sir, I don't think we are quite communicating. I believe that the Staff did not evaluate this facility on those sorts of premises, that we were required under the section of part 50 you discussed to determine whether the releases from this plant would be as low as practicable, and we did not say that 80 percent would be satisfactory. In evaluating the plant, we determined by examination of the equipment installed and proposed method of operation that the releases from this plant, that we had sufficient assurances that the releases from this plant would be a small percentage of Part 20.

Q In determining not to require a stack to be installed for the release of the effluents, which I understand would reduce the offsite doses by what Mr. Kniel has described as probably an insignificant amount, what entered into that judgment that was made?

A (Mr. Grill) Mr. Roisman, we do not in evaluating a plant attempt in any way, if we can possibly help to, to design the plant for the applicant. The applicant, if you will, approaches us with an application, which tells us how he intends to build the plant. If we find that the details of that application are unacceptable, we tell him so, and he

comes in with another plant.

We do not find the design of this plant unacceptable.

MR. ROISMAN: I understand. But how do you apply the principle that the releases are to be kept as low as practicable? I mean just that term would appear both as defined by the Atomic Energy Commission and as I think the average man would read it, to require that you get down to the minimum possible.

Now that suggests that you have to make a judgment about what is the minimum possible; what is as low as practicable. What I have been striving to find out is how you make that judgment?

MR. GRILL: I see what you are driving at, but we do not, just to correct a small semantic problem, we do not try to assure that the releases are as low as possible, but as low as practicable. There is a world of difference between the two.

MR. ROISMAN: Right. Maybe I should have had you on that question earlier about "possible" and all of those.

Will you tell me how do you apply the as low as practicable standard, then?

MR. KNIEL: One of the principal ways in which we apply that is to monitor the use of the equipment -- the first way we apply it is to review the design of the equipment.

The second way is to monitor the use of that

equipment and to see it is being used to its fullest capability.

MR. ROISMAN: What about to see that it is the best equipment around? Do you do that?

MR. KNIEL: Yes, we do that at the time.

MR. ROISMAN: At the time was there no equipment around that would make the stack higher than the stack -- there is no stack. If there were a stack -- in other words, were stacks available in 1969, whenever you did this review?

MR. KNIEL: There wasn't a significant reduction in dose due to a stack release that would justify the stack.

MR. GRILL: May I expand on that a little bit?

MR. ROISMAN: Sure.

MR. GRILL: All pressurized water reactors -- no pressurized water reactor that I know of at the moment, of current design, utilizes a stack. Boiling water reactors, however, do. Now if you are suggesting that we require the installation of a stack on all pressurized water reactors, because this might marginally decrease doses, I think you are a bit mistaken, because in putting in a stack, all that is accomplished really is to elevate the release point. And this does, as we have stated earlier, reduce marginally the doses close, close in, at the site boundary, but does very little, if anything, to reduce general doses to the population. And what controls that is the limitation on the amounts of

releases.

MR. ROISMAN: I understand all that.

CHAIRMAN JENSCH: May I interrupt a moment?

What is the stack doing out here for Indian Point #1?

MR. KNIEL: That is a super-heater stack for the --

CHAIRMAN JENSCH: Don't they vent their radioactive releases out the stack?

MR. KNIEL: They do also use that for radioactive releases.

CHAIRMAN JENSCH: The gentleman to your right said he didn't know of anyone doing it. I understood Indian Point #1 did it.

MR. KARMAN: I believe he said of current design, Mr. Chairman.

CHAIRMAN JENSCH: How current is current -- and practicable and incredible?

MR. KARMAN: Indian Point #1 has been operating for many years now.

CHAIRMAN JENSCH: Is that an obsolete design?

MR. KARMAN: I hope not.

CHAIRMAN JENSCH: We will consider it current design.

Proceed.

BY MR. ROISMAN:

Q Mr. Grill, if you wouldn't mind, are you familiar with this section of the regulations we are talking about, 50.34(a)?

A Yes, generally.

Q Subsection (a). Let me just read this again, because I think -- I am not sure you are using the same concept of the as low as practicable.

"The term 'as low as practicable,' as used in this part means as low as practically achievable, taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety and relation to the utilization of atomic energy in the public interest."

Now, let me, if I may, ask you some hyopthetical situations. In every case we will assume that in fact the installation of the stack would have no more effect on the doses at the site boundary than what you have indicated in your testimony; in short, very low.

What if the cost of installing the stack were $2.50? Would the staff say it would be keeping releases as low as practicable?

A Sir, in our evaluation, at least the section of the staff to which I belong, the cost of the stack would have absolutely no bearing on our review. As a matter of fact, we

make it a general policy never to inquire as to the cost of the various installed features.

Q How are you applying the words in 50.34 that say "the economics of improvement in relation to the benefits to the public health and safety?" Are you telling me the staff just, although they could use that as a basis for permitting a plant to open without a certain type of radioactive effluent system on it, you don't do it?

Or do you do it and I am just not understanding how you do it?

A I am saying that the portion of the Division of Reactor Licensing to which I belong, does not concern itself with the economics, that the economic determination as to what is as low as practicable was handled in the establishment of the regulations themselves and this was done not by our section of the staff.

Q How did the words "economics of improvement" get in there? As I read it, it would appear it is saying that they have thrown the ball to you, like it or not, they want you to decide what is as low as practicable, and they want you to make a determination about the economics of improvements in relation to the benefits to the public health and safety.

Just between us here -- Chairman Seaborg is not here -- the other Commissioners aren't; tell me the truth:

Are you following this little econimics of improvement, or are you sort of modifying it and I think in this case being more strict than the regulations appear to suggest?

MR. KARMAN: Mr. Chairman, I believe Mr. Kniel has indicated on several occasions that we are not designing this plant, we are reviewing the designs which come to us from the applicant and we make the determinations based on those designs as to whether or not they comply with the regulations of the Commission.

CHAIRMAN JENSCH: Yes, I think the problem, as I understand the interrogation, if 50.34 obligates the applicants to keep its releases as low as practicable, while you don't design the plant, how do you apply that regulation to know whether the applicant has in fact kept the releases as low as practicable?

For instance, here is a stack up here at Indian Point plant right now; I don't know how much more air they can choke up that opening, but if you could run the pipe through the stack and it would lower the exposures or the concentrations at the boundary line one percent, does that constitute as low as practicable? You don't have to build anything, just dig a hole in the stack and run the vent through it, as I understand it, so how do you determine whether or not an applicant has done what he could easily do or practically achieve? I think that is the question.

MR. KNOTTS: Mr. Chairman, perhaps it would be useful if I commented on that.

The Commission recognized in its proposed rule-making, on the original proposed rule-making on this very section, the difficulties that would be inherent in administering a concept such as as low as practicable, and expressed their intention to work toward a more workable definitive concept, more definitive guidance on what is as low as practicable.

That was what was proposed now in the numerical guides, which in effect answer the question when they become effective; but we must recognize they are not yet effective. But they will provide the answer to the question.

In the interim, I think one may depend on applicants to raise any question of cost that may obtain. The applicants I think can find an appropriate place to object if what the staff is asking for costs too much, and until the applicant does that, it doesn't seem the staff needs to concern itself about it. The staff can go ahead and require the utmost.

CHAIRMAN JENSCH: I suppose for the purpose of this hearing, we will have to just take as our basis the existing regulations, which may be somewhat indefinite, but that is the way we find ourselves, and while the Commission has under consideration a proposal for a definitive arrangement, we are left with this regulation, 50.34, which obligates

the applicant to have its releases as low as practicable, which means practically achievable.

Now, if there weren't a stack out there, I imagine the cost situation that you mentioned, that the applicants would object to such a cost. I don't know whether it is practicable, practically achievable to put any more air up that stack or not. But I think the question is how do these gentlement, who are applying these regulations and these terms, considering the obligation of applicants, do what they can practically achieve?

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MR. KNOTTS: Mr. Chairman, I believe that the "as low as practicable" requirement as set forth in the answer that was read relates to quantities of materials and a stack would not change the quantities. It does not apply to concentrations, as I understand it, or doess.

CHAIRMAN JENSCH: The answer didn't, but I think the question was asking for concentrations, and while the answer didn't give it, I think there was a kind of diversion down the other track.

I think what the question asked for is really seeking what you are going to do for exposures, and by that, concentrations. Of course it isn't going to affect the quantity, that was a wholly immaterial answer really. I think the question, what he is seeking to get here is would you even lessen it somewhat if you put it out a stack.

It seems to me quite obvious it would. I am wondering if this witness is going to recognize what seems to be obvious.

MR. ROISMAN: Mr. Chairman, let me say one thing, Mr. Knotts has indicated or suggested that the concept of "as low as practicable" is relatively short-lived, that is, it came into the regulations relatively recently and there is a proposed regulation out which would eliminate it.

In the Federal Register on December 5, 1970, when this regulation was adopted, there wa a statement in support of the

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regulation explaining the AEC's position and that statement included on page 1918386 of the Federal Register the following statement: The amendment "would improve the framework in Part 20 for assuring that reasonable efforts are made by all Commission licensees to continue to keep exposures to radiation and releases of radioactivity in effluents as low as practicable."

In short, as I understood that statement by the Commission, one, they were concerned both with exposure levels, and with release rates, and two, they believed that this was merely a continuation of what had always been the policy.

In short, as I understand it, it has been around for a long time and I am still anxious to find out how it is applied, or how it has been applied.

CHAIRMAN JENSCH: Proceed.

MR. ROISMAN: Mr. Grill, we are back to you.

MR. GRILL: It is obvious, Mr. Roisman, that the "as low as practicable" criterion thatyou had read gives you some problems, and quite frankly it gave the staff some problems too, and that is one of the main reasons that the new proposed criteria, the numerical criteria has been promulgated. Because trying to decide what is "as low as practicable" is a thorny question.

MR. ROISMAN: But le me say, Mr. Grill, I don't agree with you that it is a thorny question. I agree with

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you only if you agree with me that it includes consideration of risk and benefit. If it does, then what I have been searching for, what I thought I already had when an answer was given by the staff to a question asked by the Board, stating that risk-benefit does enter into analysis on a case by case basis, and here I see it appears to be written into the relations, and what I am trying to find out is do you make risk-benefit considerations in determining what is as low as practicable?

It appears to me the regulations require you to do so. If you are not following that, we can't go any further.

MR. TROSTEN: Mr. Chairman, I object to this continued line of cross-examination at this point. Mr. Roisman has been attempting for the past half hour or so to explore the question of how the staff determines the risk of particular design modifications through this line of questioning that deals with the "as low as practicable" regulation.

The point that he is purporting to explore is not governed by the "as low as practicable" regulation in Part 50 and in Part 20. It is governed by the other provisions of Part 20, and there is no comparable provision in the regulations dealing with design features to prevent accidents and to guard against accidents.

Consequently I object to the continued use of the "as low as practicable" regulation for the purpose of exploring

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this other question, since the two are not governed by the same provisions of the regulations.

It appears to me that Mr. Roisman, notwithstanding what he has said before, is simply proceeding to explore the ramifications of that particular provision in the regulations dealing with release of effluents, and I object to this, because it is inconsistent with the information that Mr. Roisman has given to the Board as to the nature of his cross-examination.

There is not a requisite connection between this line of questions and the point Mr. Roisman is seeking to make with these two iwtnesses.

MR. ROISMAN: Mr. Chairman, the point is this and I will be glad to trace it out: First of all I want to find out whether or not there is something in the AEC law which would prohibit the staff from making risk-benefit considerations.

As I understand it, the same statutory provisions govern the promulgation of regulations dealing with the release of radioactive effluents as govern standards for determining safety. If I find that a valid regulation of the Commission has b een eacted which provides for risk-benefit consideration, then I have established, I believe, that there is no statutory impediment to the risk-benefit consideration. I am then in a better position, when we subsequently are

arguing under proposed findings of fact that on the basis of cross-examination I can point to places where I believe there is an implicit risk-benefit consideration which has been undertaken by the staff in determining whether or not to require certain safety features and that I will not be faced wth an argument that that can't be so because it is statutorily prohibited.

So I believe there is a connection there. I am also hopeful that in exploring the question of risk and benefit in the context of a specific place in the regulations, wherein it appears that I may help break through this barrier or reluctance on the part of the staff to discuss with me how they go about making decisions about whether to require certain safety features be imposed on plants.

The point I am hoping to go to is to see if we can establish that in setting safety standards, the staff takes account most importantly of what the industry can do and it doesn't require that which can not be done because if it did, then there would not be a nuclear industry.

MR. TROSTEN: Mr. Chairman, the legal question of what the Atomic Energy Act authorizes has already been the sbject of briefing by Mr. Roisman and myself in connection with the joint motion filed with the Board. I submit that if Mr. Roisman wishes to establish the nature of the determinations that the staff makes, that he should address himself to

those questions that pertain to the design of the plant, that deal with engineered safety features or other such matters and not address himself to those design features that are subject to this provision of the regulatiolns dealing with releases being as low as practicable.

I submit that by continuing to explore this question he is simply doing what he has said throughout the hearing that he does not intend to do, and that is to raise the issue of compliance with this particular provision in the Commission's regulations.

Accordingly I reiterate my objection to this line of questioning.

CHAIRMAN JENSCH: I don't quite understand what your objection to this line is. Because of something he told you or because of something the regulations require?

MR. TROSTEN: I beg your pardon, Mr. Chairman? I am objecting to this because the statement of issues which Mr. Roisman intends to raise inthis hearing which are set forth in the proposed findings of fact which he filed with the Board on June 4 and June 21 do not inlcude the issue that heis cross-examining on this afternoon. That is the reason for it.

CHAIRMAN JENSCH: Well, I really haven't studied his proposals as carefully as I know you have, but supposing during the course of the cross-examination the witness would

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prefer to talk about subject "x" rather than subject "y", which would deal with the same principle that he has involved. Is it your though that we shouldn't shift in the factual matter related to a principle, even though it might be more basic for instance to the consideration the witness would entertain respecting the matter?

I am trying to find out the binding effect of what he has proposed to do, and if in the course of the examination the circumstances change, by virtue of whatever answers the witnesses give, does not that authorize him to develop his principle through a different approach?

MR. TROSTEN: No, Mr. Chairman, I don't think that is correct. I think that what Mr. Roisman is entitled to do is to raise those questions that are reasonably related to te issues that he has indicated he will raise in this proceeding. I think that a certain amount of leeway is afforded to him within the normal b ounds of relevance and materiality. But I am submitting that the continued questioning along these lines no longer bears the requisite relationship to the issues that he is entitled to raise in this hearing to be sustained by the Chairman.

CHAIRMAN JENSCH: In other words, you say that when he outlined the scope of his work, he thereby severely limited himself, even though the factual matters may change in the course of the examination?

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MR. ROSTEN: I am not saying, Mr. Chairman, that he has severely limited himself. What I am saying is he has outlined the scope of the issues that he intends to raise in this proceeding and he should stick to the outline of the issues that he has previously set forth.

CHAIRMAN JENSCH: Does anybody else care to speak to this matter?

(No response)

If not, this appears to be a convenient time for a recess. At this time we will recess to reconvene inthis room at 3:30.

(Short recess)

CHAIRMAN JENSCH: Please come to order.

The Board, during the recess, has been giving consideration to the questions and the objections thereto. In the view of the Board, the factual situation being discussed or interrogated is related to the principle that the Citizens' Committee is seeking to establish. The objection is overruled.

BY MR. ROISMAN:

Q Mr. Grill, during the break I identified for you a section of the technical specifications that I wanted to discuss with you. It is Section 3.9, beginning on page 3.9-1 of the technical specifications. And the paragraph in question is listed under the word "Specification" subsection (a), sub-subsection (1). Would you please read -- do you have that in front of you?

A Yes, I do.

Q Would you please read that paragraph?

A Specification (a). General (1). "It is expected that releases of radioactive material in effluents will be kept at small fractions of the limits specified in 20.106 of 10 CFR 20. At the same time, a licensee is permitted the flexibility of operation compatible with considerations of health and safety to assure that the public is provided a dependable source of power, even under such unusual operating conditions which may temporarily result in releases

higher than such small fractions, but still within the limits specified in 20.106 of 10 CFR 20. It is expected that in using this operational flexibility under unusual operating conditions, the licensee will exert his best efforts to keep levels of radioactive materials in effluents as low as practicable."

Q Now, Mr. Grill, the question here, and this is really the specific application of the as low as practicable standard to this particular plant, can you explain to me or discuss with me the manner in which this concept, to assure that the public is provided a dependable source of power, even under unusual operating conditions, enters into the staff judgment and influences your decisions about what technical specifications you would approve for this plant?

A I can't answer that question simply. Let me go back to something which may clarify it, about which we were discussing earlier.

Implicit in the Commission's regulations and implicit in the things we in the Regulatory try to do, is our recognition that the public does need a reliable source of power. And that under some conditions power requirements to a community -- I am using a rather gross example -- but during periods of emergency for example -- this need for power can be quite crucial.

And so, we intend in our regulations to allow

flexibility, so that this power can be supplied during critical periods. However, this does not mean that the supplying of this power is more important than our own regulations as what we consider a risk to the public health and safety. That is, exposure to radiation in excess of our own regulations, Part 20, that is.

Q In the context of this particular portion of the technical specifications, are the higher releases which might occur in those unusual circumstances which are suggested here, would you say that the public would be save even if those higher releases occurred?

A In my personal opinion, yes, sir.

Q And would they be safer if the amount of releases were the lower figure?

A That again I cannot answer that question yes or no. I must say, however, that implicit in the establishment of our regulations, 10 CFR Part 20, are the bases upon which these regulations were established, and these bases go back to ICRP, the International Committee for Radiation Protection, NCRP and ICRP, which indicates that any risk at exposure to those sorts of levels is so minimal as to be undetectable by currently available techniques.

And so exposure to the levels of Part 20, in my personal opinion, constitutes a risk so minimal as to be negligible. And to take it a step further, and in our

analysis of this plant, and our analysis of the equipment provided to minimize releases of radioactivity, and in our analysis of other operating nuclear facilities, with similar equipment installed, we reached the conclusion that the actual releases from this plant will in all probability be only small fractions of the already low limits in 10 CFR Part 20.

Q Now, are you -- I just wanted to check your professional qualifications in radiology, and that seems to be your specialty.

Can you tell me, is the development of the art, in terms of understanding the effects of radioactivity, has it reached the point where a man of your expertise is prepared to say that there is a level of radioactivity which is clearly safe and that we should not be struggling to get the amount of radioactivity below that level?

A My answers will have to be in two parts; please let me say them both.

In the first place, no. I don't think there is any lower level.

In the second place, my qualifications are not those of a radiologist. I am in that field peripherally now, but my basic qualifications are not that.

Q Am I correct that you are Chief of the Site Safety Branch of the Site and Radiological Safety Group of the Division of Reactor Licensing?

A That is correct.

Q Now, if I understand your answer, in other words, at this point as you understand it, no level has been reached where you are prepared to say we shouldn't try to be lower, that we are dealing with -- you feel confident that 10 CFR Part 20 limits are safe, but you are not willing to say that it wouldn't be better or safer, or a qualitative word here, to go to a lower level than 10 CFR Part 20, if practicable, let's say?

A Certainly.

Q Now in reaching a judgment about what is practicable, do I understand that this specification which you read a moment ago incorporates into it a consideration of the public's need for dependable power in deciding whether we ought to be safe, safer, or safest in terms of the release of radioactivity, that the risks associated with exposing the public to say 20 percent of 10 CFR Part 20 limits compared to one percent of the 10 CFR Part 20 limits are not as great as the benefits to be obtained from the public having a dependable source of power, one that doesn't get interrupted every time you get what you would consider to be an insignificant jump in the release of radioactivity from the plant?

A I beg your pardon, but I lost the thread of the question. I understood the question, but --

Q What I am asking you is the fact that the public

gets a benefit from a dependable source of power -- I assume that that is a term on which you are indicating a favorable reaction, that they should have dependable sources of power? Does that benefit outweigh, in your opinion, and therefore is that the basis for your judgment that the increases in radioactive releases that would occur under these unusual operating conditions, even though they are small fractions of 10 CFR Part 20 --

A I can't answer that question. I thought I understood your question that way. I cannot speculate as to what would be in the Commission's mind at the point in time in which these unusual circumstances, the unusual releases coincided with an unusual need of the public for reliable sources of power -- when these coincided.

Q But as I understand it, this technical specification is an authorization, an authorization approved by the staff, for the applicant to operate this plant in ways which will have, at certain times, operating releases in excess of a certain figure -- let's just say one percent?

A That is correct.

Q In excess of one percent. And that authorization is given and it states in the technical specification, at least in part because those releases could occur at a time when the public needs a dependable source of power and that is a benefit the public would get from it. In short, did you

weigh the benefit of the public of a dependable source of power against the risk in allowing what, in your opinion, would be an insignificant increase in the radioactive releases?

A It is not explicitly delineated in these specifications under what conditions or what precisely, these values, this authorization takes effect. But it is not intneded in my opinion as a blank check, as it were, to the power company to release effluents considerably greater than a small percentage of the regulations for unlimited periods of time or at their will.

Implicit in this, not explicit, but implicit in this regulation is a back and forth exchange between the Commission and the licensee, so that through our Compliance Division notification would be given to Commission when or during the times that these unusual releases were being experienced, and at that time a decision would be made by the Commission whether these releases could continue or power must be reduced or the plant shut down.

Q I understand that.

If I understand correctly, the unusual condition could occur and the release can begin, and the applicant is not prohibited from beginning it. They are required to let you know when it is happening, or if it were a short thing, it happened only for ten minutes, I assume as a practical matter,

it would happen and be over before the Commission or the Compliance Division had an opportunity to evaluate it, but that your evaluation might then cause you to come back and say, "Don't let it happen again," if you thought that the release that had occurred was an unsafe one or should not be permitted in the future. Is that correct?

A That is my understanding, yes, sir.

Q Now, the basis upon which you permit the applicant, if you will, to release now and pay later, is that -- do I understand that that decision was made in part because of a judgment by the Regulatory Staff that there is a benefit to the public to be obtained from having a dependable source of power available?

A I believe that is explicitly stated in the technical specification, yes, sir.

Q In other words, the other way of doing it would be when the operator realizes that an unusual condition is about to occur, he would have to turn the plant off, call the Compliance Division, tell them what it is unusual, what the unusual condition was going to be, find out whether it was going to be all right, and maybe at the end of a couple of days hewould be told it is okay, "Turn it back on." That would interrupt this dependable source of power.

It was to prevent that that this release now pay later, or release now investigate later concept is in here?

A That is my understanding of the way this was established, yes, sir.

Q May I fairly summarize then by saying that the Commission made a judgment or the staff made a judgment comparing the benefit to the public from a dependable source of power against the risks associated with small additional releases for short periods of time, still well below the 10 CFR Part 20 limits?

MR. KARMAN: Are we talking now about the technical specifications, Mr. Roisman?

MR. ROISMAN: Yes, I am.

WITNESS KNIEL: I would like to put it in a slightly different way: Certainly implicit in this portion of the technical specifications is a balance between the risks associated with maybe a slightly increased released rate against the risks associated with a loss of power from the plant.

BY MR. ROISMAN:

Q Risk? You mean a nuclear risk or --

A (Mr. Kniel) I mean risk to the public, loss of power to the public involves risk. Well, I don't think we have to go into detail. It certainly involves a health and safety risk to the public when the power supply is discontinued.

Q I would now like to just ask two more questions,

both of which I would like, if I may, Mr. Chairman, to have them answered in writing at a subsequent time by the Staff, rather than at this time.

One, can the Staff, these otherother witnesses, please identify for us any other decisions that were made with regard to this plant in which this consideration, that is of the risks that the public would have if power were not available, were taken into account. And I am just using your words, Mr. Kniel.

And secondly, could you please provide us with a copy of the data which the staff analyzed in reaching this conclusion, its conclusion that (1) there is a risk to the public when this plant or if this plant is shut down; and (2) that this plant is a realistic source of dependable power.

A (Mr. Kniel) What was the last part of the question?

Q It is in the transcript.

MR. ROISMAN: Will you read it back.

(The reporter read the record as requested.)

MR. TROSTEN: May I ask the reporter to read the whole question again, please.

(The reporter read the record as requested.

MR. TROSTEN: Mr. Chairman, I don't know whether counsel for the staff is going to object to these questions. I reserve the right to object to the offer into evidence of

of the response to those questions.

CHAIRMAN JENSCH: There is nothing before the Board until something has been offered, so you will be just as free to exercise your right to object whether you reserve it or not. We will be sure that you have thatopportunity.

Have you concluded your examination?

MR. ROISMAN: Yes, Mr. Chairman. I have no further questions for these two witnesses.

CHAIRMAN JENSCH: Very well, Messrs. Kniel and Grill are temporarily excused.

Did Applicant's counsel have further questions?

MR. TROSTEN: Not at this time, Mr. Chairman.

MR. KARMAN: No redirect, Mr. Chairman.

CHAIRMAN JENSCH: Very well, Messrs. Grill and Kniel are temporarily excused.

(Witnesses Grill and Kniel temporarily excused.)

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CHAIRMAN JENSCH: Who is the next witness?

MR. ROISMAN: Mr. Chairman, the next area of investigation I have requested a representative from the Staff and from the Applicant. The two men who were just on the witness stand I am told by Mr. Karman, along with a third man, Mr. Kenneke, will comprise a panel for the purposes of the Staff's answers, Mr. McAdoo will be available for the Applicant.

These gentlemen, particularly Mr. Kniel, have toiled on the stand long enough, so if it is all right with the Board, I would like to have Mr. McAdoo come to the stand and the area of examination is that identified in paragraph or Item 9-C of our submission on June 4, 1971, and it requests witnesses from the Applicant and the Staff.

CHAIRMAN JENSCH: Very well.

Mr. McAdoo, having been previously sworn, need not be sworn again.

Will you come forward, please?

Whereupon

JOHN MC ADOO

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

MR. KARMAN: Do you have any objection if we add Mr. McCoy to the panel? He has been sworn.

MR. ROISMAN: None whatsoever.

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CROSS-EXAMINATION

BY MR. ROISMAN:

Q Mr. McAdoo, could you please briefly describe what your connection is with the Indian Point No. 2 plant and whether you are an employee of Consolidated Edison or Westinghouse or neither?

A I am an employee of Westinghouse Electric Corporation in the position of Manager of Licensing and Reliability in the PWR Systems Division.

My involvement with the Indian Point Unit 2 project has encompassed both my present activities in this position and in a prior responsibility as Manager of Engineered Safeguard Systems.

As such I have been concerned with the process design of engineered safety features for the Indian Point plant and with the Safety Evaluation and Quality Assurance Programs.

Q Mr. McAdoo, in your capacity, are you familiar with 10 CFR Part 100, Section 100.10, entitled, "Site Evaluation Factors, Factors to be Considered When Evaluating Sites"?

A Generally, yes. If I may refer to a copy of it.

CHAIRMAN JENSCH: Will counsel for the Applicant submit a copy of the regulations to the witness. Mr. Larson is doing that now.

Will you proceed.

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BY MR. ROISMAN:

Q Mr. McAdoo, can I direct your attention to subsection (d) of that regulation?

A Which section?

Q Subsection (d) of 100.10.

A Yes.

Q Would you please read subsection (d)?

A "Where unfavorable physical characteristics of the site exist, the proposed site may nevertheless be found to be acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards."

Q Does your work on the plant include the application of appropriate and adequate compensating engineering safeguards in order to compensate for unfavorable physical characteristics of the site?

A Yes.

Q Could you please identify which particular safety systems were used in order to compensate for the unfavorable conditions?

A There are a number of these systems and some of them are employed in more favorable sites as well. It is only the degree to which reliance is placed on some of these systems which differ in this site from those in others.

But I would list --

Q If you would, please, list them and then I will

ln4

ask you to tell me the degree to which reliance is placed.

A All right. The containment system, including the isolation valve sealed water system and pressurized penetration system, charcoal filter system and the containment spray system.

Q Are those all of the engineering safeguards that were used to compensate for unfavorable site characteristics?

A It would be hard to exclude other engineering safeguards in whose absence the site would be unacceptable. But insofar as particular characteristics of this site are concerned, I would limit my response to those, yes, sir.

Q Just to complete it, would you list the other ones, the other safety features, the absence of which would in effect turn this back into an unfavorable site?

A The core cooling system, for example, would be one. I believe the site would be unacceptable without a core cooling system, as would other sites.

Q Are there any others?

A I believe not in the context of Part 100, no, sir.

Q Now, you mentioned that a different amount of reliance is placed upon these depending upon the site. How is that reliance determined? It is, you know, does it show up as a percentage or a factor, something like that, and can you tell me what that factor or percentage is in determining how much reliance you place on these systems you listed?

A Yes. This involves the consideration of potential

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doses to the public at the exclusion distance and in the low population zone as a result of the most, the maximum credible accident, if we can borrow that term and the magnitude of the doses calculated according to rules and guidelines which are expressed in TID-14844, which is a Commission document setting forth such rules.

Q Can you tell me if you know what are the specific factors -- can you show me how we could work out here, what things we would need to be able to work out here an evaluation of this worst possible incident -- what is the worst possible accident that is postulated for this plant?

A The accident which is used in this evaluation is the loss of coolant, major loss of coolant accident and the assumed release of certain fractions of the radioactive fission product inventory of the core to the containment atmosphere.

Q Would you please describe those?

First of all, is the loss of coolant accident the double-ended pipe break?

A The double-ended pipe break is the mechanism whereby the containment system comes into play. It becomes pressurized with the steam and water released in the loss of coolant accident. We further stipulate in making this evaluation that regardless of the design of the core cooling system, there is assumed in the containment the volatile fission product inventory according to the TID model.

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This differs in magnitude from the calculated release, which one would get from an analysis of the loss of coolant, the double-ended break.

Q In other words, the TID-14844 assumptions are not based upon calculating in the manner which you, for instance, would do, if you wanted to analyze what you consider to be the realistic effects of a loss of coolant accident?

A That is correct.

Q Do you know what those inventory figures are? Let me ask it differently, since TID-14844 is in evidence. Are all of the assumptions in TID-14844 applied by the Applicant in this case for purposes of analyzing, are there no variations in that for purposes of analyzing the effect of the loss of coolant accident? First, as to inventory?

A That is correct.

Q Just to make sure we both understand the same thing, am I right that that is 100 percent of the noble gases, 50 percent of the halogens and 1 percent of the particulate?

A It goes beyond that to the extent of specifying that only 25 percent of the halogens need be considered available for leakage.

Q What is the reason?

A This involves a consideration of deposition and plate out in the containment.

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Q Are the analyses that have been done by the Applicant here indicating the performance of these various safety systems, do all of those analyses take into account the 50 percent plate out that is referred to in TID-14844?

A There are a variety of analyses presented in the Safety and Analysis Report. I believe the one in which this determination is made, namely, the factors by which additional safety features must compensate for site characteristics, that calculation is based on the assumption of plate out, yes, sir.

Q The 50 percent plate out, the same one in TID-14844?

A Yes.

Q You mentioned earlier that the TID-14844 assumptions differed, that is they were more severe, if you will, in terms of figuring how much of the radioactive fission inventory would be released to the containment than if you were doing an analysis of the loss of coolant accident would actually occur. Is that correct?

A Yes.

Q Can you tell me why is it that that, as you understand it, why is that done, why does TID-14844 assume something which I take it in your opinion is an unrealistic figure?

A I did not use the word unrealistic. I would say it is conservative, it represents an upper bound of the releases which might be calculated for a variety of reactor

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designs, and, therefore, it represents a convenient and conservative basis for site evaluation.

Q You have been very helpful in getting me right to where we wanted to go. I am looking again for definitions of terms. That seems to be the order of the last two days. This word "conservative," what does it mean when you are using it? Does it have a precise quantitative definition that you can give me, either in a specification or generally?

A No, it does not have a precise quantitative definition. It means in effect that one errs purposely on the side of safety by making assumptions which are probably not accurate, but are in the right direction, so to speak.

Q Now, is there a limit to how conservative is conservative, for instance, just in our inventory figure, although it is 100 percent of the noble gases, it is only 50 percent of the halogens. Is that 50 percent less conservative than 100 percent, or would it be impossible for there to be 100 percent, if I may use one of these terms we have dealt with before?

A I am afraid that will get us back into the semantic discussion. Obviously 100 percent would be more conservative than 50 percent and it would be in my judgment unnecessarily conservative.

Q Is there some limiting factor that would prevent it? For instance, a scientific rule that says that anytime you have

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"X" amount of halogens in any given place, the maximum amount that can be moved away from the place is only half of it, something like that.

Or is it just that you feel that taking into account the various things that would normally prevent any halogens from getting out, it is conservative enough to assume that half of them are gotten out.

A The factor which would limit our judgment as to the fraction of the halogens released would be the temperature to which uranium oxide fuel rises during the loss of coolant accident. In our judgment a temperature rise sufficient to cause the release of even 50 percent of the halogens is not possible considering the engineered safety features in this plant.

Q Is that temperature because you have to reach the point where the fuel rods would melt, so that the radioactivity inside of them can getout, or does temperature produce halogens, which is it?

A No, it is the release mechanism rather than the production.

Q In other words, the halogens are all there, but the only way to get them out is for the thing that normally would enclose them to be breached in some way or another?

A I would not agree with your last characterization.

Q Please explain it.

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A But it is analogous to that. It would be the retention of the halogens within the uranium oxide ceramic material.

Therefore, it is not a breaching of the material, but rather a physical change at high temperature which gives the halogens more mobility and allows them to escape.

end 15

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Q How is it determined that 50 percent is conservati enough? Why couldn't it have been 45 or 55?

A This is a consensus judgment on the basis of a large number of experiments in which irradiated fuel has been heated and the release has been measured.

Q You mean it has been heated to temperatures at which it would break open and it never never got anywhere near 50 percent of it breaking open under the temperature conditions that it was subjected to?

A I think, no, I would not say that. I think that there are other factors which can't be separated from the environment of the fuel, namely, the surrounding structure in the core, the cladding material itself, and the presence of other elements which are highly reactive with respect to halogens and therefore they form compounds which are not volitile.

All of these factors come into play to varying degrees at different temperatures. And in the accummulation of experience with this system it has been judged that the conditions that would result in any greater release of halogens thatn 50 percent simply do not obtain in the water reactor accident?

Q I saw you struggle with that. Did you want to say it was incredible? If I can get some parallel between you and the other witnesses on the use of terms, it would be helpful . If that would be the word you want to use, I am not going

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to question you for hours on what you mean by it, so don't be fearful of extending your cross-examination . But is that what you mean, it is incredible, or impossible?

A I would say I do not know of any mechanism whereby the fraction of halogens released from the fuel and from the immediate surroundings of the fuel that exist in a water reactor, even under the extreme conditions of a loss of coolant accident that can be applied to this system.

Q If the emergency core cooling system for the reactor totally failed to operate, in other words, the injection system never injected, and all four of the accumulators spilled their contents onto the floor of the containment, would you have a situation in which more of the halogens could be released to the containment than 50 percent, if that condition existed?

A We have not studied that particular set of circumstances in detail, so I couldn't make a detailed judgment on it.

However, I can venture an opinion that even under those conditions the transport of iodine away from or halogens away from the fuel melt would be rather inefficient, and that 50 percent would probably still bound the quantity reaching the containment.

Q By transport, you mean, in other words, the means by which it gets out of the reactor vessel itself and

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into the containment?

A Without being otherwise trapped, deposited or reacted, yes.

Q Deposited. Is that plate-out?

A It could be plate-out, it could be by way of other mechanisms. Plate-out is not a very well defined physical phenomena and I think encompasses a variety of mechanisms, including concentration, settling of particles and so forth.

Q Is it possible to say even that the amount of halogens released will increase as the heat increases, or will decrease as the heat increases, or is it just not subject to a single factor like that that we can look to?

A The release and transport would be generally enhanced by temperature, but would also be affected by other circumstances of the system.

q Is this concept that we have discussed, the use of "conservative assumptions," is that related to another concept that I have also seen called design margin? Are these similar concepts? Are you familiar with the concept of design margin?

A I would not characterize them as bein synonomous. They both deal with -- no, I would simply answer no to that question.

Q What is your understanding of the term "design margin" ?

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A Design margin is capability which the system has in excess of that which is the minimum required for acceptability of the system.

Q Upon what basis is a design margin determined with regard -- for instance are your design margins on these safety systems we have been talking about, on what basis was it determined to incorporate the design margin? How much was used?

A That is a very broad question. Design margins may be employed to compensate for imperfect knowledge, as Mr. Kniel described it, or incomplete knowledge.

A design margin may be applied to permit flexibility in future operations. It may be applied to achieve a more desirable inspection frequency or surveillence program.

Q Let me limit it, if we can, to the situation in which it is used to compensate for imperfect knowledge.

Are there any of these safety systems in which a design margin has been provided in order to compensate for imperfect knowledge? The ones that we have been discussing? And could you give me an example?

A Yes. In the design of the charcoal filter system, I think that is one example, the system is sized in such a way that a large design margin exists in terms of the required efficiency of the charcoal system to absorb organic iodides.

To quantify that a little bit, I believe the system fulfills its design objective if the efficiency assumed is

only somewhere between 5 and 10 percent. That allowance is made because the behaviour of the charcoal under conditions of high, 100 percent relative humidity, has been subject to some question, and therefore the judgment was made that perfect knowledge is not available as to the exact efficieny of the charcoal at those conditions.

Q Let me see if I understand this. This is a question really of the size of the filters, is that right?

In other words, the design margin is represented by making the filter bigger, in effect?

A Yes.

Q Now just not using real figures, but just to keep it simple, do I understand correctly that a 10-foot squate charcoal filter would, if it operated exactly as it was designed to operate, remove all or perform at the level at which it was necessary to meet these design criteria in 10 CFR Part 100, standards like that, but that because you weren't sure that it would operate at 100 percent efficiency, you doubled or tripled or quadrupled the size of it, put in a design margin to compensate for your imperfect knowledge about how exactly it would operate in this humid atmosphere following the loss of coolant accident, and then instead of having to have it operate at 100 percent of its capacity, it will be sufficient , I think your figure was if it operates at 5 to 10 percent of its capacity and you will be able to

get rid of it? Is that correct? I don't mean the figures themselves, but the theory.

A I understand you do not mean the figures were precisely applicable to this example that I picked.

However, I would still say that that is not exactly the circumstances to which I am referring.

In this particular case the filters were sized and then tests were made to determine the efficiency which we might expect and despite the fact that efficiencies on the order of 90 percent were measured, there was sufficient uncertainty in the exact behaviour of the charcoal at that condition that it was elected not to reduce the size of the filters.

Q So,in other words, it started from the other end?

A Yes.

Q I understand. Would there have been a point at which the efficiency of those filters, let's say in your tests, the very same tests that were run, if the efficiency instead of being 90 percent had been 50 percent, would that have in your opinion warranted a design margin of increasing these filters beyond the original size to a bigger size?

A Probably not in this case.

Q What about 20 percent, if the efficiency had been --

A There would be some low efficiency, and I am not prepared to speculate as to that number, which would suggest that we simply didn't understand how filters worked.

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If the observed behaviour of this particular filter deviated that far from our expectation, we woiuld have looked carefully at the type of filter and determined whether some other system might well be preferable.

Q In other words, do I understand then that there are limiting conditions for the use of design margins? Something which you think should perform at 100 percent turns out to only perform at 3 percent, rather than increase the size by 300 times in order to get the level of operation to the point you would like it to be for the plant, you might -- which would be a design margin as I understand it -- you would go to some other system, figuring that this thing was so poor, or your understanding of what it would do would be so poor, that you better go to a whole different kind of system and forget about in this case a charcoal filter, maybe a cellulose filter or something else? Is that correct?

A Yes. I said if experience shows that your basic engineering understanding of the process is in doubt, then the situation calls for more than design margin allowance.

Q Is this true in all cases wherein the design margin concept is used?

As I understand it, in the specific case that we have been talking about, charcoal filters, it is your testimony that there is a low level of efficiency of the filter, well below this 90 percent, well below the 50 percent I talked

DB-8

to you about, at which the efficiency of the filter would make it not suitable, in your opinion, for use as a safety system in the plant, and that would be a point which you would compensate for by coming in with another system rather than by increasing size of the filter.

Are there other safety systems for which design margins are built-in, in which their performance could be lower than what you have seen so far, and your response to that would be to increase the size or the capacity of the safety system rather than go to a different type of safety system?

A I think I lost the thread of that question back at te beginning. I think you said -

Q Well, I will take the premise out. I was trying to distinguish it from the charcoal filter case, but let's start with the end of it.

Are there other safety systems on this plant for which design margins exist? And design margins that are there to compensate for imperfect knowledge, for which higher design margins would be required if those systems in their actual tests performed at lower efficiency than what they in fact had performed at ?

If you want the reporter to read it back --

A No, I think I heard your words. I do not have in mind any system for whch the same kind of example could be stated as I have given for the charcoal system.

DB-9

However, if you speculate that thests had shown that a larger design margin was appropriate, would we have provided it, I guess I would answer in the affirmative to that, yes.

Q How would you decide whether a larger design margin was appropriate?

In other words, what factors would enter into your judgement as to how large a design margin is needed to compensate for imperfect knowledge in a particular case?

A Well, there would be many factors and they would depend on the particular instance. But to generalize to the extent that I can, these would relate to the amount and consistency of prior experience with processes of the sort we were concerned with, the environmental conditions under which the system were required to operate, the degree of surveillence which can be practically imposed on that system during plant operation, et cetera.

Q Well, you tell me whether this is a worthwhile example to look at. In the case of the containment spray, is the concentration of the addative in the spray, the sodium hydroxide concentration, is the concentration of that to some extent dependent upon how effective you believe the spray will be?

In other words, if the spray looks like it is going to be less effective you might increase the concentration of the addative for a design margin?

DB -10

A No, that would not be an example.

Q Is that because in fact the spray is not, its effectiveness is not increased by t he concentration of the sodium hydroxide?

A Within the area of interest, that is correct, it would not.

Q What about in terms of the flow of the spray, would that be something which -- would the effectiveness of the spray be affected by the flow rate?

A Yes.

Q If there were some imperfect knowledge with regard to the performance of the spray system, would it be conceivable that one way you might compensate for that would be to increase the flow rate beyond what you felt was necessary in order to increase the effectiveness of the spray?

Would that b e one kind of compensating factor?

A That would be one to be considered. However, one would hav e to look at all aspects of the increase in the flow rate to determine whether that were a desirable alter--ative.

Q You mean whether it would cause some adverse effect?

A Or whether it would produce a significant benefit or significant improvement in the system.

Q You are saying you think it would have some benefit, but you are not prepared to say that you know it would

DB-11

have enough benefit that if the hypothetical that I proposed existed, you would go to the flow rate increase in order to compensate for it?

A That is correct.

Q Can you tell me in this context of compensating safety features -- I am sorry, compensating for imperfect knowledge with design margins in safety features, whether or not you can use mathematical probabilities as a way of assessing the effectiveness of the system and determining how much design margin is built in?

For instance, if a system has a certain amount of imperfect knowledge associated with it, can you say you would doub le, triple, quadruple its effectiveness in order to compensate for that if you could figure out what the measure of the imperfect knowledge was?

A The initial part of your question used the term "probability" and I didn't find that in the example you gave at the end. COuld you clarify that for me?

MR. ROISMAN: Would you read the question back?

(Read)

BY MR. ROISMAN:

Q The mathematical probability I am talking about is if you can figure out a mathematicl probability of some failure, not total failure, but failure of the complete operation of the system based upon the gray area of knowledge

DB-12

and then compensate for it by an appropriate factor of 1, or 2, or 3, in order to make up for this gap?

A I would say no.

Q You mean no you don't have the statistics available to do that, or no, you couldn't do design margins that way?

A I couldn't use a design margin in that way; by making the system more effective when it works, I can't compensate for the possibility it won't work.

Q But if the area of the failure to work is an area unrelated to where you provide the design margin, would that be one way of doing it?

A Not really. I think you are dealing in terms of degree rather than probability. So I find it difficult to relate probability of failure to the extent of over-design or design margin, if you will, that is applied.

end #17

Q If I understood what you said here, you have indiated that the design margin couldn't be used to compensate for the failure or the reduced effectiveness of the system by merely increasing effectiveness of the system. Is that an accurate restatement of what you said?

A I said that design margins could be applied to compensate for incomplete knowledge of the degree of effectiveness of a system. And in the example of the charcoal filters, if it were uncertain as to whether the efficiency per pass were 90 percent of 70 percent, I know I can be safe by passing the filers so that even if it were only 10 percent effective, I have compensated for that uncertainty or that incompleteness of knowledge.

Q How do you know that 10 percent, that something that will operate at least 10 percent makes adequate compensation for your lack of knowledge? What enters into that?

A Because I have done tests which bound the efficiency somewhere higher than that, say above 50 percent.

Q When you said "bound it," you mean in other words you mean in none of your tests was the efficiency less than 65 percent or something like that?

A Yes.

Q Why, then, don't you simply make your design margin to provide for 65 percent figure? Why do you go all of the way down to 5 or 10?

A I might do that.

Q But that is not what happened in this case, is that right?

A Well, we pick theoretical examples, Mr. Roisman.

Q I am sorry, in this case what was the boundary on the charcoal filter as a result of your tests?

A Our tests showed that under the extreme conditions, the efficiency was always above 50 percent and under conditions which we felt were likely to occur in the accident, they were above 90 percent.

Q Why then didn't you use the 50 percent efficiency instead of the mor conservative 5 to 10 percent?

A Well, I indicated there were other reasons for applying design margin. These deal with many factors, such as standardization, ease of handling, and all of these considerations are taken in toto, lead to our decision to size the filters in a particular way.

They were adequately conservative to account for a lack of knowledge or the incompleteness of knowledge of the behavior of charcoal under most conditions and therefore they were acceptable from that point of view.

Q In other words, therewere other factors that went into this, but they were available on the market place; you didn't have to have new ones manufactured -- that kind of factor?

A Factors like that, yes.

Q In evaluating the effectiveness of these systems you indicated that tests are run, for instance on the filter system tests had been run showing 50 percent or better efficiency for these systems under the worst possible conditions. Are those tests exact duplicates of the conditions that would exist in loss of coolant accident under, again, the worst possible assumptions?

A Generally they were more severe than what one would do to duplicate the conditions of the accident.

Q What kind of conditions were taken into account in determining the conditions of the loss of coolant accident? You mentioned humidity, what other factors were there?

A Temperature, pressure, in the particular case which I characterized as extreme, we actually immersed the filter in borated water and allowed it to drain and then measured the efficiency of organic iodine removal under those conditions -- which would be more extreme, because we don't see a mechanism whereby the filters could be actually immersed or flooded in the accident.

Q What about turbulence inside the reactor vessel? Did your model take account of the turbulence, in a sense the method by which the air that is going through these filters reaches the filters?

A The tests were run over a range of air velocities,

which encompassed conditions under which it would operate in the accident.

Q Velocities moving toward the filter or velocities at random?

A Through the filer.

Q What about velocities moving, say, perpendicular to the filter?

A These would be outside the structure, even closing the filters, so they would have no effect on the filter medium itself.

Q They would affect what, the amount of air that reached the filter?

A No, they might affect the cooling of the structure, for example, or the loads imposed on the structure, but they would not affect the efficiency of the filter.

Q In other words, in doing these tests on the filters, it was your conclusion that every relevant condition associated with the loss of coolant accident was taken into account in the test?

A Yes.

Q What area was the empirical knowledge in?

A Well, I would say the emperical knowledge was in the detailed mechanism whereby efficiency of the unit is controlled or determined at 100 percent relative humidity. We have done tests approaching 100 percent humidity and at

100 percent humidity, but beyond 100 percent humidity there was a noticeable drop off of efficiency. Not understanding precisely what that mechanism is, one allows for the occurrence of that kind of behavior in the accident.

That drop-off was not of a magnitude exceeding my previous limits.

Q This figure -- this 50 percent figure?

A Yes.

Q Is there a limit on how much humidity you can have, I mean above 100 percent?

A Humidity in the sense that I refer to it here in excess of 100 percent implies the existence of liquid water entrapped in the air.

Q And so that for instance if the filter were completely immersed at the time you were trying to figure out its effectiveness, that would be some function of, using your terms now for this purpose, some function of humidity whe the filter is under water at the time you are trying to see how it will operate. Is that correct?

A That is an extreme interpretation.

Q I understand.

A But, yes.

Q But tests were not run at that, in other words, they were run at some point before you reached that level?

A Yes.

Q How high did it go, roughly?

A I don't recall the precise number, but the data are presented in the safety analysis report.

Q How was it decided how high to take it?

A We were attempting to take it 100 percent. The manner in which the tests were conducted was such that one determines after the fact what the actual moisture level in the air reaching the filter was. So that under some conditions the data showed that the moisture reaching the filter was in excess of that corresponding to 100 percent. And we reported that data.

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Q I see. Then did you run additional tests where you intentionally attempted to get above 100 percent humidity to see how those results worked out?

A We concluded that the behavior we observed was a function of the moisture retained by the filter rather than the moisture flowing through it, and this led to the conduct of tests with the filter medium purposely flooded and then drained in order to get larger loadings of water on the charcoal.

Q Is there any way in which you can determine, assuming that any amount of liquid would be retained on the filter, how much that would be? In other words, how close did your experiment of immersing it and then draining it proximate what could conceivably happen?

A In the plant?

Q Yes.

A In the plant the conceivable conditions would be those determined by operation of the filter at 100 percent humidity.

Q And no further?

A And no further.

Q Why did you choose to go -- I mean once in a test that was not intended to produce in excess of 100 percent humidity you produced certain results, why did you choose to analyze further with regard to this event which you said won't

ln2

happen in a loss of coolant accident?

A In order to understand the phenomena which are just beyond the area for which you are designing it. I think this is a prudent course of action to take in engineering.

Q When you say just beyond, you mean again using this humidity thing, 105 percent or 110 percent or how do you decide what is just beyond in making these determinations, if you want to be prudent from an engineering standpoint?

Is there a standard to use for that?

A Not really. This is based on the total knowledge of the system that you are dealing with. I can't put a quantitative criterion on it in a general sense.

Q Do the tests that have been run on the performance ofthe emergency core cooling -- I am talking now about experiments as opposed to an analysis by computer -- do those tests represent total -- you used the term perfect and imperfect knowledge -- substantially close to perfect knowledge with regard to the performance of the emergency core cooling system?

In other words, are you aware of tests that have been run of tha t nature?

A Well, there are a large number of tests which comprise the experimental background for emergency core cooling. In the application of data from each of these tests conservative judgment is applied as to the margin of uncertainty

ln3

or incompleteness represented by that collection of data.

CHAIRMAN JENSCH: Excuse me, I wonder if I could have the question reread?

(The Reporter read the question as requested.)

CHAIRMAN JENSCH: Proceed, please.

BY MR. ROISMAN:

Q When you have the tests and -- you talked about conservative assumptions and design margins and areas of doubt -- what mechanism do you use or analysis or thinking process for making your assumptions appropriately consecutive or making your design margins appropriately large to compensate for the imperfect knowledge that may exist?

Maybe if it is helpful, perhaps you can talk about it in the context of a particular test that you know that has been run where consecutive assumptions have been made or design margins have been incorporated to compensate for imperfect knowledge as a result of the test?

A Are you still in the core cooling area?

Q Yes. I would prefer that you do it in the core cooling if that is possible.

A I might refer to the FLECHT test which support the design of the core cooling system.

Q For the record, would you identify the FLECHT test?

A FLECHT is an acronym which stands for the Full Length Emergency Cooling Heat Transfer test. Heat transfer

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data were obtained from that test series. A variety of tests were run in which the ambient's pressure varied to reflect various possibilities that might obtain in actual reactor designs.

In the recent review of core cooling, it was determined that in view of imperfect knowledge of what precisely the pressure would be in the containment at the time the process being simulated was occurring, that a design allowance, namely a slight reduction in the assumed pressure should be applied in the application of data from the FLECHT test.

Q Do you know how that design margin or conservatism was determined, how would you know it had gone low enough to compensate for the uncertainty?

A In this particular example, we looked at the analysis which was performed to predict the ambient pressure in the containment at the time of the process to which I refer.

Q Is that a mathematical analysis?

A Yes.

Q Okay.

A And this particular instance the pressure depends on basically thermodynamic equilibrium phenomena which are relatively well understood. In this case a margin of only 10 percent was selected in order to conservatively allow

ln5

for the uncertainty in actual pressure.

Now, had that calculation been based on a more complex set of phenomena, such as the simultaneous operation of a lot of heat transfer mechanisms, then a larger margin might have been appropriate.

In this particular instance, the uncertainty was considered relatively small, so the judgment was applied accordingly to the selection of the design allowance.

Q If two technical people, equally well qualified on this subject, were to sit down and have an argument and you were the judge and one said that the margin should have been 9 percent, and the other 11, what things, what factors would each present in his argument and what would you look for as a judge in order to find that 10 was appropriate at one, neither 9 nor 11?

A First, I would be surprised if they were that close together.

Q All right. You can spread it if it would be more convenient for your purposes?

A Well, I would look at the source material upon which each expert based his judgment, the type and consistency of the data, extent of the data, the similarity of the conditions under which the data were obtained to those to which it is to be applied.

Q Would it be surprising if the underlying data upon

ln6

which they based their conclusion was similar or identical, just in terms of the way technical people operate? Or would you normally expect you would find that they were beginning from different factual assumptions?

A Generally two experts, two highly qualified experts generally are rather close together on their background material and premises for such a judgment.

Q What other bases might exist for them to come up with different figures or would it be your opinion if they both had the same background data, they would come up with the same figure?

A Well, to a certain extent just their judgment and personal experience impinges on the decision they would make and that is why we don't always have total and precise agreement on these factors.

If the choice were not able to be made on any other basis, then one would accept the more conservative of the views presented.

Q If you found an area of disagreement, would you hunt out the most conservative view and if it was based basically on the same underlying data, apply it?

In other words, when you are actually making judgments about which design margin or which conservative assumptions to use, is an attempt made, let's say, to maybe go to a competitor or go to an academician who is not tied directly to

ln7

Westinghouse or Consolidated Edison, qualified personnel I am talking about, to ask them to sort of give you an independent judgment the way a doctor goes for a consultation, or would you use, if there was a disagreement among the personnel who were doing the analysis, and one of them did come up with a more conservative figure than the others, and there was no basis for distinction between them except the judgment of the men, and you felt they were all qualified men, would you just accept that particular conservative one?

A I don't think I can give a general answer to that. If I felt I had the most qualified people already contributing to this decision, then I would give relatively little weight to the opinion of an outsider, an independent party.

If, on the other hand, I felt that the opinions presented by my first two experts were no better than, founded on no better basis than a third party might bring to the discussion, then I would be inclined to go outside for an independent opinion.

end 19

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Q Is it frequent to go outside for an independent opinion?

Let me add at that point, without getting into a hassle with the staff about it, I would like to assume the staff is not an outside independent opinion.

A That they are not?

Q That they are not.

A I forget the role that I am playing. Am I still the judge or the designer, or what?

Q No, you are still the judge.

A Would you repeat that question? I am sorry.

Q I am just asking -- as I understand it, to some extent you have been a judge, if you will. In your experience does Westinghouse, in making these determinations about design margins and conservatism, rely primarily, exclusively, almost exclusively, on its own personnel, or does it frequently go outside for the independent judgment? That would be, as I said before, to a competitor or to an academician, someone who was not working for Westinghouse or Consolidated Edison.

A Well, Westinghouse frequently employs the services of consultants in areas where it does not have that particular expertise in its own organization. And they may be consultants from other parts of Westinghouse or from outside companies.

Q Well, the area I was talking about was what you

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and I have been discussing, where you have in-house experts and disagreements develop and you are trying to decide how much design margin to build into a certain system to compensate for imperfect knowledge or how many conservative assumptions should be made to compensate for imperfect knowledge.

When those circumstances arise, I am trying to find out whether it is frequent or infrequent that you go outside.

You mentioned if you felt you had the best people, you wouldn't. I guess another way of asking it is do you think for the most part you have the very best people, and therefore it is not necessary to go outside?

A I would agree with that to the extent that it is not a frequent requirement that we go outside. We do go outside occasionally, as I said, for consultation.

Whether it is because we can't come to agreement in-house or for other reasons, we do employ the knowledge and experience that is generally the best available inside of the company or outside.

Q Do you find frequently that your best available staff frequently is called upon by other manufacturers of reactor equipment to advise them?

A No, I dont know of any occasion where that has occurred, except where our technical experts have participated

DB-3

in programs which are broader than in-company programs.

For example, committee work, research and development programs sponsored by other organizations for which we provide the manpower or facilities to conduct them.

MR. ROISMAN: I think that is all, Mr. McAdoo. As you know, I have other questions for you on a different subject.

CHAIRMAN JENSCH: Very well. Thank you. Mr.McAdoo, you are temporarily excused.

(Witness temporarily excused)

CHAIRMAN JENSCH: We are coming to the end of the day. I don't expect we should start another witness at this time. I have pretty close to five o'clock.

Is there anything we can consider before we recess for the evening?

MR. TROSTEN: Mr. Chairman, I would like to inquire concerning the Board's plans for this present session of the hearing.

I understand from the Chairman's previous remarks that you intend to adjourn the hearing tomorrow evening. Is that correct, sir?

CHAIRMAN JENSCH: Or Friday. We will go as far as we can go conveniently, to the extent of the review that can be taken respecting any of these matters submitted to us on Tuesday and we would like to see if the intervenors can complete the examination that he has contemplated of both the

applicant and the staff, withthe reservation of the ECCS. I think we will stay here as long as we can. But I think that we are going to have to have a recess to review these submittals to the extent we can, and also to accommodate Mr. Davies from the State of New York.

So either tomorrow night or Friday we would recess until Tuesday.

MR. TROSTEN: Fine, Mr. CHairman. I would also like to inquire of Mr. Roisman and the Board, Mr. ROisman's further cross-examination will resume tomorrow. Do I understand that we will commence the hearing tomorrow morning first with the matters pertaining to security precautions?

CHAIRMAN JENSCH: Yes. The Board has given consideration to that. I think it is necessary that steps be taken to preserve the security of the plant, whatever it is. I think adequate opportunity must be afforded for examination into those proposals for security. It was the thought of the Board that we would give consideration at the outset in the morning to those security matters under parallel procedures which are provided for under the rules of the Commission. Those parallel procedures are describ ed and set forth in the rules of the Commission to provide for a seaprate transcript and a separate hearing in that regard. The Board would propose that we convene at 9:30 for that purpose. And from the information the Board received at the conference at

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the bench after the noon recess, we understand that approximately an hour and a half might well be applied for that purpose.

For those parallel procedures the attendance would be limited to those contemplated by the rules, that is, the parties and their specifically assigned assistants. And we would propose to convene that parallel proceeding at 9:30 in the morning, and that the regular public hearing would of course resume at 11 o'clock in the morning.

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MR. TROSTEN: All right, sir. I have only one further question to ask the Chairman: Mr. Wiesemann and Mr. McAdoo will be here tomorrow. I wanted to find out if there are any witnesses that the Chairman can identify for me that he would specifically want to have here tomorrow, from the standpoint of the Board.

CHAIRMAN JENSCH: I don't think the Board has completed such a review as to make that indication at this time. I think we will have to leave it to the parties to envision the necessities of the things they are considering, and contemplating and arranging among themselves.

MR. TROSTEN: All right, sir.

CHAIRMAN JENSCH: If there is some thought that Mr. McAdoo and Mr. Wiesemann are otherwise engaged, I don't know what the contemplation of the parties are for their presence.

MR. TROSTEN: The most specific question I have is whether it will be necessary for Mr. Fletcher to be here as well. Mr. Fletcher is not in the room at this time.

CHAIRMAN JENSCH: The Board does not have any suggestions to the parties for the attendance of witnesses, because the Board is not ready to proceed with its expression of concerns.

MR. TROSTEN: Fine. I understand.

MR. ROISMAN: Let me just say, Mr. Chairman, we

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don't contemplate calling Mr. Fletcher or recalling Mr. Wiesemann. I think I already indicated the one additional area I want to question Mr. McAdoo about.

So from our standpoint there is no need for those two gentlemen to be here.

CHAIRMAN JENSCH: Tomorrow?

MR. ROISMAN: Tomorrow or any other day, except when we have the ECCS examination.

CHAIRMAN JENSCH: I see. Well, what is the scope of the interrogation contemplated for tomorrow then?

MR. ROISMAN: I think that it is spelled out -- just a moment, let me get a document out.

CHAIRMAN JENSCH: I am not thinking of subject matter; I am thinking of witnesses. What witnesses will you want to have available for interrogation tomorrow?

MR. ROISMAN: Mr. Prestele, Mr. McAdoo, the panel from the Staff that is going to discuss the same question that Mr. McAdoo just discussed, and then I understand the panel from the Staff that is going to discuss th- containment spray system and the comparison of the sodium hydroxide to sodium thiosulphate and related matters.

MR. TROSTEN: Mr. Chairman, I would also suggest that at the conclusion of the cross-examination tomorrow that we readdress ourselves to the matter of the fuel loading motion.

CHAIRMAN JENSCH: Yes. I may be that if we extended

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the session tomorrow into the evening perhaps we might conclude as far as we can practically go and keep it as low as practicable as we can tomorrow in which event we would recess tomorrow night and reconvene on Tuesday, if that is agreeable to the parties.

MR. TROSTEN: That would be fine.

MR. KARMAN: Mr. Chairman, one problem I have is we are contemplating next week, as far as the Chairman has indicated, to get into the emergency plans with the State of New York and with Mr. Davies.

What I would like to know at this time is does the Board contemplate asking the questions during next week or may we anticipate thatour witnesses, other than the emergency plans witness, would not necessarily have to be here next week?

CHAIRMAN JENSCH: My understanding is that if the Staff witnesses could be here, it would be very fruitful to have them here.

Let us give consideration to that matter --

MR. KARMAN: I wish you would take consideration that several of our witnesses have other commitments for next week and it may be extremely difficult, if not impossible, for them to get here.

CHAIRMAN JENSCH: The Board will consider it over the evening and try to indicate tomorrow. I might indicate

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that it does appear that one of the members of the Board will be unable to be here next week, and for that reason the Board might be inclined to defer many of its inquiries until the Board can fully reassemble and have all of its matters, which necessarily will mean that at this ECCS session we may have more inquiries than just those limited to that subject.

MR. TROSTEN: We would certainly hope and urge the Board to, if at all possible, to raise any inquiries that it intends to raise with us next week, so that we could address ourselves to those matters next week.

CHAIRMAN JENSCH: We will endeavor to do that.

It may be some inquiry can be directed to the Applicant's witnesses, we will consider that over the evening, and defer further inquiry from the Staff until a time convenient for all of the members of the Staff to be here.

We may have to defer that --

MR. KARMAN: It might even be possible for you to submit the questions to the Staff and we may respond in written form.

MR. TROSTEN: I would hope the Staff would make itself available next week, if this is necessary, because we would most earnestly like to consider all matters other than the emergency core cooling matter next week.

MR. KARMAN: As I indicated, we may have some difficulty with that, Mr. Trosten.

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CHAIRMAN JENSCH: If there is nothing further, this public hearing will recess to reconvene in this room tomorrow morning at eleven o'clock.

(Whereupon, at 5:10 p.m., the hearing was adjourned, to reconvene at 11:00 a.m., Thursday, July 14, 1971.)

end

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