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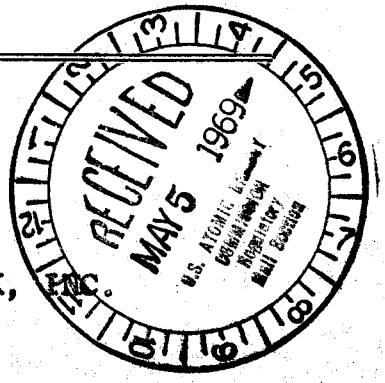

IN THE MATTER OF:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

(Indian Point Unit No. 3)

Docket No. 50-286

Place - Crugers, N. Y.

Date - 1 May 1969

Pages..... 1353 - 1535

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UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the matter of:	:	
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.	:	Docket No. 50-286
(Indian Point Unit No. 3)	:	

Auditorium, Springvale Inn
Route 9A, Crugers, New York

Thursday, 1 May 1969

Met, pursuant to adjournment, at 9:30 a.m.

BEFORE:

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

DR. THOMAS H. PIGFORD, Member.

DR. JOHN HENRY BUCK, Member.

APPEARANCES:

(As heretofore noted.)

eb

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Witness:	Direct	Cross	Redirect	Recross
J. S. Moore)				
J. D. McAdoo, Jr.)				
J. J. Grob, Jr.)				
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Dr. C. R. McCullough)				
Dr. M. E. Wrenn)			1457	
Dr. James Halitsky)				
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Gordon Burley)		1355		
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P R O C E E D I N G S

CHAIRMAN JENSCH: Please come to order. I believe we made arrangements for the presentation of evidence by the Citizen's Committee for the Protection of the Environment--a new witness this morning, is that correct?

MR. BOGART: Mr. Chairman, we just received word from the witness that he locked his key in the house and has had trouble getting here, but he is on the way.

CHAIRMAN JENSCH: We will go forward with some other matters then.

Whereupon,

J. S. MOORE,

J. D. MC ADOO, JR.,

J. J. GROB, JR.,

W. J. CAHILL, JR.,

DR. C. R. MC CULLOUGH,

DR. M. E. WRENN, and

DR. JAMES HALITSKY,

and

JAMES B. HENDERSON,

IRWIN SPICKLER,

GORDON BURLEY,

DANIEL MULLER, and

JOSEPH A. MURPHY

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

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CROSS EXAMINATION (Cont'd.)

DR. BUCK: We will go ahead with some of the questions that I had. I have some on page 114. I want to bypass those. Let's go over to page 1019.

I need to get back to radioactivity in Chelsea which seems to have gotten beaten around. On lines 5 to 7, the levels that would be expected at Chelsea Pumping Station was the question. Answer given by Mr. Cahill on levels expected.

Perhaps I missed this in the testimony. I would like to know under what conditions of flow were the calculations made? Both under the normal emission and accident emissions?

In other words, was this done for a drought condition when Chelsea would normally be operating, or was it done under normal river full conditions? Could you explain that?

MR. CAHILL: Yes. This was done under drought conditions taken at the level of salinity in Chelsea of 1000 parts per million, whichcoincides with Commissioner Feldman's testimony that the limit for use of the water because of salinity at Chelsea would be several hundred parts per million.

This condition of 1000 parts per million would occur under drought-type conditions in the river.

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DR. BUCK: So, your speed of the river downflow and the speed of the tide flow were calculated on the river level conditions at that point or under those conditions? Is that correct?

MR. CAHILL: Yes, sir.

DR. BUCK: Thank you. Do you consider these to be basically the worst conditions that could occur?

MR. CAHILL: These are the worst conditions that could occur under -- excuse me. You mean the worst drought conditions or the worst conditions of radioactivity release?

DR. BUCK: I am talking about drought conditions.

MR. CAHILL: All right. There could be more severe drought conditions than this, although this is a farily severe condition.

The limit of the 1000 parts per million was taken because we understand from Commissioner Feldman's testimony this is beyond the salinity level that they would pump water for drinking water use.

I would like to point out also that the concentrations I gave there for continuous release were taken on the basis of discharging at Indian Point at 100 percent of the 10 CFR, Part 20 limits, so this was an illustrative example of how continuous discharge at Indian Point at the limit of 10 CFR 20 would, even under that circumstance, result in very low levels of radioactivity concentration at Chelsea.

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Of course, the expected discharge is far below -- at Indian Point -- the limits of 10 CFR 20, as was covered in some other part of my testimony.

DR. BUCK: Thank you. Do you have a question?

DR. PIGFORD: Yes.

Mr. Cahill, when you say a discharge at the limit, are you speaking of discharge from Indian Point 3 or all three p lants?

MR. CAHILL: The example I gave was for discharge from Unit 3.

DR. PIGFORD: Now, on the salinity, I don't understand what the salinity has to do with the diffusion in transport or the discharge of radioactive nuclides. Could you explain that?

MR. CAHILL: The salinity at Chelsea -- or at any point in the river between other points in the river -- is an indication of the dilution -- the mixing capability of the river.

It also is an indication of the relative drought condition. High salinity up the river or further intrusion of sea water into the river occurs when there is drought flow in the river.

DR. PIGFORD: All right. Is this explained in that reference -- in that appendix in your Volume 1 by Mr. Kirk and some other people?

MR. CAHILL: I am not sure. Yes, it is.

DR. PIGFORD: All right.

Now, one other question of clarification. In your summary page 15 you talk about the discharge from Unit 3 stating it would not result in allowable limits for drinking water beingexceeded at Chelsea and Poughkeepsie. Are you referring there to potential normal and accidental releases?

MR. CAHILL: Thank you.

DR. BUCK: Over on page 1036, concerning the statements given about the 10 percent assumption on the methyl iodide content of the iodine in the containment, down on line 12, "We note specifically that in a preponderant majority of those cases the fraction which is present as organic iodine is less than 4 percent of the total. Certainly in all cases in which the conditions simulate those of a water reactor accident this is true." In the simulation of the water reactor accident, what temperatures were simulated? Were these done at room temperature or higher temperature?

MR. MC ADOO: Of course there are a variety of experiments and observations included in this statement. There may have been some at low temperature, but the conditions which I would refer to as most accurately simulating the accident are those in which the gases are introduced at a high temperature equivalent to that of at least partial melting of the uranium oxide fuel.

DR. BUCK: They were above the ambient temperature of the containment. Considerably above that.

MR. MC ADOO: A full simulation would include the release from the fuel matrix at a high temperature and then perhaps a cooling down to temperatures comparable to those of the containment during which some additional reactions might take place.

DR. BUCK: I presume on the next page we talk about the statement or the theory that methyl iodide for mation is a reversible phenomenon.

Do you happen to know what dependence on temperature is as far as the formation and the breakdown of methyl iodide?

MR. MC ADOO: I have Mr. Fletcher here who is better qualified to answer that question.

MR. FLETCHER: I believe, Dr. Buck, the equilibrium would indicate a maximum methyl iodide concentration is attained at approximately 700 degrees C. --

CHAIRMAN JENSCH: Would you speak more directly into

the mike?

MR. FLETCHER: The maximum methyl iodide concentration would be indicated at temperature of 700 degrees C, and below that temperature the methyl iodide concentration is lowered from equilibrium considerations.

In any case, the equilibrium would indicate the methyl iodide concentration is very, very, very low in its concentration. On the order of much less than a tenth of a percent of the total iodides present.

DR. BUCK: Let me get back to this question again. The methyl iodide would be formed at the higher temperatures. You are assuming it's formed at the inter reactor, or close to the reactor at the time of the accident at relatively high temperatures, the initial methyl iodide. Or do you say it gets formed at any temperature?

MR. FLETCHER: No. The equilibria is considered for a system consisting of iodine, methyl iodide, methane. It doesn't relate to where or how it might be formed.

DR. BUCK: As the temperature decreases, is the methyl iodide stable or more stable?

MR. FLETCHER: As temperature decreases, methyl iodide is unstable.

DR. BUCK: So that as the combination enters the containment and gets cooled down you're saying there is a breakdown, tendancy towards breakdown, of methyl iodide rather

than reformation?

MR. FLETCHER: That's correct.

DR. BUCK: Thank you, Mr. Fletcher. Do you have any questions?

DR. PIGFORD: Yes. Supplement 1, pages -- section 13, pages 1 and 2, there is a response to a question from the Commission concerning methyl iodide.

Quoting out of context they state, "Recently published literature BNL level 329 indicates of the 16 percent of total radioiodine released from UO_2 fuel heated to temperatures of 1,000 C., 1300 C. in a steam hydrogen atmosphere may be in organic form."

On your answer I gather from the statement on page 3 that it is your position line 3 on page 3, that no more than 5 percent of the iodine actually in the core will be in the form of methyl iodide.

MR. TROSTEN: May we have the reference again?

DR. PIGFORD: Supplement 1, Section 13. I started reading from about the fourth sentence of the staff question. Then I skipped to page 3 of that section and quoted from the third line of your answer.

Did you want me to repeat the question?

MR. FLETCHER: Yes, if you will.

DR. PIGFORD: Is that correct? Or did you want me to explain what I'm asking?

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MR. FLETCHER: Would you please?

DR. PIGFORD: Is it correct on line 3 page 3, section 13, that you are saying that you expect that the organic iodine fraction in the core itself is no more than five percent? In the core itself?

MR. MC ADOO: May I answer that one, Dr. Pigford?

DR. PIGFORD: Certainly.

MR. MC ADOO: I believe as I read this page the statement is that we will design so that the containment system will be able to tolerate the formation of methyl iodide up to a percentage corresponding to five percent of the fission product iodine inventory. That does not mean that the methyl iodide is formed in the core. That is just a reference to the quantity present.

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MR. MC ADOO: Perhaps we have to go back to your original question again.

DR. PIGFORD: I'm trying to seek an upper limit now to what you think the iodine in the core could be. Does this mean you think iodine in the core will have a methyl iodide content of no greater than 5 percent of the total iodine?

MR. MC ADOO: You have said in the core. Do you mean that literally?

DR. PIGFORD: Yes, sir.

MR. MC ADOO: The answer would be no, not in the core. In the containment, it would.

DR. PIGFORD: Does it mean in the core you think it can have a fraction greater than 5 percent?

MR. MC ADOO: No, sir. Less than that.

DR. PIGFORD: Let's try getting off to a good start again because I'm really having trouble. My question is -- and I really mean this literally -- do you think the iodine fraction in the core -- that is, methyl iodide -- is no greater than 5 percent?

MR. MC ADOO: That statement is true. We also believe it is no greater than a fraction of 1 percent.

DR. PIGFORD: Thank you. That does help.

Now what is the temperature for partial fuel melting that you mentioned a moment ago in your answer to

eb2 Dr. Buck's question?

MR. MC ADOO: The melting point of uranium oxide is approximately 5,000 degrees Fahrenheit.

DR. PIGFORD: Could you give that in Centigrade, please, because your other answers in this section are in Centigrade? I'm happy with an estimate.

MR. MC ADOO: I think it's around 80 to 100 degrees Centigrade.

DR. PIGFORD: In the first part of the answer --

MR. MC ADOO: I'm sorry, may I correct that before we go too much farther? 2700 would be a better answer.

DR. PIGFORD: In the first part of your answer to the question, now referring more specifically to the part of the question I quoted which dealt with the Brookhaven reference that indicates that up to 16 percent of total radioides released from UO_2 fuel heated may be in the organic form, you state that the report indicates that up to 16 percent of the total radioiodine released from UO_2 fuel heated to temperatures to 1,000 Centigrade, to 1300 Centigrade in a steamed hydrogen atmosphere may be in organic form. Mixes of the result of this experiment to PW are loss of coolant and environment conditions is unrealistic.

Would you please explain why that is unrealistic?

MR. FLETCHER: Dr. Pigford, I believe with respect to this statement the temperature of the Brookhaven

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experiments were comparable to those which one might see for the molten fuel itself.

CHAIRMAN JENSCH: Will you speak a little louder? Thank you.

MR. FLETCHER: The principal differences that we see in this experiment is the concentration of the iodine that was evolved which is several orders of magnitude below that which we would expect for the hypothetical meltdown we are considering for the reactor.

DR. PIGFORD: I thought you were saying that this Brookhaven experiment gives greater concentrations than what you are projecting, Mr. Fletcher.

MR. FLETCHER: That's correct. Concentrations of methyl iodide.

DR. PIGFORD: That's correct. Thank you.

I would like to knwo why it is unrealistic for your conditions -- and I believe relevant to that specific question you say the Brookhaven experiments are characteristic of molten fuel. Did you not say that?

MR. FLETCHER: I believe that is correct.

DR. PIGFORD: Yet here they say temperatures are 1,000 Centigrade and we learned from Mr. McAdoo that the melting temperature of UO_2 is 2750?

CHAIRMAN JENSCH: Was your answer 2700?

MR. MC ADOO: Yes.

eb4 1 DR. PIGFORD: My question is: Please explain why
2 the Brookhaven experiments are characteristic of molten
3 fuel?
4 MR. FLETCHER: I made an error. I believe
5 the relation or the similarity between the two temperatures
6 is not the same as molten fuel. The different that I would
7 like to point out between the Brookhaven experiment and what
8 we see for the reactor is the concentration of iodine --
9 concentration of methyl iodide is high. The total inventory
10 of iodine in the Brookhaven experiment is very low.
11 DR. PIGFORD: So I gather it is not a matter of the
12 temperatures and steam water environment of that experiment
13 that makes it, in your opinion, inapplicable, but it is a
14 matter of the iodine concentrations in their experiment
15 versus yours.
16 MR. FLETCHER: That's correct. The relative iodine
17 inventory.
18 DR. PIGFORD: Is it because you used this kinetic
19 model on the formation rate of iodine which has in it a con-
20 centration effect that leads you to this conclusion?
21 MR. FLETCHER: Well, the existence of -- I beg
22 your pardon. Would you please repeat that?
23 DR. PIGFORD: Is it because you used this kinetic
24 model on the formation rate of methyl iodide which has in it
25 a concentration term that leads you to this conclusion?

eb5 1 I think that is a question which is bad because I
2 haven't defined what kinetic model I'm talking about. If you
3 can take it at that point I would appreciate it.
4 MR. FLETCHER: Well, of course the kinetics-- Of
5 course the kinetics reactions are formations-- The kinetics
6 for the formation of methyl iodide are not altogether under-
7 stood, Dr. Pigford.
8 DR. PIGFORD: Then my question is: I gather that
9 you feel that the reasons that the Brookhaven experiments are
10 unrealistic is that they have a different and higher concen-
11 tration of iodine in their experiment, is that right?
12 MR. FLETCHER: No, sir. Lower.
13 DR. PIGFORD: Could you be specific? How much
14 lower?
15 MR. FLETCHER: On a comparative basis for the
16 reactor, we would be talking in terms of 10 to the minus 7
17 mols per liter, whereas the Brookhaven experiments were at 10
18 to the minus 10 mols per liter.
19 DR. PIGFORD: Per liter of what?
20 MR. FLETCHER: Of vapor or gas space.
21 DR. PIGFORD: Gas space in the reactor?
22 MR. FLETCHER: Yes, sir.
23 DR. PIGFORD: Where is that located?
24 MR. FLETCHER: In the containment, sir.
25 DR. PIGFORD: Now I'm really lost. When I'm

eb6 1 speaking of the reactor, I mean the reactor core. Did you
2 mean the reactor core gas space?
3 MR. FLETCHER: No. I mean the containment gas
4 space. With respect to the iodine concentration in the core,
5 it would be much higher, of course.
6 DR. PIGFORD: What would be much higher?
7 MR. FLETCHER: The iodine concentration.
8 DR. PIGFORD: In both Brookhaven conditions and
9 yours?
10 MR. FLETCHER: No, sir. Certainly in ours. In
11 the Brookhaven experiment, the iodine concentration in the
12 space -- the iodine in the gas issuing from the molten fuel
3 13 was 10 to the minus 10 mols per liter.
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DR. PIGFORD: Per liter of what?

MR. FLETCHER: Per liter of gas

DR. PIGFORD: The last number you quoted, please, mols per liter of gas, you said -- of iodine gas, is that correct?

MR. FLETCHER: No, sir. That is a steam-air environment. The Brookhaven experiment was conducted where iodine was evolved from the fuel into steam and air. That concentration was 10^{-10} mols per liter in that mixture. In the containment atmosphere of this plant for that amount of iodine, 25 percent of the total core iodine released in the containment would give you approximately 10^{-7} mols per liter in the containment, related back to the steam iodine mixture issuing from the core, one would expect it to be much higher of course.

DR. PIGFORD: You are now using in your analysis 25 percent of the total core iodine released in the containment?

MR. MC ADOO: We actually assume that 50 percent of the iodine is evolved from the fuel. The TID model, which certain calculations are based on, assumes 25 percent is then available for leakage during the first two hours, so this factor of two which is attributed to this is plate-out enroute from the fuel to the containment.

DR. PIGFORD: I want to get back to my question

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but is that factor applicable to this system?

MR. MC ADOO: To this system.

DR. PIGFORD: Indian Point 3, Mr. McAdoo.

MR. MC ADOO: I believe you will find some calculations that are done in each way, Dr. Pigford. We have assumed in calculating the performance of the containment spray system that removal by spray is competitive with this plate-out process.

And, therefore, we start with 50 percent when we make those calculations. Specifically, where we have related quantities of fission products to the TID model, we use literally the TID assumptions that 25 percent is available for leakage.

This is merely to place it on a comparable basis to a standard calculation which is generally used in the field.

DR. PIGFORD: I think you told me once that that is applicable. When you have a dry containment where you can talk abmt plate out, it sounds reasonable to use a factor of two.

Whereas, here with your engineered safeguard systems you get a diffemnt effect which may be considerably greater in your actual Indian Point design, isn't that correct.

MR. MC ADOO: The total effect, including condensation

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and absorption by spray is much greater than the effect of plate-out, if that is what you mean by that statement.

DR. PIGFORD: The other part of the statement: Is the factor of two developed in the first place to be some estimate for a dry containment system?

MR. MC ADOO: No, sir. I believe a factor of two is associated with plate-out and condensation. I wouldn't characterize it as being a dry system in the literal sense, and the TID model is not specific as to just what mechanism accounts for this factor of two.

But it attempts to relate calculational model to the information available from a variety of experiments in which it was generally observed that half of the iodine released under these conditions was generally rapidly condensed or plated out in the walls of the system.

DR. PIGFORD: Yes, you are quite right. My worries aren't really precise. When the factor of two arose, was it applicable to a containment system where there were no sprays envisioned in the system, Mr. Muller?

MR. MULLER: The answer is yes, but I would like to ask Dr. Burley to elaborate on this.

MR. BURLEY: Do you want to go on with the plate-out factor at the moment, Dr. Pigford?

DR. PIGFORD: If you are asking me, the answer is no. But I don't want to take away from you the opportunity of

elaborating on anything that has been said if you want to.

MR. BURLEY: The TID-14844 is not specific as to the mechanism of plate-out. It does apply to the present generation of boiling water in the pressurized water reactors, however. And the depletion of the airborne iodine is both a surface condensation plate-out phenomenon and a depletion due to the steam flux which is present, initially carrying the iodine to the surfaces and the combination of these two mechanisms has been shown in many, many experiments to be much greater than -- shows a depletion factor much greater than this factor of two.

DR. BUCK: What do you mean by depletion of the steam flux?

MR. BURLEY: Depletion of the birborne iodine by steam carrying it to the surfaces.

DR. BUCK: Is this another method of plating out, in other words?

MR. BURLEY: Yes.

DR. BUCK: A Method where steam is carried --

MR. BURLEY: Yes.

DR. PIGFORD: Mr. McAdoo, if I may return to my earlier question, in the applicant's analysis of these accident conditions, do you assume that 50 percent of the iodine in the core is released to the containment space?

MR. MC ADOO: Those calculations which have been

presented in chapter 12 and earlier in our testimony in this hearing were based on the initial existence of 50 percent of the core iodine as a leakage source in the containment.

DR. PIGFORD: Thank you.

DR. BUCK: Are there some other experiments that are closer simulations with actual conditions than the Brookhaven experiment.

MR. BURLEY: Dr. Buck, may I answer it.

DR. BUCK: Surely.

MR. BURLEY: Yes, there are a large number of experiments which have attempted to simulate, at least in part, the formation of methyl iodide under post-accident conditions. Most of these were carried out at Oak Ridge by George Parker and for one of these hearings we prepared a little tabulation of most of the applicable experiments. I can let you have a copy which I have which might be useful for your information at least.

DR. BUCK: Thank you.

MR. BURLEY: There are something like a hundred or so different experiments.

DR. BUCK: I knew there were a lot of experiments. I was trying to find out the ones that were closer to simulation.

MR. BURLEY: Most of these show conversion percentages of the available iodine of the range of a tenth

of a percent to about 3 or 4 percent.

The Brookhaven experiment, we also consider to be unrealistic for two reasons. One is the reason Dr. Fletcher gave, that the iodine concentration is much lower than the maximum which is envisioned if one has a TID type release by about a factor of 3 -- a thousand.

The other one is that this small amount of iodine is in the hot temperature zone much longer there than it would be in an actual post-accident enfironment.

As Dr. Fletcher also said, the conversion to methyl iodide occurs much more effectively, much more rapidly at the high temperatures.

Dr. Buck. And conversion away from it is better at low temperatures?

MR. BURLEY: That is right. There are a number of other formation mechanisms. We have looked at all of the possible formationmechanisms theoretically, and the formation in the high temperature zone probably accounts for a majoirty of the organic iodide produced but not for all of it.

end 4

CHAIRMAN JENSCH: Go ahead.

MR. BURLEY: There is some conversion possible in the containment but there is an equilibrium formation mechanism.

DR. BUCK: Now, we say there are other experiments that are closer simulations. These are closer in concentration, are they, to the concentration levels?

MR. BURLEY: Closer concentrations, closer in actual temperature conditions, closer in release mechanisms.

DR. BUCK: What do we know about the effect of radiation on --

MR. BURLEY: There is only one set of experiments that I'm aware of which was carried out at Battelle last year which was reported in BMI-1829, and for realistic ratios of iodine and methane gas, which were both introduced into the containment, the conversion fractions were on the order of up to about one percent, usually less.

They did run one experiment where they had a 390 to 1 ratio of iodine and with large radiation doses -- I will have to refresh my memory --

DR. BUCK: Over what period of time?

MR. BURLEY: All that is important here is the total radiation dose.

DR. BUCK: All right.

MR. BURLEY: So, for a total radiation dose of 10

to the 7th rads at a 10 to 1 mol ratio of methane to iodine, the percent conversion of iodine to methyl iodide was on the order of about six percent.

DR. BUCK: There is a net effect going towards methyl iodide, but smaller?

MR. BURLEY: That's correct. For the 490 to 1 mol ratio of methane to iodine at 10 to the seventh rads, the conversion was about 11 percent.

DR. BUCK: Thank you.

DR. PIGFORD: I don't want to interrupe. Mr. McAdoo, what is the effect of the operation of the flame recombiner on the methyl iodide content?

MR. MC ADOO: We haven't done experiments in which we have introduced the methyl iodide into the flame recombiner. However, one would expect the flame to decompose methyl iodide into probably carbon dioxide, water vapor and elemental iodine.

DR. PIGFORD: So it appears that it might actually lower the methyl iodine content?

MR. MC ADOO: Yes, sir.

DR. PIGFORD: Now on first glance that sounds inconsistent with an earlier statement that high temperatures tend to promote the formation of methyl iodide.

MR. MC ADOO: In the presence of methane, iodine, water vapor, the constituents which we hypothesized for this equilibrium -- theoretical equilibrium -- was referred to,

there appears to be a maximum in the equilibrium concentration of methyl iodide at, as Mr. Fletcher pointed out, around 700 to 800 degrees C.

DR. PIGFORD: Yes. We know, of course, that there is appreciable water vapor in the gases just leaving a flame, and that is taken into account when you answer that the flame recombiner should decrease the methyl iodide content.

MR. MC ADOO: Yes. I believe the important factor here would be the non existence of an organic such as methane leaving the flame. Any methane present would tend to be completely oxidized in the flame.

DR. PIGFORD: There are carbon inhabited species though in that environment in the flame, are there not?

MR. MC ADOO: The fuel used in the flame is hydrogen gas, so the operation of the recombiner does not introduce organics.

DR. PIGFORD: So if there are carbon species, it was already there in the environment; is that correct?

MR. MC ADOO: Yes.

DR. PIGFORD: Now, if the flame recombiner had some effect upon methyl iodide, good or bad, does it make any difference in your dose calculations?

MR. MC ADOO: The premise again is --

DR. PIGFORD: If the flame recombiner did have some effect upon the methyl iodide, whether it increases it or

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decreases it, would it significantly change your dose calculations?

MR. MC ADOO: Well, it might be helpful if I pointed out that if, indeed, the recombiner operation is necessary, it would be on the order of one to two weeks after the accident. By that time, essentially all of the elemental iodine which is available as a raw material for the synthesis of methyl iodide, would be removed by the spray system.

In fact, that would occur well within the first day. So that the effect which one might look for in the operation of the recombiner would be one of decreasing the amount of methyl iodide already in existence. It would tend to decompose any methyl iodide present when the recombiner is operated. We have not taken that into account in calculating the leakage of methyl iodide from the containment.

The rate at which we process containment gas through the recombiner is much slower than the rate at which we pass it through the organic iodine removal filters, so that any removal effect would be minor compared to the filters.

DR. PIGFORD: So it sounds like the answer is no, if we say the recombiner doesn't go into operation until this extended length of time?

MR. MC ADOO: That's right.

DR. PIGFORD: You did describe earlier in this hearing that the recombiner could operate -- I forget now how

you put it -- I think even while the spray system is running or during an earlier stage of the hypothetical accident, did you not?

MR. MC ADOO: There is nothing in the containment conditions which would prevent us from starting the recombiner as early as say -- well, certainly as early as one day after the accident.

DR. PIGFORD: Since we didn't really ask you if it could, as I recall, this sort of indicates to me that you think it might be a possibility that you would want to run it that soon.

MR. MC ADOO: We would expect to operate the recombiner only if it were necessary to do so. And the necessity would be indicated by samples of the containment atmosphere having been analyzed for the presence of hydrogen.

Even if the hydrogen formation rate is as high as theoretically possible, we would not expect these hydrogen concentrations to be -- to have reached a point where a recombiner operation was necessary, for the first two weeks or so after the accident.

This is the basis for my statement that we would not expect to operate the recombiner as early as one day.

CHAIRMAN JENSCH: Excuse me. A gentleman has come into the room. I wonder if this might be an appropriate time to inquire -- is your witness for the Citizens Committee

present now?

MR. BOGART: Yes, Mr. Chairman.

CHAIRMAN JENSCH: Are you ready to proceed?

MR. BOGART: Yes.

CHAIRMAN JENSCH: Before we proceed with a different subject, we will take a recess at this time. Let's recess, to reconvene in this room at 10:35.

(Recess.)

end #5

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CHAIRMAN JENSCH: Please come to order.

Citizens' Committee, are you ready to proceed?

MR. BOGART: We are.

CHAIRMAN JENSCH: Call your witness, please.

MR. BOGART: Dr. Beardsley, will you come forward to the witness stand.

CHAIRMAN JENSCH: Do you have some document you would like to bring with you? We would like to have you prepared to testify.

Whereupon,

ROBERT BEARDSLEY

was called as a witness on behalf of the Citizens' Committee and, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BOGART:

Q Dr. Beardsley, for the record will you state your name and address, please?

A Robert Beardsley, 242 Mountaindale Road, Yonkers, New York.

Q What is your present affiliation?

A I am professor of Biology and Director of the Laboratory of Plant Orthogenesis.

Q Dr. Beardsley, would you give a brief resume of your education and experience and in what fields you believe

eb2 you could qualify as an expert?

A Actually I received my doctorate in microbial-genetics. I did my post-doctoral training in part at the University of Michigan, radiation biology. I certainly don't qualify there as a true expert in these days.

MR. CONNER: We can't hear, I'm sorry.

CHAIRMAN JENSCH: I do urge the witness to bring the microphone close and speak directly to it.

It might save some difficulty if witnesses will not attempt to classify themselves as to whether they construe themselves to be an expert or not. Tell us what you have done and what your experience has been. I think we will be in a position to draw an inference in that regard.

Will you proceed?

THE WITNESS: I also did post-doctoral work in Paris on a Guggenheim Fellowship in 1966.

CHAIRMAN JENSCH: You can bring that closer to you rather than you trying to lean into it.

BY MR. BOGART:

Q Did you have a chance to examine the papers, the application and the summary of the applicant, Con Edison, seeking to build a third nuclear power plant, Indian Point 3?

A Briefly.

Q Are you familiar with the operation of Indian Point 1 and the facts about Indian Point 2 now under construction?

eb3 1 A Peripherally.

2 Q Are you aware that in the application the appli-
3 cant, Con Ed, estimates the amount of radioactive materials
4 that the plant in normal operation will discharge into the
5 air and water?

6 A Yes.

7 Q What is your view as to the effects of low level
8 waste on the living environment?

9 MR. CONNER: If the Board please, the question is
10 objectionable in the form stated. I hate to have to object
11 at this point but the question has several assumptions in it.
12 I think implicitly the basis of my objection is the Commis-
13 sion's regulation in Part 20 governs what may be released
14 and that is the standard which has been established.

15 Therefore, it would be inappropriate for the
16 witness to argue one way or the other with the adequacies
17 of the Commission's regulation because that is the governing
18 standard.

19 CHAIRMAN JENSCH: I didn't understand the question
20 as directed to any question about accepting the premise of
21 the regulation. I think the question was will you give your
22 view as to the effects of those releases, assuming the standard
23 established in the Commission's regulation --

24 MR. CONNER: On that basis it would be irrelevant.

25 MR. TROSTEN: Mr. Chairman?

eb4 1 CHAIRMAN JENSCH: Yes?

2 MR. TROSTEN: I believe that no proper foundation
3 has been laid for Dr. Beardsley to express his opinion con-
4 cerning the effects of low level waste since he has not pro-
5 perly been qualified as an expert witness.

6 CHAIRMAN JENSCH: Objection overruled.

7 The witness may answer.

8 THE WITNESS: I have lost track of the question
9 at this point.

10 CHAIRMAN JENSCH: Will the Reporter read the
11 question?

12 (Whereupon, the Reporter read from the record
13 as requested.)

14 THE WITNESS: As a biologist, as a microbial-
15 geneticist, I am familiar with the current literature and I
16 feel we don't know what the effects of low level waste will be
17 in the biosphere.

18 BY MR. BOGART:

19 Q Dr. Beardsley, I believe you authored a paper
20 several years back entitled "Radiation Control." I would
21 like to read you Chapter 4, conclusions from that report.

22 "The development and use --"

23 MR. CONNER: Can't we just have the document
24 offered in evidence rather than read the entire chapter of
25 the report?

EB5 1 CHAIRMAN JENSCH: I think this is proper cross-
2 examination to lay the premise for the question.
3 Will the examination continue.
4 MR. BOGART: I have copies of a very short --
5 CHAIRMAN JENSCH: That isn't encumbent upon your
6 presentation. Will you proceed to state the premise for your
7 question?
8 MR. BOGART: I want to know whether Dr. Beardsley
9 still believes what he set forth in this at this time.
10 CHAIRMAN JENSCH: You may proceed.
11 BY MR. BOGART:
12 Q Part 4, conclusion.
13 "The development and use of nuclear
14 energy has been accompanied by an increasing aware-
15 ness of the biological damage induced by radiation.
16 Until recently it was generally assumed that exposure
17 to radiation below certain critical thresholds was
18 completely harmless in its effects on the human
19 organism.
20 "On the basis of this assumption the
21 problem of establishing radiation protective stan-
22 dards for society was reduced to the problem of set-
23 ting maximum permissible limits of exposure that
24 were below the thresholds. Thus radiation protec-
25 tion was considered to be primarily a problem for

eb6 1 scientists who are responsible for determining
2 threshold levels.
3 "It is now clear that radiation control
4 is no longer primarily within the province of science.
5 Since any exposure to radiation however small is
6 hazardous the formation of radiation protection
7 standards requires that the risk of exposure be
8 weighed against the benefits society hopes to gain
9 by taking these risks.
10 "In 1959 John F. Kennedy, the Senator
11 from Massachusetts expressed the crux of the matter
12 in the following words: 'There is no amount of
13 radiation so small that it has no ill effects at
14 all on anybody. There is actually no such thing
15 as a minimum permissible dose.'
16 "'Perhaps we are talking about only a
17 very small number of individual tragedies. The
18 number of atomic age children with cancer. The new
19 victims of leukemia. The damage to skin tissues
20 here and reproduction systems there. Perhaps these
21 are too small to measure with statistics. But they
22 nevertheless loom very large indeed in human and
23 moral terms.
24 "'Moreover there is still much we don't
25 know and too often in the past we have minimized

eb7 these perils and shrugged aside these dangers only to find that our estimates were faulty and the real dangers were worse than we knew.'"

Dr. Beardsley, does that represent your opinion today?

A Yes.

Q At the March hearings of the Safety and Licensing Board, Dr. Lamont Cole, professor of ecology at Cornell, testified to the effect that he would feel much more comfortable if the allowable radioactivity from nuclear power plants routinely discharged into air and water were reduced to zero.

Do you agree with that estimation?

A Yes.

Q In the files of the Atomic Energy Commission, there is an application from the Sacramento Municipal Utility District seeking permission to build a nuclear power plant and specifications on this application state that no radiation will be discharged into water. Do you think that that is an improvement over the present practice of other nuclear power plants being allowed to discharge quantities as specified in 10 CFR 20?

MR. CONNER: Objection to the question. It is irrelevant to this case and it misstates the premise. There's no specification on the reactor one way or another that is

eb8 not located on a body of water.

CHAIRMAN JENSCH: I think that the form of the question perhaps includes language wuch as a specification and indicates that possibly the Sacramento application is a necessary premise for the question.

If I infer from this question being propounded by a layman for a Committee which is not now represented by a lawyer--

I understand you are not a lawyer --

MR. BOGART: No, I'm not.

CHAIRMAN JENSCH: The net effect of the question is: Would this witness in support of the last previous answer recommend that there be no discharge of liquid effluents to bodies of water.

Is that the net effect of the question?

MR. BOGART: Yes.

MR. TROSTEN: Mr. Chairman, I concur in the objection of the staff counsel to the question. It is irrelevant to the issues in this proceeding.

CHAIRMAN JENSCH: Objection overruled.

The witness may answer.

THE WITNESS: In the context of the way in which the Chairman rephrased the question, my answer is Yes.

BY MR. BOGART:

Q In other words, as I understand the technology

eb9 1 exists to make it feasible to set the release limits of low
2 level radioactivity waste at zero. Does this in your opinion
3 represent something that should be more generally applied
4 from the standpoint of possibly avoiding damage to the en-
5 vironment?
6 A You are stating as a fact the technology makes
7 this feasible at the moment. If this is true, and since
8 this is true, would I accept this conclusion? The answer
9 would be Yes, of course.
10 Q What I mean to say is that the only thing now that
11 let's say permits the discharge of radioactive waste is the
12 economic factor. Dr.Cole testified that he believed that
13 in the operation of a nuclear power plant a light water
14 reactor, that the effect of the discharged radioactivity on
15 organisms was heightened because the radioactivity is dis-
16 charged into the condensor water cooling system which is at
17 a temperature elevated above the intake temperature of the
18 system.
19 Does your experience confirm the heightened effect
20 of radioactive waste in the presence of higher degrees of
21 heat?
22 A Well, for two reasons, yes.
23 Q Could you explain what those are?
24 A That the mutogenetic effects on biological systems
25 of radiation are enhanced. Vital chemical processes that

eb10 underlie the events that lead to the altered genetic blueprint are heightened at increased temperatures.

Secondly, the expression of the gene is temperature dependent. This is an old established fact that hasn't been taken into consideration unfortunately in considering discharges of waste to the environment.

Q Are you aware that the gaseous waste presumably released in the largest concentrations from Indian Point 1, 2, and 3 will be krypton 85?

A I am aware of it.

Q Do you have any knowledge of the activity or inactivity or the diffusion to the total radioactive budget that krypton 85 will make?

A No.

Q Yesterday it was brought out that the Indian Point 1 plant, a pressurized water reactor of I believe 173 megawatts, is allowed to release in the course of a year a total into the air of 16 million curies of radioactivity, still being within the maximum permissible concentrations permitted by AEC regulation.

From your knowledge of radiation biology, would you consider that this amount of radiation released in the Hudson River Valley, a radionuclide that is heavier than the air, would have any environmental effect?

MR. TROSTEN: I object to the question. It is

irrelevant to the issues in this proceeding since it constitutes an attack on the validity of 10 CFR 20 limits.

MR. CONNER: For the record it also is a hypothetical question which doesn't have all the elements necessary in the background. Therefore, improper foundation.

CHAIRMAN JENSCH: What additional elements do you suggest be involved?

MR. CONNER: The question suggests that 16 million curies are in fact released. This is contrary to the evidence which exists. It does not take into account the average over the year. It does not include the release to air and water, among other things. It does not take account of the fact that such a release would be to air and water.

MR. BOGART: It is not my understanding this had anything to do with water. I understood it was a gaseous discharge.

LRW 7
rms 1

DR. PIGFORD: I have trouble too. I thought the 16 million curies was an airborne release allowed under the technical specifications. I don't understand the water effect.

MR. CONNER: Of course, I am in effect protecting the record in making an objection to the form of a hypothetical question, and the framing that Mr.Bogart made -- effect on the environment -- and I think it should have been more specific.

I admit my objection is a technical one, but as I construe my job I must try to protect the record.

DR. PIGFORD: That is very helpful. I have a question. I thought the 16 million curies per year was an allowable release to the gaseous atmosphere of the air under the technical specifications.

I don't understand your statement that it does not include the water, or however you brought the water in. Could you explain that, please?

MR. CONNER: I will endeavor to try to do it for your benefit, but it has no relation to my objection. I want to make that very clear.

Of course, the release rate, if they did release right up to part 20 limits, it would be 16 million curies.

CHAIRMAN JENSCH: I understood Mr. Cahill said they had the advantage of a heated stack and because of that they had this greater release to Indian Point 1. I think the question may reflect that this amount is going to be released.

And I think to that extent the objection is well taken. And this is perhaps a matter of phraseology, but as I understand the question you are saying if Con Edison did release the amount which is permitted by the Atomic Energy Commission to be released under -- as I understand the specifications described by Mr. Cahill -- and if they released 16 million curies of radioactivity averaged over a year. what would be the effect on the environment, without contesting whether you agree or disagree with the 16 million curies or without regard to whether you agree or disagree with the regulation under which that was arranged.

MR. BOGART: Yes, I did want to imply the regulations say this much could be released and still with apparent safety.

CHAIRMAN JENSCH: The objection is sustained, but I wonder if you would care to consider the matter in light of the objections.

MR. BOGART: Instead of saying that all of the allowable 16 million curies were released, let me say that 1 percent of this amount is released.

Dr. Beardsley, would you care to make a statement as to whether you feel that this amount of radiation consisting largely of Krypton 85, heavier than air, would have an effect on the Hudson River Valley environment?

MR. TROSTEN: I object to the question for the same

reasons given a moment ago, Mr. Chairman.

CHAIRMAN JENSCH: I didn't quite get your objection.

MR. TROSTEN: I object to the question because the question asks for a response which is irrelevant to the issues in this proceeding and constitutes an attempt to ask the witness for his opinion as to whether the levels of radioactivity permitted to be released by 10 CFR 20 are safe.

CHAIRMAN JENSCH: I wonder if the reporter will read the question.

(Whereupon, the reporter read the record, as requested.)

CHAIRMAN JENSCH: The Board is having difficulty with the form of your question. I don't know if the records necessarily establish the premise first of all that it is largely Krypton 85.

Insofar as the effect on the environment is concerned, the Board believes that is a proper inquiry that does not infringe upon the determination made by the Atomic Energy Commission under Part 20, particularly for this reason: We are considering Indian Point 3, but we have established through the course of our inquiries in this proceeding that you have an interrelated operation, and the effect of the -- the operation of the Indian Point 3 unit may be affected in part by the transactions at Indian Point 1. And I take it that the question here deals with 16 million curies radioactivity

of various constituents released from Indian Point 1, or rather the possibility exists that it might because it is permitted. Now, Mr. Cahill said they don't expect to reach that level, but upon the assumption -- and this is where the hypothetical comes in -- from the assumption of 16 million curies of radioactivity are released, I understand the question is limited to what is the effect on the environment? To that extent the Board believes the question is proper.

The particular question, however, the objection is sustained as to that.

MR. BOGART: I velieve Mr. Trosten used the word "safe" in connection with the AEC standards. I don't think the AEC standards in any place use the word "safe."

CHAIRMAN JENSCH: Do you desire to propound an additional question?

MR. BOGART: I wanted to make a correction of that point. AEC standards don't say 10 CFR 20 has any factor of safety.

CHAIRMAN JENSCH: Will you proceed?

BY MR. BOGART:

Q Dr. Beardsley, to your knowledge, is there anything in the literature on the effects of Krypton 85 on the environment?

A The environment or biosphere?

Q Biosphere?

A Yes.

Q Could you speak as you will about this at whatever length you wish to?

A I am really not prepared to speak at length on this at this point. I have not been concerned with airborne radiation for at least a number of months and under oath I would have to look at my books -- except to say as with all forms of radiation the effects are uniformly deleterious to biological systems.

Q Deleterious in what respect?

A Deleterious in respect of the effects of radiation on cellular processes and cellular structures.

Q In the human organism what forms might these deleterious effects take?

A I can't comment on that.

MR. TROSTEN: I didn't hear the answer.

THE WITNESS: I can't comment on that without further research.

end 7

BY MR. BOGART:

Q Dr. Beardsley, in the normal operation of a pressurized water reactor such as the proposed unit #3, after the reactor has been operating for a period of 180 days, are you aware that there is a very large quotient of fission products built up within the reactor?

A Yes.

Q The applicant has postulated a number of so-called credible accidents that could happen. The document, WASH-740 issued by the Atomic Energy Commission, sometimes known as the Brookhaven Report, March 1957, gave a description of an accident that postulated the release of a considerable part of stored fission products in the reactor.

If the Indian Point #3 unit would have several billion curies of fission products built up in the course of its normal operation at the end of six months, and if an accident as remote as that suggested in WASH-740, or if it takes place, could you give some idea of the consequences -- let's assume that just one-tenth of one percent of those billion curies of the different radioisotopes were released into the environment at a point 24 miles north of the New York City boundary --

MR. CONNER: Objection.

CHAIRMAN JENSCH: He hasn't finished the question yet. If you let the question be finished, we will hear your objection.

MR. CONNER: I'm sorry. I thought he was finished.

BY MR. BOGART:

Q Could you, under those hypothetical circumstances, give some idea of the consequences and magnitude of what would happen to the biosphere from the release of that amount of waste fission products?

CHAIRMAN JENSCH: Just a minute. The Staff would like to interpose an objection.

MR. CONNER: I will make a formal objection. No demonstrated relevance to this case.

CHAIRMAN JENSCH: Will you explain that? That there is no demonstrated relevance if there is a large quantity of fission product released to the atmosphere having no relevance to this proceeding involving safety?

MR. CONNER: You're rephrasing the gentleman's question. I objected to his question.

CHAIRMAN JENSCH: Will the reporter read the question?

(Record read.)

CHAIRMAN JENSCH: The objection is overruled. The witness may answer.

THE WITNESS: This is a question that was examined -- this was examined in detail before the joint committee on several occasions and led ultimately to the Price Anderson Bill providing liability protection for the utilities. I mean the

event you asked me to comment on, a catastrophe of radiation damage to people, so much damage to people in the area at the moment and to subsequent radiations and all forms of life in the area, I think there has been previous testimony here on liability protection on the Price Anderson Bill.

BY MR. BOGART:

Q Not in these hearings, no. Could you comment on that?

A Well, originally there was a statement made, going back to 1956, the President of the Power Reactor Development Company declared:

"We would not build or operate a reactor which we believed to be dangerous. Yet we must realize there is a remote possibility of serious incidents or even catastrophe which we cannot conceive. The lack of catastrophe liability protection will seriously affect the ability of private industry to finance its participation in the power demonstration reactor program."

Willard Libby, Commissioner of the AEC, was somewhat more optimistic in the testimony he gave during the same hearing. He stated:

"One must reiterate the probability of major reactor failure, although apparently indeterminate the damage can be small and the essential integrity of containment structure can probably be ensured by conventional design

and construction. Systems less than perfect are still highly desirable."

Out of this arose the Price Anderson Bill which provides under public funds the liability insurance for a major catastrophe of the kind envisioned.

Q But in this populated an area, with 16 million people living within 55 miles of Indian Point, would the amount appropriated or set aside, the maximum amount, $500 million, compensate for the degree of damage you think would be done?

A I have --

MR. TROSTEN: I object to that question.

CHAIRMAN JENSCH: The objection is sustained. The question we are waiting to hear answered is, what is the effect on the environment. I thought that was your original question.

MR. BOGART: I will get on with that question. It was just since the public here is probably not familiar with the Price Anderson Act, I thought since Dr. Beardsley brought it up, the implications of that Act might be brought out.

CHAIRMAN JENSCH: Go back to the question, what is the effect on the environment.

BY MR. BOGART:

Q There are about 19,000 people in Peekskill a mile and a half north of the reactor, and about the same number in Ossinning, four miles south of the reactor. In your opinion, the release of the amount of fission products that was

mentioned, what effect would that have on the population of these two communities?

A You're asking a specific question that requires in this case some specific calculations.

Q Would people be affected?

A Clearly some people would be affected. There are many factors you would have to take into consideration. Time of day in which this hypothetical incident occurred, prevailing winds, whether or not we are under a diversion at this time of the year - -

Q In other words, there could be a release of this degree of radioactivity and a good part of the valley would escape unscathed?

A I would doubt it.

Q Thank you. I have one more question.

end #8

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BY MR. BOGART:

Q In a paper, "Nuclear Safeguards," issued by the Rochester Scientists' Committee for Public Information in February 1969, E. Grant Pike, an engineer, made the following statement:

"On one hand, nuclear fuel may prove cleaner in use than fossil fuel. On the other hand, current AEC regulations do not enforce this kind of cleanliness, but rather allow the radioactive wastes of industry to build up in surface waters, oceans and air, to levels much higher than those previously brought about by fallout. For example, New York State surface waters had up to 5 pCi/l of Strontium-90 as a result of fallout, but the permissible level from industrial wastes would be up to 300 pCi/l, 60 times greater. The policy of the U. S. Government in eliminating fallout from atomic weapons tests was to bring environmental radioactivity down, as close as practicable to natural (background) levels. This suggests that Government agencies other than the AEC should take charge of implementing this policy with respect to peaceful uses of atomic energy."

Do you believe that the permitted level of 300 microcuries per liter in surface water of New York State is

lrw2

a safe level for organisms?

MR. TROSTEN: Mr. Chairman, I object to this question. If Mr. Bogart is referring to the permissible level of radioactivity allowed to be released from the Indian Point 3 facility -- which is what I conceive his question to be -- it is objectionable on the grounds that he is asking a witness for a conclusion which is irrelevant to the issues in this proceeding.

CHAIRMAN JENSCH: Would the reporter read that portion of the question after the long quote?

(Whereupon, the reporter read as follows:

"Do you believe that the permitted level of 300 microcuries per liter in surface water of New York State is a safe level for organisms?")

CHAIRMAN JENSCH: The Board is having difficulty with the "300" computation. We don't know whether it is related to some --

MR. BOGART: Strontium-90.

CHAIRMAN JENSCH: Let me ask Applicant's counsel if he has computed it out.

Is this some figure within Part 20 or outside Part 20? Do you know?

MR. TROSTEN: I am assuming Mr. Bogart was referring to the Part 20 level, Mr. Chairman.

CHAIRMAN JENSCH: Is 300 permitted by the Part 20

lrw3

level? I shouldn't use the word "permitted" but --

MR. TROSTEN: For Strontium-90, it is.

CHAIRMAN JENSCH: 300 is the limit to which releases could be made, is that correct, under Part 20?

MR. TROSTEN: 300 microcuries per liter.

CHAIRMAN JENSCH: The objection is sustained.

Will you proceed?

MR. BOGART: In that event, I will just ask one more question.

BY MR. BOGART:

Q Dr. Beardsley, have you heard of Dr. Teller's opinion about the danger of nuclear reactors?

A Yes.

Q I would like to see if you agree with Dr. Teller. I am quoting from an article authored by Dr. Teller in the "Journal of Petroleum Industry", May 1963, page 506:

"In principle, nuclear reactors are dangerous. They are not dangerous because they may blow up. The explosion of a nuclear reactor is not likely to be as violent as an explosion of a chemical plant. But a powerful nuclear reactor which has functioned for some time has radioactivity stored in it greatly in excess of that released from a powerful nuclear bomb. There is one difference, and this difference makes the nuclear bomb look like a relatively safe

lrw4

instrument. In case of an atmospheric nuclear explosion the radioactivity ascends into the stratosphere. Relatively small amounts are deposited in the immediate neighborhood. The active products will be widely distributed and diluted to a practically harmless level before being returned to the ground.

A gently seeping nuclear reactor can put its radioactive poison under a stable inversion layer and concentrate it onto a few hundred square miles in a truly deadly fashion. This is why we must be exceedingly careful in constructing nuclear reactors. By being careful and also by good luck, we have so far avoided all serious nuclear accidents."

Then he says:

"I do not want to miss the occasion to emphasize one point, to propose one change that should be introduced and that I hope can be introduced. In my mind, nuclear reactors do not belong on the surface of the earth. Nuclear reactors belong underground. They should be provided with sufficient and safe interlocks so that, even in case of an accident, the radioactivity can be confined and will not be widely disseminated. The fact that progress in this direction can be made -- and at not very great

lrw5

expense -- has been demonstrated by the Swedes, who are farther along in this respect than we are."

Do you agree with Dr. Teller's conclusions on nuclear reactors being dangerous in principle?

MR. CONNER: Objection. The witness, by his own statement, indicated he is not qualified to render an expert opinion in this area.

END#9

LRW 10
rms 1

CHAIRMAN JENSCH: Though the question has the possibility of involving determinations based upon nuclear technology which the Board feels is not adequately supported in the background information from this witness, if the question is related to its effect on biology or the environment, then it appears to be a proper foundation.

There appears to be a proper foundation for a question of this kind. But considering the form of this question, the objection is sustained.

MR. BOGART: May I rephrase the question?

CHAIRMAN JENSCH: Yes.

BY MR. BOGART:

Q Dr. Beardsley, do you agree that nuclear reactors pose a severe risk of harm to the environment such as to warrant taking all possible safety measures to prevent any routine discharge or any accidental discharge of waste to the environment?

MR. CONNER: Same objection.

MR. BOGART: I will withdraw the question.

CHAIRMAN JENSCH: Just a minute. Since an objection has been interposed, we will make the ruling. The objection is overruled.

Now, do you still want the question?

MR. BOGART: I was going to suggest we phrase it in a different way, but if this is all right --

CHAIRMAN JENSCH: Will the witness answer the question, please?

MR. SCINTO: May I have the question read back. I am not sure whether I have an objection to the form.

CHAIRMAN JENSCH: Will the reporter read the question.

(Whereupon, the reporter read the record, as requested.)

MR. SCINTO: Mr. Chairman, I have a difficulty in the fact that this is a rephrased question relating to a prior question in which an article attributing to Dr. Teller is quoted. If the question suggests that we are asking the witness whether he agrees with something purportedly attributed to Dr. Teller --

CHAIRMAN JENSCH: The question doesn't relate to that at all.

MR. SCINTO: Then I have no objections.

CHAIRMAN JENSCH: Will you answer, please?

THE WITNESS: Yes.

BY MR. BOGART:

Q Dr. Beardsley, have you in the past testified before any body like this or any other governmental or quasi-governmental body interested in the problems of nuclear reactors?

A Not as a sworn witness.

Q In what capacity did you testify?

A Apparently as an interrogator. Apparently, I guess,

as an interested citizen.

Q What was the expression of your views and what was the occasion on which you so testified?

MR. CONNER: If the Board please, I understood they were foundation questions, so I didn't object. But there is no demonstrated relevance to this gentleman giving his opinion in other places and in unsworn testimony.

CHAIRMAN JENSCH: I think that objection is well taken. I think the question is what are his views now. And although a qualification question ordinarily is given to a witness, what is his training, experience and his experience related not only to the field in which he has studied and in which he has worked, but also whether he has had experience before commissions and so forth in testifying -- qualification testimony. I don't think the views expressed at those hearings are necessarily a part of that qualification. The objection is sustained.

BY MR. BOGART:

Q Dr. Beardsley, from what you know, do you think, speaking as a biologist, that Indian Point 3 can be built without posing an undue risk to the environment?

A This is the sort of question I don't think that in view of the -- may I hear the first part of the question again? I am not quite sure in what context I am asked to answer this.

rms 4

CHAIRMAN JENSCH: Will the reporter please read the question.

(Whereupon, the reporter read the record, as requested.)

THE WITNESS: I can't answer the question, certainly not as an expert witness, no.

As a biologist -- this involves judgments that have nothing to do with my being a biologist. I can't answer this question as a biologist.

MR. BOGART: I have no further questions.

CHAIRMAN JENSCH: Cross examination?

MR. CONNER: If the Board please, I would like to make a formal motion to strike all of Dr. Beardsley's testimony on the ground it was mt demonstrated as qualified opinion testimony and is irrelevant to issues in this proceeding.

CHAIRMAN JENSCH: I wonder if you would explain your objection. What parts do you think are not relevant? Will you give us the specifics of the portions of the testimony to which you find irrelevance?

MR. CONNER: All I need say is that the Commission Regulation in Part 20 would govern discharges that were made, and this gentleman's testimony --

end 10

CHAIRMAN JENSCH: Is your microphone on? I can't hear you too well.

MR. CONNER: It's on, and I will speak louder.

It's very simple. Our objection is that Dr. Beardsley does not agree with the adequacy of the Commission's regulations governing the release of material. To that extent, his opinions are irrelevant to any issue before the Board.

Moreover, he has expressed his opinions in areas in which, by his own statement, go beyond his qualifications as a biologist.

CHAIRMAN JENSCH: The motion to strike is denied. Cross-examination by the applicant?

MR. TROSTEN: We have no cross-examination at this time,but we would like to reserve the opportunity to cross-examine Dr. Beardsley after the luncheon recess, Mr. Chairman.

CHAIRMAN JENSCH: Cross-examination by the Staff?

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CROSS-EXAMINATION

BY MR. CONNER:

Q Dr. Beardsley, are you aware of the Commission Regulation 10 CFR Part 20, Standards for Protection Against Radiation?

A Yes, I am.

Q And you are, of course, aware that under these regulations, certain quantities, certain concentrations of

radioactivity, may be discharged to the environment from operations of sources generating by-products, especially nuclear material?

A Yes, sir.

Q Is it your position that these levels are incorrect, too high?

A It is my position that the establishment of these levels is scientifically unsound.

Q So your objection, the basis of all your testimony, is that you don't agree with the Commission's established standards; is that correct?

A I don't accept the premises upon which those standards were established. I don't accept the scientific evidence upon which those standards were established.

MR. CONNER: No further questions.

CHAIRMAN JENSCH: Cross-examination by the New York State Atomic Energy Council?

MR. SCINTO: No questions.

CHAIRMAN JENSCH: Mary Hays Weik, Intervenor?

(No response.)

CHAIRMAN JENSCH: I hear no response. As I understood her statement yesterday, she would not be here. This is a little in advance of our noon recess. Would this be an appropriate time to recess and reconvene earlier? Would that be convenient? What time would you suggest?

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MR. TROSTEN: Well, I would suggest we could reconvene by one o'clock, Mr. Chairman, or 1:15.

CHAIRMAN JENSCH: At this time let us recess to reconvene in this room at 1:15.

(Whereupon, at 11:40 a.m., the hearing was recessed, to reconvene at 1:15 p.m., this same day.)

end #11

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AFTERNOON SESSION

(1:15 p.m.)

CHAIRMAN JENSCH: Please come to order.

Dr. Beardsley, return to the stand please.

Whereupon,

ROBERT BEARDSLEY

resumed the stand as a witness on behalf of the Citizen's Committee for the Protection of the Environment and, having been previously duly sworn, was examined and testified further as follows:

CHAIRMAN JENSCH: Is the applicant ready to proceed?

MR. TROSTEN: Yes, we are.

CHAIRMAN JENSCH: Will you proceed please?

CROSS EXAMINATION (resumed)

BY MR. TROSTEN:

Q Dr. Beardsley, this morning you expressed an opinion concerning the relationship of temperature changes and radiation effects. Was this opinkn based on experiments that you have performed yourself?

A This morning I didn't state an opinion. I restated biological effects which are well documented, not experiments I performed myself but experiments going back in time to numbrous laboratories, some of which have been repeated in my laboratory.

Q I gather the answer to my question is no.

A Some of the experiments I have done myself.

Q Would you specify which experiments you have performed yourself?

A We have studied the effects of temperature on the expression of a number of mutations in bacteria which affect regularity of genes.

Q Are these experiments that you have just described the basis for your opinion?

A In part, they are the basis for my opinion. However, my opinion is based upon evidence that goes back in reality to the Himalayan rabbit, I suppose, which is one of the first cases of temperature affecting genes.

Q You appear to be referring to temperature effects in terms of gene expression, as I understand your testimony. Are you referring now to the relationship between radiation effects and temperature effecrs?

A In the case of the Himalayan rabbit, who knows whether the mutation was of radiation origin or not. In the case of my own experiments, yes, I am speaking of radiation effects.

Q So, I gather the experiment that you just referred to is not directly related to the interrelationship of radiation effects and thermal effects.

A Which experiment?

Q The Himalayan rabbit.

A This isn't an experiment. It is an observation in nature.

Q Are you aware of the levels of radioactivity that are permitted to be discharged from the Indian Point 3 plant into the Hudson River in accordance with 10 CFR, Part 20 of the Atomic Energy Commission --

CHAIRMAN JENSCH: Did you say 3?

MR. TROSTEN: Levels that would be permitted to be discharged into the Hudson River from the Indian Point 3 facility?

CHAIRMAN JENSCH: As I understand the testimony there has been a calculation of what the applicant expects. I thought your evidence was that this is all technical specifications for the operating license.

MR. TROSTEN: Mr. Chairman, I was merely addressing my question to this witness asking whether he was aware of the levels that would be permitted by the AEC regulations to be discharged into the Hudson River.

I wasn't referring to the levels that were expected to be discharged into the river at this point.

CHAIRMAN JENSCH: I am trying to understand your question. If it is something that has to be determined by the Atomic Energy Commission, can he tell what that would be?

MR. TROSTEN: I am merely asking him is he aware of

the levels that are specified in the Appendix to Part 2, the appendices to 10 CFR, Part 20, theprincipal concentrations of radioactivity that are permitted by 10 CFR, Part 20. That is my question.

CHAIRMAN JENSCH: I understand now.

THE WITNESS: Are you asking whether or not I am aware of these levels or whether I have recorded in my memory cells the specific levels for specific isotopes?

BY MR. TROSTEN:

Q Are you aware in the sense that you know -- you have studied these levels and are aware of what they are?

A Yes.

Q Are you aware of any experiments or tests which demonstrate a relationship between thermal effects and radioactivity at the levels of radioactivity permitted to be discharged by 10 CFR, Part 20, these levels I just referred to?

A Yes.

Q Would you tell me what these experiments or tests are?

A These are experiments dealing with the activation of a prophage in the bacterial system, escherichia coli.

Q Dr. Beardsley, I have no further questions.

MR. TROSTEN: Mr. Chairman, I have no further questions of Dr. Beardsley at this time.

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CHAIRMAN JENSCH: Very well. Cross examination by New York -- I guess we inquired and you have no questions.

MR. SCINTO: No questions.

CHAIRMAN JENSCH: Is there any rebuttal evidence? Examination by the Citizen's Committee? Do you have any further questions?

MR. BOGART: Additional questions other than those I asked this morning?

CHAIRMAN JENSCH: Yes.

MR. BOGART: No.

CHAIRMAN JENSCH: Dr. Pigford.

DR. PIGFORD: Dr. Beardsley, I am trying to determine some way I can cope with your last answer. I need your help on this. I think you are answering a question related to the possible effects of temperature upon organic life. Is that a fair statement of the question?

THE WITNESS: Yes, sir.

DR. PIGFORD: Mr. Trosten, is that a fair statement? I don't want to get off on a tangent.

MR. TROSTEN: My question was: Was this witness aware of any experiments or tests which demonstrated a relationship between thermal effects and radioactivity at the levels of radioactivity permitted by 10 CFR, Part 20.

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DR. PIGFORD: Yes. I guess I will have to pose my own question, then.

We need some way of bringing that around to the issues before us here, Dr. Beardsley. Do you know of any specific effect of this nature -- namely, the effect of temperature upon radioactive intake of some animal species which might be present in the Hudson River which might affect the food chain?

THE WITNESS: I think this is a very difficult -- as you phrase it -- question to approach because we know so little about the complicated eco-system like the Hudson River and exactly what the chain of events might be in the food chain or in the energy flow system.

You have two things going on here. You have molecules, carbon, hydrogen, oxygen, nitrogen, and so forth, which are integrated into a living system which are being re-used over and over again as theygo up through various organisms. Actually the more we understand about something involving so many different organisms as the Hudson River the more we come to the realization there really is no such thing as a direct food chain but rather there are food nets.

The phenomenon -- I answered part of the answer. There are food nets in the sense that energy has to start from someplace. You utilize an organic waste or utilize the energy of sunlight in beginning the flow of energy through

eb2 the biological system or food net and also you have these atoms that are being reshuffled.

These phenomena occur and living things exist because they are formed in the sense there are highly organized blueprints that exist within the cell, in its nucleic acid or genetic structure, if you will, which is passed on from generation to generation.

When we talk about the flow of a radioactive atom or talk about the flow of the effect of a radioactive atom in wuch a complicated eco-system, of course we have to have a great deal more information than we have if you are going to talk about specifics. But one can talk in generalities and say, well, the effect may be on the flow.

You may suddenly eliminate an organism so that organism is gone and whatever was feeding on it can no longer survive. So gradually you evolve a concept that there is no such thing for example as the evolution of a single species. There is evolution only of an eco-system. Even in a very simple eco-system like a balanced aquarium in your home, you eliminate or alter one species and it evolves in some direction and everything else must change in that system, too, and all the other forms involved in the same atom flow systems and energy flow systems.

Now the specific problem that I was referring to is not a classical problem in genetics. As I said we are

eb3 1 dealing with what are called regulator genes. These are genes
2 that don't determine whether an organism is going to have
3 blue eyes but rather where the eyes will be, if I may.
4 Now in my laboratory we are concerned with the
5 problem of cancer studies and we believe that most forms
6 of cancer that we are dealing with are due to virus parti-
7 cles and these viruses that become integrated into the
8 genetic structure of the cell so they are part of the genetic
9 information systems of these cells. Whether these so-called
10 oncogeric or tumor-causing viruses will ever ben expressed in
11 the organism or not depends upon largely unknown factors but one
12 of the factors is certainly radiation.
13 Now we have no direct evidence as yet that when
14 we activate an oncogenic virus by applying radiation to
15 it, or to the cellular system containing it, that this is
16 thermally dependent. The work has been done in another system
17 where you have another kind of virus carried within the
18 genetic information of the cells as the bacterium, also the
19 bacterium may have these virus particles of another kind
20 integrated into their genetic makeup.
21 These can be activated at extremely low levels of
22 radiation, one ionizing event per cell, and the subsequent
23 events after the radiation have been absorbed by the cell
24 are thermally dependent. We have not yet done the experiments
25 to see whether this is also true in terms of activating one

eb4 1 of the tumor causing viruses.

2 DR. PIGFORD: I understand that you are talking
3 about bacteria and viruses in your answer, is that correct?
4 THE WITNESS: Yes.
5 DR. PIGFORD: Do you intend to apply this effect
6 to any extent to any selected organisms that may be indi-
7 genous to this area that might concentrate in radioactive
8 isotopes?
9 THE WITNESS: Of course we are ultimately in my
10 laboratory concerned with an organism indigenous in this
11 area called homo sapiens, or man. But we haven't yet begun
12 the work in our laboratory on the ecology of the river. As
13 a matter of fact we are planning to do that in cooperation with
14 the Department of Sanitary Engineering very soon.
15 DR. PIGFORD: Does it mean leaving out man, that
16 you don't know to what extent this effect would occur for
17 those organisms I mentioned?
18 THE WITNESS: No, because we don't know-- We have
19 not yet classified the number of -- those organisms in the
20 Hudson River eco-system which may have the kind of cancer
21 or kind of tumors we are interested in. It may turn out we
22 have a large population of fish in here that we might be
23 very interested in or even something smaller than a fish.
24 We don't know yet.
2 25

DR. PIGHORN: So we neither know whether there is or isn't a problem, is that correct, from your point of view, with respect to the organisms other than man?

THE WITNESS: I would say that I would have to answer that: Yes, we do know there is a problem but whether you are talking about whether there is a problem affecting the species that exist within the complicated and interconnected econet in the Hudson River or not, no; I don't know.

DR. BUCK: I'm not sure I understand completely some of the answers, Dr. Beardsley. Would you mind perhaps repeating this to the effect I'm trying to find out here, you were talking about the effect of radiation on the organism itself which might in turn be affected by viruses. Am I correct in that?

What I'm getting at here, what is the effect of the virus itself of temperature and radiation?

THE WITNESS: Well, of course, radiation will mutate a virus just as it will mutate any other genetically formed system. I'm not quite sure that the context in which you're asking the question --

DR. BUCK: Well, as I understand you to say that most of your cancer formations, as presently believed, is due to virus.

THE WITNESS: The ones we are working on -- I will limit myself to this -- many people believe this is universally

true, but the ones we are working on we are fairly certain have a virile ecology.

DR. BUCK: What effect does the mutation of the virus have? Will it still continue to cause cancer?

THE WITNESS: No. There are some mutations within the virile genome which render it incapable, apparently, of forming tumors.

DR. BUCK: So one can't then automatically say that all transmutations of this nature are bad?

THE WITNESS: I wouldn't say that in this particular case the one that I know of is especially good because no, it no longer forms tumors. It kills the cells.

DR. BUCK: Well, at least the cells don't multiply in the cancerous fashion.

THE WITNESS: No, but a dead organism doesn't care too much about that.

DR. BUCK: What I'm trying to get at: Are all transmutations necessarily bad or are all changes in the genes necessarily bad?

THE WITNESS: Oh, I see what you mean. In the context that life must go on, it is never the same in any two generations. There is always involvement. You can't go back in time, not evolving in circles.

There are some mutations which are selected in each generation and the types that are selected to carry these

needs are fitter, better capable of surviving.

When you ask the question, does this, are these better or worse, I don't know. It may very well be that the organisms that you selected in the next generation, the constitution of the ecosystem is such that it no longer fulfills the purposes for which you need the ecosystem.

Maybe I can clarify that by saying you may wind up with you have an ecosystem from which you are growing food at the top of the heap. Say gamefish. And now the system evolves and in the sense that evolution is progressive, the mutations that have been selected are good. In the sense that you no longer have the gamefish you wanted, the mutations have been bad.

It's a double-handed question. It's a two-edged sword. It's a difficult thing to wrestle with.

DR. BUCK: That's all.

CHAIRMAN JENSCH: Dr. Beardsley, I think one of the last questions from applicant's counsel was something to the effect of do you know of any tests -- something about the thermal effects and radioactivity are interrelated, and you stated something about down at Oak Ridge -- was that the question, your last question, Mr. Trosten?

MR. TROSTEN: My question asked about any experiments which demonstrated that a relationship between thermal effects and radioactivity, of the levels of radioactivity permitted to

be discharged by AEC regulations.

CHAIRMAN JENSCH: And he answered yes. I was hoping you would tell us what those tests are.

THE WITNESS: I gave a very complicated answer to that. These were experiments with a bacterial system that I named. This is a bacterial system that carries a pro-virus, not an active virus, but a virus integrated into its chromosomes.

Now, this virus can be activated by a single ionizing event, and the expression of this is thermal dependent.

CHAIRMAN JENSCH: What I am trying to do is, as a layman, understand: Is there a test that shows there is an interrelationship between -- let me see if I can state it in my language -- between a thermal effect and the levels or the concentrations of radioactivity?

THE WITNESS: Yes. That is the point I'm making. When you talk about we are going to establish this level of radiation, you have to define -- and you are going to say because it produces this level of damage, and we consider this an acceptable risk, you must now define the system into which you put that, and the temperature at which it is being introduced in the system, and many other factors.

The econets within that system must also be defined. There is no such thing as a standard environment. I'm going

to put so much radioactivity into the environment. What environment? That's all I'm saying.

One of the physical variables that becomes important here, and we are beginning now finally to appreciate this, is temperature. And I am also adding this morning that it was kind of stupid to wait this long to appreciate this, because we have known such things as the expression -- effect of temperature on expression of such genes as that of the Himalayan rabbit. We have known this for years.

CHAIRMAN JENSCH: I think there has been some concern expressed by some of the limited participants here, and I think it has been touched upon in the direct testimony, that there is a possibility of reconcentration of radioactive substances in fish products, mollusks, or some such. Are they likely to be affected in the Hudson River? Do you know?

THE WITNESS: That's the other part. That's why I said there is no such thing as introducing a contaminant into the environment. You must say what environment. You have to know something about the ecosystem into which you are introducing it.

This is really what I had in mind in making that statement. Because there are a large number of organisms that concentrate radioisotopes and then this concentrated -- this organism may in turn be food for something else, or a series of other elses, and the concentrated radioisotope is

passed along. You get this reconcentration. You may also get elimination in the system. You don't know that much about the bottom and so forth of the Hudson River.

What I said this morning is I object to this whole business of maximum permissible standards, because I object on the philosophical basis of it, and the scientific basis of it. I just stated why I object to it scientifically, in part. Because we don't really know what will happen, because nobody can define the ecosystems of the Hudson River. Nobody knows in terms of the ebb and flow of the tide how long these things will stay in the Hudson River Valley, where they will wind up, what organisms and so on. We don't know.

CHAIRMAN JENSCH: That is what bothers me then. Why is there any concern?

THE WITNESS: The concern exists because we don't know. Too often in the past we have taken the attitude, well -- I'm not trying to be vulgar now -- we reach the point in ecology -- ecologists, generally speaking -- ecologists specifically, and biologists in general haven't been adequately consulted in this whole matter.

We've reached the point that now we understand the solution of many of these problems requires the concerted efforts of experts in many different areas, and we suddenly realize when everything has been polluted, air polluted, and so forth, that there is no such thing as a little bit of

pollution, just as there is no such thing as a little bit of pregnancy.

There are problems associated with this, and behind it you always have to ask the question -- you're taking a risk. The risk is not defined. We may not know for fifty years what the risk is. How can we ask people to take a risk for a gain -- we may be able to define the gain to them, possibly, but how do you ask them to take a risk when you don't know what it is, but you know there is a risk there?

Here, so far as radiation is concerned, there is with at least genetic effects and probably morphogenic effects, no such thing as a dose below which deleterious effects don't occur.

CHAIRMAN JENSCH: Are you saying then on the basis of these smaller experiments you feel that there may arise a risk to the higher levels of organisms, like man?

THE WITNESS: Yes.

DR. BUCK: May I state a point that bothers me? I heard this same statement before, that the best type of radiation is none at all, but what bothers me is that man has survived and developed and so on under a fairly high level of radiation, natural radiation, including that from the sun and including that from natural radioactive materials.

Now, if the level of radiation which man has developed under has not harmed his progress, I can't see that one can say

definitely that a zero radiation would be the best thing for man.

THE WITNESS: Well, there is no such thing as zero radiation possible.

DR. BUCK: What I'm getting at is that the statement made essentially by you now is that as long as there is any radiation, there are deleterious effects. Therefore, one should aim towards zero radiation, which you obviously can't have. And my point is, I think you're extrapolating here -- there are no zero levels, let's put it that way.

THE WITNESS: I couldn't disagree more, in a way. First of all, I think what I have stated is accepted philosophically by the Atomic Energy Commission, Federal Radiation Council, that no exposure to radiation should be permitted -- in fact, I'll use their words -- excuse me.

"Federal Radiation Council Report -- No exposure to radiation should be permitted unless it satisfies two criteria."

No exposure to radiation.

"One. The various benefits to be expected as a result of the exposure as evaluated by the appropriate responsible group must outweigh the potential hazard or risk. Two, the reasons for accepting or permitting a particular level of exposure to a lower level. . ."

I'm just saying including zero --

". . . must outweigh the decrease in risk to be expected from reducing the exposure."

DR. BUCK: Did they say, "including zero?"

THE WITNESS: I added that.

DR. BUCK: Thank you.

THE WITNESS: Particular levels of exposure.

DR. BUCK: That was your addition?

THE WITNESS: That was my addition.

end #

DR. BEARDSLEY: One other point, if I may, in answer to your question.

You said man has done very well. Eco-systems have evolved and background radiation -- this is an issue that unfortunately is widely misunderstood. This is true if I take a given eco-system, let's say an eco-system in a well containing a relatively large amount of radioactive materialsfrom natural sources, and an eco-system is evolved there over, say, a pond out in the middle of nowhere which has natural radioactivity compared to this area, let's say, but evolution has taken place there. We now have a stable system. We have our balanced aquarium, if you will, consisting of the organisms in that area.

What we are talking about is the introduction of radiation raising the level in a given environment. Anything you introduce into a balanced stable natural environment will upset it. That is all.

DR. BUCK: Again, it somewhat depends on the rate of introduction of this, doesn't it? If the introduction of the excess radioactivity or any other change --

THE WITNESS: I don't believe so.

DR. BUCK: -- is slow enough, do you not develop a balanced system?

THE WITNESS: It depends on whether it is decaying faster than you are putting it in. In a system like the one

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we talk about, the Hudson River, for example, you have no evidence it is not the total radioactivity that is accumulating that is the major factor.

For example, you have the radioactivity not only from the sources that you are specifically concerned with here but other sources further up along the Hudson River. We also have the Strontium 90 there already. The Cesium from fallout. The Hudson River collected a great deal of material in this run-off from the bomb tests. So, it isn't the rate at which you are introducing it. It is the total accumulated radiation in that area.

DR. BUCK: This is still the rate at which you introduce it into the area.

THE WITNESS: I don't think so.

DR. BUCK: From various means.

THE WITNESS: No, I think it is the total that accumulates there.

DR. BUCK: In a little more time. The total that hit the earth over the time it has been there, you can't take that. You have to take the rate of radiation.

THE WITNESS: Well, if you talk about cosmic radiation, I will grant you that a given level is the rate at which cosmic radiation is arriving because this is arriving as discrete radiation. We are talking about the accumulation of radiation sources. If you want to say it is the rate of

rms 3

emission from these sources, yes, I agree with you. But what we are introducing into the environment is not radiation. We are introducing sources of radiation, millions of little ray machines, if you will.

DR. BUCK: I think we are talking about exctly the same thing, because to introduce a source introduces what I consider to be an increasing amount of discrete radiation, and I think the rate of addition has a great deal of effect.

CHAIRMAN JENSCH: I don't know whether the last statement was intended as a question, but do you agree or disagree?

THE WITNESS: No.

CHAIRMAN JENSCH: You disagree?

THE WITNESS: Depends on how you look at it. Rate is important if you talk about the next two years. If you talk about expecting the Hudson River and its eco-system to stay around for a while, rate is not as important as the -- rate of introduction isn't as important as the rate of decay. It is the total amount that accumulatrs that is important. Rate becomes important because you have decay and introduction. Some place along the line these should get balanced, I suppose.

DR. PIGFORD: Dr. Beardsley, are you familiar with the background experiments which led to the recommendations by the Federal Radiation Council which now appear as maximum

permissible concentrations of radioactivity?

THE WITNESS: Yes. You mean am I familiar with the mathematics that were employed and the raw data that were used to derive some of these, is that what you mean?

DR. PIGFORD: Yes.

THE WITNESS: Yes.

DR. PIGFORD: I wasn't so much interested in the mathematics.

Now, have there been experiments of the sort you are describing here today in the same range of radiation levels as those experiments which you just mentioned now? I am talking about two sets. Do you know which two sets I am talking about?

THE WITNESS: Yes.

DR. PIGFORD: All right.

THE WITNESS: Am I familiar with new data that would contradict the initial data, is that what you mean?

DR. PIGFORD: No, sir. You have described today some certain thermal effects which have some bearing apparently upon the radioactivity effect upon certain organisms.

Now, my question is: Are those experiments carried out in similar ranges of radiation levels as the background experiments -- those experiments which are background for the present radiation standards?

THE WITNESS: Yes.

DR. PIGFORD: I would like to ask you: One of the issues before this Board, and something this Board will have to make a decision on, a very hard one, is something that sounds like undue risk with respect to health and safety to the public.

From the point of view of a biologist, or in the area that you qualified yourself, what would you consider to be the definition of what constitutes an undue risk for this facility?

THE WITNESS: I really don't think this is a question I can answer as a biologist because it involves moral conclusions that I make as a private citizen, really. I have wrestled with this problem for a long time. That is why I wrote the initial article, because somewhere along the line I got disturbed about the fallability of science. I realized that I really wasn't struggling with the scientific problem. I was struggling with the moral problem. It is sort of like what would I consider a suitable risk -- It depends on what I hope to gain.

There are conditions, for example, under which I, probably all of us here, would be willing to surrender our lives because the principle involved and what I hope to gain is worth it. There are other situations that are areas of shadow, where I don't really know what I am supposed to gain, and I really don't know what the alternatives are.

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And I don't know what the risk is. And my attitude -- maybe this is as a biologist -- I just feel there are too many areas of shadow and too much that is ill-defined in this whole issue for me to believe that the risks involved are worthy of the chance.

Now, as I said, this is a conclusion of a private citizen. As a biologist my only statement is that biologically speaking, the scientific evidence on which the maximum permissible standards were based are, in my opinion, in need of review.

And I challenge in many ways, for the reasons I just stated, the philosophical basis of these. I can't, as a biologist, say how much risk we should take. I really don't know. I am merely saying there is a risk, and that risk disappears only at zero exposure.

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DR. PIGFORD: I would like to relate this again to our specific problem. Have you read this application?

THE WITNESS: As I stated in the beginning, very, very hurriedly. I received it last night and --

DR. PIGFORD: Are there any specific parts of it that you would take issue with from the point of view of the biologist?

THE WITNESS: With this application, no. I will restate my position.

I suppose, as was pointed out by Consolidated Edison and by the staff members of the AEC this morning, what I'm taking issue with I guess is the idea of taking a standard and saying that this standard of release to the environment can apply in all situations including this one of the Hudson River Valley.

Also, as a citizen now, not as a biologist, I think we are getting a little bit uncomfortable as with an experiment that hasn't been tried before but that is --

CHAIRMAN JENSCH: Dr. Beardsley, I was interested in what I thought we were going to get as an answer this morning -- one of the questions propounded had to do with the effect on the environment, if I can find it in the transcript.

I think the way the question was originally framed, it assumed that there would be the release of 16 million

eb2 1 curies. That premise, the Board indicated, hadn't been
2 established. I think it is quite generally recognized in
3 this evidence that the 16 million curies in here from Indian
4 Point 1 is an allowable release but while Consolidated Edison
5 doesn't expect to reach it, assuming that it did happen,
6 however, and I think that is a hypothetical because of that
7 assumption, that assuming 17 millionths of gaseous release
8 were made during the course of the year, what would be the
9 effect on the environment of Indian Point facilities, bearing
10 in mind Peekskill and these other towns around here? Now I
11 wonder if you would consider the environmental aspect of it?
12 THE WITNESS: After this morning I thought about
13 that also a little bit more and I am wondering if there is
14 anyone with the Atomic Energy Commission who would care to comment
15 and answer a question of mine relative to this. Namely, do
16 you know to what extent these radioactive noble gases might
17 be soluble in the hydrocarbons that are emitted also from
18 the same stack?
19 CHAIRMAN JENSCH: Well, we won't interrupt to get
20 an answer to that but can you consider from the possibility
21 that they would be soluble or not soluble and then we will
22 see;maybe that phase of the assumption can be established
23 later. If you just consider whatever would be the form of the
24 16 million curies, assuming the unlikely unexpected event
25 that it would be released on a massive basis -- would you

eb3

have different effects on the environment if you had different forms of radioactivity in those curies?

THE WITNESS: This is a puzzling thing. It just occurred to me. It is a very interesting research problem, I think.

These noble gases, if they were taken into particulates, into oils and hydrocarbons, might very well find themselves into respiratory chains as stable components, as they get trapped there, whereas normally they might not. They would perhaps enter into the equilibrium in terms of their solubility and body fluids in the blood, whereas if trapped in the hydrocarbon they might very well remain there. This was a question that occurred to me as we were talking this morning.

More directly there are other factors, -- as I said it was a very cursory review -- that bothered me, because we seem to discount the whole business of thermal effects on the environment but they are considerations here, it seems to me, because the amount of radioactivity that is going to accumulate at breathing level, not only of man but other organisms here, it seems to me would be determined by the cloud cover and vapor cover and this in turn would be determined by the temperature of the river and how much water is evaporating and in just thinking about all these considerations, I gave up.

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CHAIRMAN JENSCH: Let me see if I can relate some of your answers to the question I have.

As I understand it, from the small -- for the experiments with small forms of organisms, that there is some interrelationship between temperature and radioactivity. Are you suggesting that if there is a release of radioactivity on a hot day there would be more of an intake into the human organism?

THE WITNESS: Oh, intake in a terrestrial organism as opposed to aquatic. I don't know. If the organism does not have -- doesn't have a homeostatic mechanism, doesn't maintain a constant body temperature like man, I would presume so. Any radiation effect would be increased, would be temperature dependent in such organisms.

CHAIRMAN JENSCH: Let me go back to this other thought you expressed, that if this radioactivity is attached to a particulate -- There has been some mention here there might be some krypton in a gaseous release. Do you know what the effect would be if a krypton bit of radioactivity attached to a particulate, what would be the effect environmentally?

THE WITNESS: Well, like any nuclide, there is a radioactive nuclide which will decay -- emit radiation. The atomic nucleous is unstable. It will emit radiation at a definitely established physical rate, which by the way is temperature independent, the rate of emission of the radio-

eb5 1 activity.

To tell you the truth, I'm not quite sure I have a handle on what it is you want. All I was saying before was that if this radioactive nuclide which will decay and emit radiation is integrated into something which itself becomes integrated into a biological system, as a stable component of that system, this would be very different than having this particular radioactive nuclide depend solely on its effects for solubility in water or body fluids or something like that.

Have I made that clear?

CHAIRMAN JENSCH: Yes, I believe you have. Let me go back to one other thing.

I think you in one answer indicated that the effect of a gaseous release in so far as temperature is concerned might be a little different because man has a stable temperature level or some such. Are you suggesting that a different organism might have a different temperature level-- Suppose you had beef cattle and they breathe some of these nuclides which emit radiation. Would there be a reconcentration-- Do they have a temperature level so they get into this food net or change or whatever it would be?

Suppose the krypton which I understand had a fairly long life, would that carry on and be reconcentrated and so forth?

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THE WITNESS: Well, birds and mammals, including cattle, are homeothermic. They maintain a relatively constant body temperature. Thermal effects, that is, the augmentation of radiation effects due to temperature would not apply in these specific organisms.

Now, going back to your other question, let's say I have a pile of 100 atoms and they are going to undergo decay at a certain rate -- this is very arbitrary, a perfectly random process -- one atom will disappear every ten minutes or every day. Whether these will do -- for example, cause lung cancer in your cow or not cause lung cancer in the specific organism will depend on how long it stays around in that cow, obviously. Soluable in something that is trapped there, as DDT is soluble in membranes so it accumulates in biological systems. This would be different than the effect of the radiation if it passed right back out of the system.

The ability of a cow to concentrate the specific one you are picking on, krypton, as far as I know, it doesn't-- You could pass it on in milk -- I would consider this as a very dangerous statement for me to make to flatly deny it but I would consider it unlikely.

CHAIRMAN JENSCH: Is there any other likely nuclide that would be say in the food chain, would it get embedded in the muscle which might be given in the food chain and that sort of thing? You know what I mean.

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THE WITNESS: Yes, there are nuclides for example that would tend to concentrate in-- Some of the nuclides will tend to become integrated in parts of certain molecules. I am thinking specifically of some of the things that are being discovered now that might become integrated in a lipid--

CHAIRMAN JENSCH: Could you repeat the last few words? Something about treating them --

THE WITNESS: If tritium became integrated into an organic molecule which in turn became integrated into the membrane system or the lipid systems of the cell, this might be persistent in that form, although there is a great deal of mobility here too in the exchange. It is hard to speak in generalities.

CHAIRMAN JENSCH: I don't believe the Board has any more questions. Does the applicant have any more questions?

MR. TROSTEN: No further questions.

CHAIRMAN JENSCH: Staff?

MR. CONNER: We have no questions. The State of New York apparently has.

CHAIRMAN JENSCH: I will get to them. You have no further questions?

MR. CONNER: No.

CHAIRMAN JENSCH: New York State Council?

MR. SCINTO: Cross examination.

BY MR. SCINTO:

Q During the course of your discussion I believe you quoted a statement from the Federal Radiation Council. Is that statement selected from paragraph 1.11 of the Federal Radiation Council report number 2, dated September, 1961?

A It was taken from page 2.

Q Page 2.

A Was it page 2? Wait a minute. There is a typographical error or something here. If you give me the specific reference again -- I have to work backwards, because --

Q I was asking if it came from Paragraph 1.11, which happens to be on page 2 of the Federal Radiation Council's report number two entitled background material for the development of radiation protection standards, September, 1961.

A It is the staff report 1961, page 2, but I don't have closer documentation on it. I wasn't quoting directly from it. It was an article. The paragraph I don't have.

MR. SCINTO: Mr. Chairman, I have here a reprint of report number 2 which is set forth in the hearings before the Subcommittee on Research, Development and Radiation and the Joint Committee on Health Energy in the Congress of the United States, 87th Congress, Second Session, on radiation standards, including fallout. '62, part 2, appendix.

May I submit this copy to the witness as an accurate copy of the Federal Radiation Council report number two?

CHAIRMAN JENSCH: Watever would be the purpose, submit it to the witness and then propound your next question.

MR. SCINTO: I have just received a more accurate copy of the report itself.

CHAIRMAN JENSCH: A more accurate copy?

MR. SCINTO: I have a copy of the Federal Radiation Council rather than a reprint. That is what I mean.

CHAIRMAN JENSCH: That might be worthwhile too. While he is looking at it, can you tell us what is it-- is it your thought that the reading was not correct or are there some parts you would like to point out? We would be glad to have it if you would read that portion from the report.

MR. SCINTO: That would be just as easy. I thought

the next immediately following two paragraphs are particularly pertinent to the specific portions quoted.

CHAIRMAN JENSCH: Do you want to read it in?

MR. SCINTO: I would like to read those two portions in. I myself don't wish to be accused of selective reading of FRC guidelines.

CHAIRMAN JENSCH: You will be the first one to have an opportunity to see if it is out of context.

MR. SCINTO: Dr. Beardsley, is the portion I point to -- in the immediately following paragraphs --

THE WITNESS: 1.12.

MR. SCINTO: May I read them?

CHAIRMAN JENSCH: Yes, please do.

MR. SCINTO: In view of the considerations discussed above, ideally an individual radiation protection guide should be developed for each activity or set of circumstances involving exposure to radiation.

Recognizing the impracticability of establishing an individual guide for each application, the Council in its report number one pointed out the need for a compromise between this ideal and the application of a single guide to widely differing sets of conditions.

The following is taken from the Council's recommendation to the President. "There can be no single permissible or acceptable level of exposure without regard to the reasons

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for permitting the exposure, etc.

It is basic that exposure to radiation should result from a real determination of necessity, etc. There can be different radiation protection guides with different numerical values depending on the circumstances. The guides recommended herein are appropriate for normal peacetime operations.

1.13 goes on to say, "On the basis of extensive consultations the Council recommended to the President a set of radiation protection guides which represent a generalized balance between considerations discussed above. Despite wide differences in the assignment of relative values to the various factors involved, the Council believes the overall benefits from useful activities involving exposure to radiation at levels within those specified in these guides will outweigh the risks associated with such exposures.

There is also sufficient experience in limiting radiation exposures to levels similar to these to demonstrate the general feasibility with few exceptions of operating at or below the levels specified in these guides for normal peacetime operations?

CHAIRMAN JENSCH: Was a part of that reading that the recommended levels were all right for peacetime? Was that part of what you read?

MR. SCINTO: Yes.

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CHAIRMAN JENSCH: Are we in peacetime or is there a war going on now --

MR. SCINTO: I don't know whether we are in peacetime within the framework of the Federal Radiation Council. I thought we were.

CHAIRMAN JENSCH: Do you have anything further?

MR. SCINTO: No. I just wanted to see if that was an accurate reading.

THE WITNESS: Well, I am grateful for your pointing out what did follow, because I was merely stating before the philosophy of radiation control and the criteria upon which it was based which I took from, it turns out, paragraph 1.11. What follows in 1.12 and 13 and 14 are specific considerations.

And now I would like to ask a question. The specific levels that were picked by the Federal Radiation Council in setting up these specific radiation protection guides for normal peacetime operation were based on what previously existing evidence -- I think this now should be introduced into the meeting. And now I go back to something I was hesitant to say at that point -- a Conference held in Paris in 1957, which preceded this -- this is the impact of science on society, volume 8, 1957, page 209.

I suggest also a statement of the Atomic Industrial Forum Incorporated in congressional hearings -- footnote,

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page 289-291, these are the hearings before the Joint Committee in 1959 -- at a conference held in Paris in 1957 -- this was the conference where documentation was provided -- it was pointed out standards established for the protection of the public are based upon radiation standards in industry and that the establishment of these standards is "not basically a scientific problem but more a matter of philosophy, morality and sheer wisdom."

Yet after analyzing the impact of limiting industrial exposure to a dose of five rems per year per worker, the cost of plant operation, this could seriously retard the atomic industry and be very costly. The dollars and cents approach to establishment of radiation protection standards may prove to be less economical than previously anticipated in view of the increasing number of cash settlements in radiation damage and injury cases.

In 1958 the American Public Health Association issued a handbook where the following points were made: The American Public Health Association document is "Public Exposure to Ionizing Radiation," published in New York by the American Public Health Association in 1958.

One, the present degree of danger from current sources of radiation can't be evaluated accurately. Two, many effects of radiation tend to be cumulative and irreversible. Three, unnecessary exposure to radiation should

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be prevented.

In 1958 the Surgeon General appointed a National Advisory Committee on Radiation under the Chairmanship of Russel Morgan. The report was released to the public in March, 1959, report to the Surgeon General, footnote 144, page 2562, states among other things: "Primary responsibility for the nation's protection from radiation hazards should be established in a signel agency of the federal government. The Committee believes that this agency should logically be the U.S. Public Health Service, Department of Health, Education and Welfare. And it urges immediate legislation to achieve this objective."

CHAIRMAN JENSCH: Have you concluded?

MR. SCINTO: Yes, sir.

CHAIRMAN JENSCH: Did you have any rebuttal questions?

MR. BOGART: Mr. Chairman, before Dr. Beardsley steps down I believe Mr. Scinto owes me an answer for a question yesterday that he was going to look up and let us know this morning.

CHAIRMAN JENSCH: What is the question?

MR. BOGART: Whether the state monitoring network in the Indian Point neighborhood includes a monitoring station for gross beta activity in wells in the surrounding area.

CHAIRMAN JENSCH: Have you ascertained that situation?

MR. SCINTO: Yes. The state monitoring network does not take samples of gross beta of well water on a routine basis.

MR. BOGART: I might note I think this is a very important omission. A great deal depends upon the integrity of the monitoring system because obviously neither the Atomic Energy Commission nor the applicant really have done a thorough job of monitoring,and intervenor Weik has questioned the integrity of the Department of Health and the figures for the Ossining-Peekskill neighborhood. I would like to read into the record a report on the Health Physics Society Symposium, January 24-26, 1968, in Augusta, Georgia, entitled, "Symposium on Environmental Surveillance in the Vicinity of Nuclear Facilities."

I am reading from page 3 of this report, "Dr. G. Hoyt Whipple of the University of Michigan, and advisor to the U.S. Departments of State and Defense, question the testing itself. His survey on testing techniques used by nuclear plants which had been operating more than two years showed great variations in methods and scope.

Though the basic procedure of first making a survey for background radiation before operation and following with another after operation started was uniform, "collection points and sampling periods range enormously." Though most did some gross gamma count, few reported on

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tritium, and many did not report "outside the fence" of the plant grounds.

In answer to Professor Eisenbud's suggestion, his answer was, "No. We do not know enough about the environment yet to be certain of all the ways these products reach man."

CHAIRMAN JENSCH: Have you concluded?

MR. BOGART: I have.

CHAIRMAN JENSCH: Do you have any further questions of the witness?

MR. TROSTEN: No.

CHAIRMAN JENSCH: Thank you, Dr. Beardsley. You are excused.

(Witness excused.)

CHAIRMAN JENSCH: Have you concluded the presentation of evidence on behalf of the Citizen's Committee for the Protection of the Environment?

MR. BOGART: Yes.

CHAIRMAN JENSCH: Very well. We are back to considerations we initiated this morning?

MR. TROSTEN: Yes.

MR. BOGART: Will there be an opportunity for a closing statement?

CHAIRMAN JENSCH: Yes. We generally receive that by way of a brief, but if there is a request, it can be done

orally. Perhaps we could do it at the conclusion of the evidence.

MR. BOGART: At the conclusion of this week's --

CHAIRMAN JENSCH: At the conclusion of this proceeding, whenever that occurs.

MR. BOGART: At the very end. Not today but some other time.

CHAIRMAN JENSCH: It doesn't look like it today.

At this time let us recess to reconvene in this room at 2:35 p.m.

(Recess.)

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CHAIRMAN JENSCH: Please come to order.

Citizens Committee, did you have a statement?

MR. BOGART: Mr. Chairman, for the balance of the afternoon session, the Citizens Committee will be represented by a member from Montrose, Miss Florence Ellinghaus.

CHAIRMAN JENSCH: Dr. Buck had some further questions

MR. TROSTEN: I wonder if I might request the indulgence of the Board to deviate from the established order for a moment in order to present one piece of rebuttal evidence that applicant had intended to put forth.

In view of the testimony that the Board has heard this morning and then earlier this afternoon, I thought it would be useful to take up this matter now, and we would like to present testimony by Dr. McDonald Wrenn.

CHAIRMAN JENSCH: Very well. Will he come forward and sit in the stand, please? I believe Dr. Wrenn has previously been sworn.

MR. TROSTEN: Yes. Dr. Wrenn's qualifications are in the record. However, for the benefit of the public who may be present I thought it might be useful if Dr. Wrenn could restate his qualifications.

CHAIRMAN JENSCH: If you would go through and give his name and address for the record, perhaps.

MR. TROSTEN: Yes, sir.

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Whereupon,

DR. M. E. WRENN

was recalled as a witness on behalf of the applicant, and having been previously duly sworn, was examined and testified further as follows:

REDIRECT EXAMINATION

BY MR. TROSTEN:

XXX Q Dr. Wrenn, would you give your address and professional affiliations?

A My name is McDonald E. Wrenn. My address if Warwickbrook Road, Tuxedo, New York. I am an environmental health consultant to the Con Edison Company.

Q Would you please state your educational experience and your professional background and training?

A Yes. I graduated from Princeton University in 1958. I received a Master's Degree in Radiological Health from New York University in 1962, and a PHD in a joint program in nuclear engineering and environmental medicine from New York University in 1967.

I was an officer in the U. S. Navy from 1958 to 1961 and during that period of time was engaged in the supervision and training and the practical aspects of evaluation in handling radiation emergencies.

I am presently employed by the New York University Medical Center's Institute of Environmental Medicine, where I

am the assistant director of the Laboratory for Environmental Studies and the acting director of our Radiological Health Training Program.

In these capacities, I am involved in research and evaluation of ionizing and non-ionizing radiation and other environmental concerns such as stable pollutants.

I am assistant professor in the medical school. I teach graduate courses in the radiation protection field as well as administer the graduate radiological health training program.

I am presently President of the Greater New York Chapter of the Health Physics Society, member of the American Industrial Hygiene Association, and the American Public Health Association.

I have written a number of articles for scientific journals, reports, and am certified by the American Board of Health Physics.

Q Dr. Wrenn, in their testimony, Dr. Cole and Dr. Beardsley suggested the possibility of a relationship between the effects of radioactivity, and an increase in the temperature of the environment due to operation of a plant such as Indian Point #3.

In your opinion, does increased temperature increase the effect of radioactivity on living organisms?

A At the levels of radiation that we are considering

here, one would expect no deleterious effect from the radiation itself, or from the interaction of the radiation and temperature.

CHAIRMAN JENSCH: I wonder if I may interrupt so I will be clear in understanding the question. What are the levels? Will you put them in figures?

THE WITNESS: I could elaborate on that. The radiation levels I'm talking about are at or below normal environmental levels.

CHAIRMAN JENSCH: Can you put a figure on that?

THE WITNESS: Yes. The normal background runs on the order of 100 millirads per year, and I'm talking about radiation dose rates in this range.

DR. PIGFORD: Excuse me, Dr. Wrenn. I don't want to interrupt any train of thought, but I thought Mr. Trosten asked you if the temperature affected the radiation effects on the organisms. I think you said it has no deleterious effects. Does it have any other effects?

THE WITNESS: Could I perhaps give my full answer first and then we could come back to other effects, after I talk about one?

DR. PIGFORD: Yes. If you could just remember this and explain to me as you go along or someplace, what you mean by deleterious or non-deleterious, so we will be able to cope with this.

THE WITNESS: I think that perhaps my amplification on this, which will describe some of the biological work in the literature, will put this in the proper context.

DR. PIGFORD: All right. Please continue.

BY MR. TROSTEN:

Q Continue, please.

A The experimental work on radiation effects historically and presently is done by radiating test biota with relatively large doses compared to natural background.

One organism mentioned by Dr. Cole is drosophila, the fruit fly. Dr. Cole indicated that the effects of irradiating at a higher temperature would be to increase the radiation effects seen in drosophila, fruit fly.

end #7

A The original report by Muller in 1930 indicated that in fact the radiation effects were in the opposite direction, namely, that when drosophila were irradiated at the same doses at lower temperatures, that radiation effects were increased. Here he was talking about the mutation rate with respect to the spermatozoa. He probably put it a little better than I have.

He wrote a summary of this in the early '50's -- He wrote a very excellent summary of all of his remarkable work -- in which he said, "Thus there can no longer be any doubt about the enhancing effect of cold on the induction of both chromosome changes and point mutations in drosophila spermatazoa.

This relationship is, as one might expect, based upon the tremendous amount of research that has gone into the field of radiation biology. Oneof the results of these large numbers of researchers are -- it's a relatively general result -- that radiobiological effects are dependent upon the amount of oxygen present. The higher the oxygen content of the tissue at iiradiation, the greater the effect for a given dose.

Now the capacity of body tissues, or water for that matter, to hold oxygen is greater at lower temperatures than at high. And particularly, with those organisms that are not thermally regulated, namely which come into temperature

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equilibrium with their surroundings, one would expect to find higher oxygen concentrations at lower temperatures than at high.

In addition, at lower temperatures, the rate of removal of oxygen from the tissues by normal metabolic processes is far slower. Accordingly, at lower temperatures, there is less oxygen present and one would expect to see less effect and hence the results that Muller summarized.

These results have been represented in drosophila by at least a half dozen other investigators. In any event, since the doses at which these investigations are carried out are considerably higher than those expected from low level releases, the demonstration of any radiological effect -- and I will use deleterious radiological effect here with respect to drosophila being mutations -- is that these don't show up in the experiments at low doses.

So, accordingly, I think that one can confidently say that no deleterious effects are expected at these levels.

BY MR. TROSTEN:

Q At one point in your testimony I believe you made the statement the colder the organism, the lower the oxygen. I believe you meant the reverse. Isn't that right?

A If I said the colder the lower, I did mean the reverse. I was probably thinking a sentence ahead.

CHAIRMAN JENSCH: Will you restate it then the way

eb3

you would like to have it?

THE WITNESS: Well, the lower the temperature of the organism, the greater the capacity to hold oxygen.

BY MR. TROSTEN:

Q Dr. Wrenn, in your opinion is it necessary to perform additional research concerning the relationship between radiation effects and increased temperature in order to determine whether present standards for discharge of radioactivity from Indian Point 3 as expressed in 10 CFR Part 20 are adequate?

A No, I don't.

MR. TORSTEN: That concludes my questions of Dr. Wrenn.

CHAIRMAN JENSCH: Cross-examination by the staff?

MR. CONNER: No, sir, but to be consistent we believe that a formal motion to strike should be made because we believe that this all relates to matters not properly withing the purview of the Board in this proceeding.

CHAIRMAN JENSCH: The motion is denied. The Board feels that these environmental considerations are pertinent and whether it is related to these standards or not, I think the testimony of the witnesses we just heard is important in the consideration of determining the safety aspect.

Cross-examination by the New York State Atomic Energy Council?

MR. SCINTO: No questions, Mr. Chairman.

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CHAIRMAN JENSCH: Citizens Committee for the Protection of the Environment.

MISS ELLINGHAUS: No question.

CHAIRMAN JENSCH: Mary Hays Weik is not here.

DR. PIGFORD: I would like to ask some questions, Dr. Wrenn, but I don't really know how to ask them right now. But there is one question you might be able to answer.

It sounds as if you are speaking in testimony given by Dr. Cole, is there any specific statement made by the most recent witness, Dr. Beardsley, on this thermal effect as affecting radiation on organisms that you take exception with?

THE WITNESS: Well, if my memory is correct, I can't give you the specific word-for-word statement. Dr. Beardsley also indicated that an increased temperature would show an increased radiation effect at high doses. I believe this is the opposite direction in which the evidence in the literature indicates that the experimental results is important.

MR. TROSTEN: The page of the transcript on which Dr. Beardsley's testimony of this morning appears is 1390.

CHAIRMAN JENSCH: Is Dr. Beardsley here? I want to be sure we don't have a transcript correction situation. He is not here? Well, I think both of these gentlemen who testified, both Dr. Beardsley and Dr. Wrenn, would want to be sure the transcript correctly reflects their testimony on these several matters.

eb5 When one witness says the experiments and literature are in direct contradiction of the assertion, I first wonder whether there is a correct hearing of it and not that the transcription may not be correct but we have had some acoustical problems here today with outside motors and that sort of thing and I would like to have it--

I call attention to the Citizens' Committee that Dr. Beardsley's testimony be brought to his attention because I'm sure Dr. Wrenn has reviewed the matter and he wants it likewise to be as the literature and the experiments show.

Have you concluded?

bl fls DR. PIGFORD: Yes.

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CHAIRMAN JENSCH: Dr. Wrenn, I don't think I quite understood the last question propounded to you by applicant's counsel. Is it necessary that there be additional R&D to determine the effects of temperature and radioactivity?

MR. TROSTEN: Not research and development, but additional research or additional studies.

CHAIRMAN JENSCH: You don't need to have any additional studies -- would you re-read your question again?

MR. TROSTEN: My precise question was this:

In your opinion, is it necessary to perform additional research concerning the relationship between radiation effects and the increased temperature in order to determine whether present standards for discharge of radioactivity from Indian Point #3 as expressed in 10 CFR Part 20 are adequate?

CHAIRMAN JENSCH: His answer was "no."

MR. TROSTEN: That is correct.

CHAIRMAN JENSCH: Let me ask Dr. Wrenn, because there have been so many references to this situation, about the 16 million curies from Indian Point #1, the operation of which may have some effect on Indian Point #3.

As I understand the question propounded by applicant's counsel, was the level permitted by 10 CFR, 16 million curies, within that range? Are you satisfied that the release of 16 million curies on an annual basis, as proposed for Indian Point #1 will not have effects that require further study or research?

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DR. WRENN: I think there would be no adverse biological effects resulting from a release of this type on an annual basis.

I take it your question is addressed to the biology?

CHAIRMAN JENSCH: Yes. The environmental effects particularly would affect the biological specimens.

Do you have anything further you want to add?

DR. WRENN: No.

DR. PIGFORD: I don't know if you are making a reservation on just biology, Dr. Wrenn. Are there some other areas? Because I know, when you described your technical background, it was very, very broad, including nuclear engineering. Are there some other areas which this permitted release might affect that you have some reservations on?

DR. WRENN: I think the question assumed that the release were at a rate of 16 million curies a year and I think that this is considerably above the operational history of the plant and were a release going on at that level I would have the environmental monitoring program upped in intensity considerably, yes.

CHAIRMAN JENSCH: My question is: What further research might be advisable if it were going at that 16 million curie level basis?

DR. WRENN: Radiobiological reserach?

CHAIRMAN JENSCH: Or any research.

eb2 DR. WRENN: If a release at this level were occurring, I can foresee that it would stimulate some radiobiological research.

CHAIRMAN JENSCH: Why?

DR. WRENN: Well, I think that people in the Public Health field always ask themselves a question: What would happen if we were operating at levels many times in excess of that? And I think that there is some basic radiobiological research that could be done with very high levels of noble gases that still remain to be done.

CHAIRMAN JENSCH: What would the research seek to learn?

DR. WRENN: I think perhaps one would try to investigate radiation effects in biological systems using noble gases. And by "radiation effects" I mean production of lethality in irradiation systems.

Bear in mind here I am extrapolating considerably above the release proposed to me and I'm answering as a scientist concerned also with research.

CHAIRMAN JENSCH: I want you to use your entire background and not compartmentalize your answers.

Is there anything further you want to add that research might seek to learn about or would be the objectives of a research program?

DR. WRENN: I normally take about six months to think

eb3

these ones up.

CHAIRMAN JENSCH: I don't think this will last that long.

(Laughter.)

But if you could work something in before the end of the hearing it will be all right. Would you prefer to give an answer later in that regard?

DR. WRENN: I would like to think about it a bit.

CHAIRMAN JENSCH: Will the witness be here further? If he would like to ponder the matter and come back later, do you think it would interfere with his appearance as you planned it?

MR. TROSTEN: No.

DR. PIGFORD: Dr. Wrenn, I hope that we can limit the breadth to which you ponder here. I believe you perhaps responded as a scientist perhaps intrigues with the opportunity of doing some experiments in a readiation field that you don't normally have. But I think what we are getting at here is if that release that Mr. Jensch quoted were occurring, what, in your opinion, needs to be done, what research, to continue with the satisfactory assurancy that it is safe to people in the environment that would be exposed to that radiation? Could you answer that one?

And that is not like formulating a research program to the National Science Foundation, which has to have suitable

eb4 technical merit without necessary application. We are interested in a real problem here. That is what I want you to concentrate on.

DR. WRENN: The general field of radiobiological research includes experiments performed with a wide variety of radioactive materials, including the noble gases. The experience we have with many of these materials, even in man, have been very helpful in the setting of radiation standards. In fact, they have been fundamental.

One of the things that has made the field a little easier to handle is the fact that it is possible to compare these radiations from one emitter to another because they are all beta and gamma radiations that are in fact quite similar. In the field of radiobiology it is possible to go just about nuclide by nuclide through the -- I should say element by element through the periodic chart and look at radiation effects.

Again I am talking about dose levels that are quite high compared with natural environment levels. I suppose my answer to your question is that should exposures to levels in excess of those present in the natural environment begin to occur, that we would probably do more radiobiological research with the noble gases such as krypton and xenon.

I would suspect that there is adequate information now to predict what the sort of results would be. But

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essentially I think that one would go to the experiments with these particular nuclides themselves.

Have I answered your question?

DR. PIGFORD: I don't know, really. It is possible you have. I will try to see if I can find that out.

So, when you said you would do more research on the noble gases like xenon and krypton, is that because those are the primary constituents of this gas that would be released?

DR. WRENN: Well, essentially yes.

DR. PIGFORD: Is there some significance in the qualification essentially? Are there others?

DR. WRENN: No, there is no significance in the qualifications.

DR. PIGFORD: Now, what information do you need? What kind of effects are uncertain about krypton and xenon in terms of which we need more information about?

DR. WRENN: I think that I have somehow implied that we need more informatin about them at the present levels.

DR. PIGFORD: You didn't imply that to me, Dr. Wrenn. You did say we were talking about dose levels that are quite high compared to the present levels when we talk about this premise that 16 million curies per year would be released, so certainly you didn't imply if you are talking about the present levels --

DR. WRENN: Perhaps I didn't understand this, but with respect to the word "high," although it is a large number, the 16 million curies result in equivalent doses to

the skin on the order of that due to the natural background. When I talk about high, I am talking about the elevation of the doses above that.

DR. PIGFORD: Yes, sir, compared to present levels, certainly, which you have earlier stated are very low, haven't you?

DR. WRENN: Yes.

DR. PIGFORD: So there is no problem in my understanding at least that we are dealing now with an extrapolation far beyond presently measured levels, so I am happy to limit it to that. Now, could you answer my question?

DR. WRENN: Yes. I think I am extrapolating several centuries into the future and perhaps to the whole world rather than this particular plant.

CHAIRMAN JENSCH: Did you say planet?

DR. WRENN: No, plant.

(Laughter.)

DR. PIGFORD: Really, Dr. Wrenn, it is a hypothesized situation right now, and I will hypothesize that it occurs soon, just a hypothesis, that the plant is releasing 16 million curies per year.

Let's not worry about whether it occurs in the next century or not. Let's say it is releasing 16 million curies a year. Now, could you answer the question I pose?

MR. TROSTEN: Dr. Pigford, could you repeat your

rms 3

precise question given the assumption that you just gave?

DR. PIGFORD: I probably can't, but I will tell you what I am looking for.

MR. TROSTEN: Yes, please.

DR. PIGFORD: Dr. Wrenn mentioned some research and development on the effect of noble gases, xenon and krypton, under these assumed conditions, and we found out why he is talking about xenon and krypton, so my question was: What information is needed from the research?

MR. TROSTEN: Excuse me, I didn't hear Dr. Wrenn refer to a need for research and development in the situation in which 16 million curies a year were being released. Am I correct?

DR. PIGFORD: I did, but it is possible I am wrong.

DR. WRENN: Yes, Mr. Trosten is correct.

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wel 1

DR. PIGFORD: Let's try again. Dr. Wrenn, I'm going to assume that these reactors from the site are releasing 16 million curies per year, airborne radioactive material.

What further research and development or studies or testing is needed for us to -- for that facility to be operated without any concerns as to the safety of the public from such radiation?

MR. CONNER: I would like to note an objection to that question on Indian Point #1 and also on the fact that it pre-supposes that there is some hazard to the public in complying with the Commissions established regulations.

CHAIRMAN JENSCH: I don't think the question is finished yet. Would you withhold your statement until the end of the question?

Will you read the question, please?

(Record read.)

CHAIRMAN JENSCH: The question was complete, I guess. Will you state your objection again please?

MR. CONNER: The premise of the question -- well, the 16 million, of course, from the previous discussions relate to the release from Indian Point 1 and the objection is that Dr. Pigford's question seems to presuppose that releases within the accepted range of the Commission's Part 20 regulation in some way requires testing or R&D or something in order to make it safe.

My objection is based on the simple premise that the Commission has already established the standard of safety by, in this case, part 20, and therefore no R&D is necessary and no further testing is necessary, and that is it.

The standard has been established.

CHAIRMAN JENSCH: Do I understand that automatically every reactor gets the Part 20 levels authorized in operating license?

MR. CONNER: Mr. Muller has testified the technical specifications adjust releases to show how Part 20 levels would be met.

CHAIRMAN JENSCH: Does every reactor get a Part 20 limit authorized? Are there some instances where lower levels are permitted for different types of operations?

MR. CONNER: I'm not aware of any restrictions on any reactor below Part 20 levels.

CHAIRMAN JENSCH: Mr. Muller, are you?

MR. MULLER: No, sir.

CHAIRMAN JENSCH: Is it a fair assumption that every reactor gets the Part 20 authorized level available to it?

MR. MULLER: I think I can only speak to date, Chairman Jensch, and, as I just indicated, I believe every site that we have licensed to date has received an effluent level consistent with the values given in Part 20.

CHAIRMAN JENSCH: Consistent with isn't quite my

question. Is it up to the maximum permitted by it?

MR. MULLER: I believe so, but to really give you a straight answer, I would have to look at each individual technical spec.

CHAIRMAN JENSCH: When you consider the release levels from a reactor, do you analyze the character and nature of the expected operations in order to fix that level and out of that, you have the maximum permitted by Part 20; is that correct?

MR. MULLER: If I understand your question correctly. I think the answer is no.

CHAIRMAN JENSCH: You don't analyze the expected operations in order to fix the maximum release level?

MR. MULLER: I think basically what we do is we look at the particular site in question, the nature of the meteorology of the site, the manner in which the particular material is going to be released, and based on this, we establish the tech spec limit.

CHAIRMAN JENSCH: You undertake that kind of approach for every reactor operating license, is that correct?

MR. MULLER: Yes.

CHAIRMAN JENSCH: That was my original question.

MR. MULLER: I'm sorry. I guess I misunderstood the original question.

DR. BUCK: Have operating licenses been granted to

any site for more than one reactor at the present moment? I know there are sites being built, but has a second reactor at any one site actually been given an operating license at the present time?

MR. MULLER: The only one I know of is the Valisido site. I believe there are two --

DR. BUCK: The smaller experimental one and the large one. I'm talking about power reactors now.

MR. MULLER: I don't think we have a site where there are two reactors.

DR. BUCK: So you may have some different considerations or different procedures when you get to a second and third --

MR. MULLER: Except of course in March we did go through -- I think the Commission generally indicated what we would do, and we would consider the site would have a Part 20 limit, not each individual reactor.

DR. BUCK: All right.

MR. UPTON: May I make a comment please? I am always disinclined to object to a Board Member's question, but I would like to point out one premise in Dr. Pigford's question that seems to be so unrealistic that the Board might hesitate to apply to this situation. The question inquires whether or not more research is needed before 15 million curies can be released from a reactor. I hope I'm characterizing it

correctly.

Now, 16 million curies is being released only from Indian Point 1, which is a reactor that has been in operation for a long time, approved by the AEC. I believe the record will show only 570,000 curies, if my memory is correct, will be -- is that right -- can be released as the maximum from Indian Point #3.

The operation of the three reactors together, considered together, the maximum, according to the applicant's own statement, would be the maximum attributed to Indian Point #3, is that correct?

MR. GROB: The maximum -- let me rephrase it. The maximum that can be released from Indian Point Unit #1, in order to stable load the concentrations required by 10 CFR 20, is 16 million curies per year.

The actual releases have been 20 million -- excuse me -- please -- an average of 20 curies per year, approximately -- 28 -- excuse me, 28 -- that is considering unit #1 alone.

Unit 2 or 3 considered alone, the maximum that can be released to be within the requirements of 10 CFR 20 in concentrations is in the order of 570,000 curies per year. The combined releases from these three plants have to take into account that the releases from the three plants on an annual basis will not cause concentrations due to their combined effects in excess of those required by the limit set forth in

10 CFR 20.

I hope Ihave clarified the whole thing. I might add also we don't expect any more on units 2 and 3, any more than we -- to be releasing 570,000 curies per year, but this is the standard that gives us 10 CFR 20 concentrations.

DR. PIGFORD: That certainly is helpful, Mr. Upton. The reason I quoted 15 million curies per year as this assumed release from the three plants is because that is the highest number I get out of these permutations which the applicant has described.

CHAIRMAN JENSCH: Let me see if I understand the last statement by Mr. Grob. You say the level from the three plants can't exceed the levels by 10 CFR 20. What will that figure be from the three plants, as you compute it?

MR. GROB: For the noble gases, MPC is three times 10 to the minus 7th microcuries per cc. This is the concentration which can't be exceeded by the combined releases of the three plants on an annual average basis.

end #11

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CHAIRMAN JENSCH: Let me explain the problem I have. 16 million has been allowed as a maximum limit for Indian Point 1. That is from the site. I don't know how the three plants can ever exceed that figure. Can you tell me how?

MR. GROB: If Indian Point-- The three plants can't, on the basis of what we know about their operation and our experience with the operation on Unit 1. They cannot exceed that figure nor come anywhere near it.

On the basis of what the requirements of 10 CFR 20 are, Unit 1 could not release 16 million curies per year with Units 2 and 3 in operation unless Units 2 and 3 were releasing nothing.

CHAIRMAN JENSCH: What is the total figure for the maximum release for each of the three plants -- from each of the three plants assuming that you sought the full 10 CFR Part 20 limit? Express it, if you will, in the same type of calculation that is shown for the 16 million curies.

MR. GROB: This has to be related to an operating license question. I'm not prepared to answer that except to say that it is something that may be easily done based on the known meteorology of the site and using, as I mentioned, the conservative worst sector of meteorology on an annual basis, and I would rather leave it at that.

I could discuss a way of doing it but this has to be developed during the technical specification review of

this plant.

CHAIRMAN JENSCH: The problem I have is this:

If the amount of release Mr. Muller stated is for each site, and these three are really at one site, how can the three exceed 16 million?

MR. GROB: I didn't say they could exceed 16 million. I said that-- They certainly could not exceed 16 million curies and, however, I want to point out that Units 2 and 3 could not release anywhere near 16 million curies, either one, if it was releasing all by itself, and stay within the concentrations as permitted by 10 CFR Part 20, for a number of reasons.

CHAIRMAN JENSCH: Some of these things become so interrelated that it is difficult perhaps to have to much precision at the moment but if you considered each of the reactors separately, assuming that Indian Point 1 has this maximum level of 16 million curies largely due to the stack effect, I don't know what advantages would accrue in the determination for Indian Point 2 and 3 but assuming it came out 8 million for Indian Point 2 as the maximuj level you would seek that you could establish under this--

MR. GROB: I would assume something less than say approximately 750,000.

CHAIRMAN JENSCH: That is what you expect to release.

eb3

MR. GROB: No.

DR. BUCK: There is a very complicated interrelationship because of the different heights of the stack. I don't see how really you can answer it off-hand. This is a complicated relationship because, if I understand this, if Indian Point 1 was to be releasing 16 million you could not operate either 2 or 3.

On the other hand if you were operating three at its full CFR limit of what I think was 570,000 you again could not operate either 1 or 2, is that correct?

MR. GROB: That's right.

DR. BUCK: So there is an interrelationship here. You can't throw this out as a direct answer without a complicated computation.

CHAIRMAN JENSCH: Do you agree with Dr. Buck?

MR. GROB: Yes.

(Laughter.)

CHAIRMAN JENSCH: I will take it from there.

(Laughter.)

DR. PIGFORD: Mr. Jensch asked the yearly release rates if each were operated individually without the others operating and if each then under those conditions released gas that just came continuously within 10 CFR 20. Haven't you answered that question already at a previous date?

MR. GROB: I thought we had.

DR. PIGFORD: Could you recall the answer for us?

MR. GROB: Mr. Cahill, I believe, testified to that.

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MR. CAHILL: As I recall the answer, taking each of the plants as if they were at different sites, the Indian Point 1 plant releasing gas at the limit of 10 CFR 20 would -- the noble gases we are talking about -- 16 million curies would give us the limiting concentration corresponding to 10 CFR 20. Now, the design of Indian Point 1 is different from the more modern Indian Point 2 and Indian Point 3 in that Indian Point 1 has a superheater with a high stack.

Now, I mentioned in the last answer to this question that the discharge from the stack is a heated plume giving very good meteorological dilution. I think there is perhaps a necessary clarification here in that the 16 million curies is based on release from that stack but without credit for the additional dilution due to the high temperature of the stack effluents.

Indian Points 2 and 3 don't have high stacks. They discharge from the top of the containment, and this discharge is taken as a ground release, therefore, taking Indian Point 2 -- actually my numbers were based on Indian Point 3, so let's take Indian Point 3. The ground release at the maximum concentration allowed for the noble gases would permit 570000 curies to be released.

Now, in the answer previously, I used the same 570,000 curies for Unit 2. Later in the course of the hearing it was pointed out that this is somewhat lower than what would

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actually be the case because Unit 2 is further from the site boundary, so there is some difference on the order of perhaps 800,000 curies instead of 570,000 curies.

Now, if each of the plants were at different sites, you could add to the 16 million from the first plant the 570,000 from the third plant and the somewhat larger amount -- 800,000 -- from the second plant.

But since they are on one site, then there will be a limit which has to be determined in detail and agreed to by the AEC staff and set forth in the technical specifications. But this limit would not exceed the 16 million for unit 1 because, let's say, unit 1 was running at the limit, 16 million curies.

Even though that release is up in the air, one more curie from unit 2 would add to that limit -- the hundred percent .001 is over the limit that wouldn't be allowed.

On the other hand, if unit 3 were at its limit, 570,000 curies, again mathematically there would be no more budget left for the other unit.

So, the precise answer as to how much can be discharged from these three sites has to be worked out, but it will not exceed 16 million, and it won't be less within the accuracy of these numbers, but in the range of what we are talking about -- won't be less than 570,000 curies. It will be somewhere in between, with each unit having a budget set by its characteristics, the elevation of its release and

rms 3

the distance from the site and meteorology.

CHAIRMAN JENSCH: Thank you very much. That is what I hoped would turn out to be the answer. I am glad you answered it.

DR. PIGFORD: Now, I am really not seeking to ask Dr. Wrenn any question relating to how -- to the releases after the plants are constructed and of operation license and so forth. I am asking him a question which I will rephrase as follows: It has been emphasized to the Board that the 10 CFR 20 limits are the ones that are applicable, and so I am going to assume for the moment that they are met in terms of concentrations from this release.

I am assuming specifically that the concentration at the site boundary calculated by the techniques the applicant has described is at 10 CFR 20 maximum permissible concentration limits.

Further, I am going to assume that the source of the radioactive gas from that happens to occur from Indian Point 1 releasing gas and Indian Point 3 releasing gas. I am not going to be constrained right now about expected releases, but I am going to assume they are releasing enough to reach this Part 20 maximum permissible concentration, which is the governing regulation.

Further, to be specific, I will assume, which I think comes within the framework suggested by Mr. Cahill,

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that Indian Point 3 is releasing -- I want to retract that. That is a question of assumption. I am going to assume that those two plants, Indian Point 1 and 3, are releasing on the order of, say, something between 10 and 16 million curies per year, which I think comes within a reasonable framework of the numbers given by Mr. Cahill.

Now, with those assumptions and recognizing that these release rates are tied to the 10 CFR 20 governing regulations, through meteorological data and calculations, I would then like to ask you what further information is needed on xenon and krypton to insure that the health and safety of the public is adequate here -- acceptable.

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THE WITNESS: That's an easier question to answer. Essentially, none.

CHAIRMAN JENSCH: Does anybody have any further questions of the witness?

(No response.)

CHAIRMAN JENSCH: Hearing no requests, you were going to consider something and you will be called upon later, is that correct?

THE WITNESS: I thought that we -- this question actually followed up that matter, and had taken care of it.

CHAIRMAN JENSCH: Let us look at the transcript. I think there was a little difference, and in the light of your first answer, you may find you may want to consider it further.

We would be glad to hear from you further in that regard. You are temporarily excused, Dr. Wrenn.

(Witness excused.

CHAIRMAN JENSCH: At this time let us recess to reconvene in this room at 3:55.

(Recess.)

CHAIRMAN JENSCH: Please come to order.

Before Dr. Buck proceeds on another subject, let me continue with one statement. I would ask Mr. Cahill if our understanding is correct of the limits of releases to which we have just been considering.

Supposing Indian Point #1 were releasing on an annual basis some like this: 15,750,000 curies of radioactivity. Would Indian Point #2 then have available for release an amount in some ratio of something like this: 250,000 over 16 million, multiplied by 800,000?

MR. CAHILL: Mr. Jensch, I just want to make sure I have the question right. As I understand it, you postulated that Indian Point 1 was releasing at 15,750,000.

CHAIRMAN JENSCH: Correct.

MR. CAHILL: And you suggested that then Indian Point 2 would have allowed for it 250 --

CHAIRMAN JENSCH: There would be available in that one year an amount measured by a ratio of 250,000 over 16 million measured by 800,000. I'm getting a lot of affirmative nods around the table, but I don't know whether you agree.

(Laughter.)

MR. CAHILL: Well, I'm not sure -- this is generally the approach. I'm not sure whether these relationships would be linear -- the mathematics and the mathematical approach to the combination has to be computed allowing for the

meteorological dilution of each and the distances, but the basis would be for that limit that the off-site dose under any combination of these releases anywhere off-site could not exceed the limit of 10 CFR 20, which is a half rem per year, and this would be worked back through the concentrations, the maximum permissible concentrations, for the gases which equivolate to that does through to the allowable rate of release from each plant in terms of curies per unit time.

Now, I think the mathematical example you gave, Mr. Jensch, is within that principle. Whether it would actually be those ratios -- I don't think, even though there seems to be some agreement that that is right, I know this is a complicated calculation which has to be developed, and I do think that the principle upon which these releases will be defined has been set forth in this hearing now, and of course it will be precisely defined in the technical specifications at the operating license stage.

CHAIRMAN JENSCH: Very well. Do you want to proceed? Thank you.

DR. BUCK: Let's turn to page 1015 of the transcript. This gets into the answer on quality assurance that was given by Mr. Grob yesterday or the day before -- I forget which. This was a question that I posed at the pre-hearing conference. Will procedures be written on or before the time they are needed? Your answer at that time was procedures for quality

assurance program on Indian Point #3 have existed since the beginning of this program. These procedures have existed for quality control surveillance and other procedures have existed in the form of memoranda and other communications. The procedures required for the program as it develops will be prepared prior to their need.

This, to me, seems a contradictory statement. The first one says procedures for the quality assurance program have been completed. The last paragraph says they will be completed as needed.

Can you tell me exactly what has been prepared and in the second paragraph, what form does the memorandum and communications take? Are these actually written procedures or not?

MR. GROB: The work underway on this project so far has consisted of some site preparation work, plus fabrication of certain components.

As time progresses, other stages of work becomes involved. The biggest effort so far since what has been going on so far has been in the area of quality control surveillance of components fabricated in shops -- vendor shops.

For this work, a procedure exists -- procedures exist. As work goes into construction on-site, other procedures for handling, storage and such will be prepared prior to such work being done in the form of the written procedures

given in our -- titles of which were given in our supplement. We have such procedures. We have utilized them on our other projects.

We have, for the purpose --

DR. BUCK: When you say you have such procedures, are they in a different form?

MR. GROB: Yes.

DR. BUCK: Go ahead.

MR. GROB: For the purposes of the plan, we compiled a bunch of titles that would contain these procedures to allow more expeditious auditing of procedures. So we have had procedures. We have procedures, I was trying to be clear that the titles as described in the supplement to the summary of application, that these procedures are in that form, and not in their entirety yet.

DR. BUCK: Are the procedures in the proper and finalized form for the units you have ordered -- when I talk about units, I'm talking about materials you have ordered. Let me make an assumption here.

Suppose you have ordered the pressure vessel or the heat exchangers. Have procedures been written for those? I may have the wrong example.

MR. GROB: Yes.

DR. BUCK: Procedures in a proper form have been written for those?

MR. GROB: Yes.

DR. BUCK: They are being audited?

MR. GROB: Yes.

DR. BUCK: By yourself or U. S. Testing, one or the other, I presume.

MR. GROB: The auditing of the records and quality control surveillance work is being done primarily by U. S. Testing, which is our agent.

We have also utilized at times our own company personnel in certain areas.

DR. BUCK: All right. Now, going to the second paragraph here, where you have procedures in the form of memoranda and other communications, do you expect to have the finalized form, the proper form of Q.A. procedures written for other things as you order them or before the time you order them?

MR. GROB: Yes.

DR. BUCK: You will carry this on all through the whole setup?

MR. GROB: Yes.

DR. BUCK: How about sub-systems testing? Are you formulating procedures for testing for quality assurance as a system in any of these cases?

MR. GROB: Test procedures will be formulated. Test procedures exist -- this is pre-operational or final

testing.

DR. BUCK: Yes.

MR. GROB: These procedures will be prepared prior to the -- prior to when such testing gets underway.

DR. BUCK: Is a representative of U. S. Testing here?

MR. GROB: Yes.

DR. BUCK: I wonder if I could ask him a few questions. Where is he?

MR. TROSTEN: Mr. Fuches is coming to the witness table.

CHAIRMAN JENSCH: Has he been sworn?

MR. TROSTEN: Yes.

Whereupon,

IRVIN J. FUCHES

was called as a witness on behalf of applicant, and having been previously duly sworn, was examined and testified further as follows:

CHAIRMAN JENSCH: For the sake of the record, give your full name and address.

THE WITNESS: Irvin J. Fuches. I live at 32 North-view Terrace, Cedar Grove, New Jersey.

DR. BUCK: I would like to have you get out -- I believe it's Exhibit 3 -- no, sorry -- Exhibit 2.

THE WITNESS: Let me get that from my chair.

DR. BUCK: In that exhibit, you have given, or the

applicant has given, I presume through you -- three charts, outlining the organization of U. S. Testing.

THE WITNESS: Yes.

DR. BUCK: It's Appendix -- Section 4, item C -- no, wait a minute. Appendix B.

Taking the first of your charts marked as figure 2 in here, U. S. Testing Company Table of Organization, under the box for second vice-president from the left, there are a series of boxes across there that all say "vice-president." The second from the left as you come down that chart you come to "Nuclear Services." Is that the section responsible for maintaining the contract that you have with Con Ed?

THE WITNESS: That's right, within that division itself is a sub-section that is responsible for this job.

DR. BUCK: And the organization of that section, the outline is in figure 3?

THE WITNESS: Yes. The one entitled "Quality Assurance Section."

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DR. BUCK: Quality assurance section. The question I want to ask -- figure 4, quality assurance section, where does that fit into the nuclear engineering services?

MR. FUCHES: That is a section within nuclear services division, as shown on figure 1, which is the overall company chart.

DR. BUCK: So, figure 3 has nothing to do with the --

MR. FUCHES: No, figure 3 describes broadly the services available to the nuclear community within which is surveillance services.

DR. BUCK: I see. So the organization that you are working under is this figure 4, actually, quality assurance section, which reports up to one of your vice presidents?

MR. FUCHES: Yes, which is myself.

DR. BUCK: All right. Now in Mr. Grob's testimony on page 1014, lines 11 to 13 it says, "The Nuclear Engineering Services Section reports both to the manager of engineering and a vice president." Can you tell me how you do this? What is the basis for this?

MR. FUCHES: I think the best way to put that within the context of our company is probably to give you a bit of a rundown as to how we are organized and exactly why it is this way.

DR. BUCK: I would appreciate it if you could.

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MR. FUCHES: Fine.

DR. BUCK: Do you want to draw it on a chart?

MR. FUCHES: I think I could just go through it. It isn't too difficult. U.S. Testing Company is basically an independent testing laboratory with 450 technical and supporting personnel. And as such it devotes itself entirely to lab and field testing, inspection and consulting services in the field of engineering, chemistry, biological science and also to the behavioral sciences.

It is organized basically in terms of departments or divisions which encompass either services to these particular technologies or particular areas of technology as mechanical engineering or electronics or environmental testing and also in terms of departments which address themselves to particular industries. It is the latter case where it is to determine the best organizational method for nuclear services would be for a divisional status addressing itself to all the things that have been asked of U.S. Testing Company in this area and for example it encompasses the contract we have with the AEC at Hanford Radiation Protection Services of both the personnel, and the environment there including air and water in the Columbia River and also the vegetation. It also includes, for example, this entire division called nuclear services division, the operation of the 2 MEV Vandegraff generator that does

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fault detection work on large castings and heavy-wall forgings for the nuclear industry.

DR. BUCK: That is in your own laboratory?

MR. FUCHES: That's right. It happens not to be in one location, but it is an encompassing thing. Within this nuclear services division is, of course, the thengs we talk about today, surveillance of quality assurance programs and also what I would consider to be at the lower echelons, the on-site testing and inspection services that we provide for such things as concrete and cad-well(?) supplies and reinforcing steel and that kind of thing.

To coordinate these things which in some cases draw upon the resources or the human resources within our various different technological divisions -- for example in chemistry where people may be drawn out for particular problems here in terms of quality assurance surveillance, we have felt that it first of all needs day-to-day supervision and management and direction, which it gets through our engineering division.

As stated here, the engineering division manager makes certain it works in terms of drawing upon all the resources of the various departments of our company. I have been chosen to have it report to me as a parallel function to enhance it until it gets into a stage where it is adult enough to ride on its own keel.

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DR. BUCK: I see. Thank you. Well, let me ask: From the statements that are in here, I assume that you have done a service similar to what you are doing for Con Ed for other reactors?

MR. FUCHES: Yes.

DR. BUCK: Can you tell me what your job is as far as -- I am talking about your company's job now -- what exactly is your company's job? What services will it perform for Con ED, to your understanding?

MR. FUCHES: To my understanding on Indian Point 3 it will be to augment their own personnel forces, to monitor the quality assurance program within the plants of others and on-site to make certain that those provisions that are called out either through codes or specifications or the purchase orders are in fact being carried out and to do this in a method by which we would do it on a monitoring basis rather than on a 100 percent attendance at each individual plant.

DR. BUCK: Your company will have its own personnel, or itself -- will it conduct any primary non-destructive testing on the site or monitor other contracts in doing this?

MR. FUCHES: We will only monitor other contracts on unit 3.

DR. BUCK: That is the same throughout the -- you don't do any of this work in your own laboratory other

than monitoring for this contract, is that correct?

MR. FUCHES: Yes.

DR. BUCK: Do you have what I guess I will call a project manager for this particular contract?

MR. FUCHES: Yes, I might add there are provisions in our arrangement with Con Ed that they may call upon us to do specific check tests where they feel this is necessary, but it would not be our primary responsibility.

DR. BUCK: I don't like to see the auditor also doing the primary job.

MR. FUCHES: No, we won't allow ourselves to get in that predicament.

DR. BUCK: In this case what you are saying is if there is a question about a group of tests or something like that, your group might be called upon to repeat tests or do a section of the test, is that correct?

MR. FUCHES: Yes.

DR. BUCK: Is that your understanding, Mr. Grob?

MR. GROB: Yes.

DR. BUCK: I am trying to be sure there was no auditing by the same group doing the testing. I started asking you about a project manager for the contract. Do you have such, Mr.Fuches?

MR. FUCHES: Yes. We yave a project manager in charge of translating our requirements on Unit 3 into actual

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day-to-day practice.

DR. BUCK: Is he an on-site man or in your headquarters?

MR. FUCHES: He would be in our headquarters.

DR. BUCK: Do youhave an on-site man or a man here all the time or located here all the time?

MR. FUCHES: No. We do periodically visit the site as we do in the plants of others, Westinghouse and their subsidiaries and also UNC and their subsidiaries. There is no one at this particular time who hs been assigned full time in any particular site or plant.

DR. BUCK: I see. Do you expect that you will at some time as the plant approaches completion?

MR. FUCHES: I think it is too early now to say. It is my own prediction it will be something approaching full time in one place or another, but not consistently from --

DR. BUCK: Do you expect to do the auditing on incoming materials at the plant or do you just audit the quality assurance tests on the incoming?

MR. FUCHES: That is right, we would audit as opposed to actually doing it.

DR. BUCK: So, you would have to have a man here a fairly frequent amount of time as the plant proceeds?

MR. FUCHES: Frequent in terms of,say, once or

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twice a week, probably so.

DR. BUCK: Do you have any -- your project engineer or your project manager, he will be on this full time?

MR. FUCHES: Yes, he is.

DR. BUCK: Anybody else besides that?

MR. FUCHES: The group as constituted is as follows: We have a small complement of full time people assigned to this particular project. These people, as I say, these engineers translate the responsibilities delineated in the quality assurance plan.

I think the key here as to our role as U.S. Testing and the particular benefit we have to offer is the extraction or use of technologists from our various divisions who are called upon by the full time engineers so that, for example, if there is a radiographic review to be made at the particular plant, there we would dispatch a technologist who is working at radiography full time within our non destructive testing laboratory and he would be given the procedures that we are writing and have written and he would carry out the actual review of both the personnel as they are carrying out the radiography, also the interpretation of the film and on into the specifications that have been agreed upon that must be met and the same for chemistry and metallurgy and any different technological area. What we have is a small fulltime complement and a relatively large part time

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complement that is called upon.

DR. BUCK: Are you presently aware of what has been ordered already for this project?

MR. FUCHES: I myself am not.

DR. BUCK: I mean the company.

MR. FUCHES: Yes.

DR. BUCK: And your project manager for this operation is aware of those things that have been ordered?

MR. FUCHES: In the very details, yes.

end 15

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DR. BUCK: Have the technical specifications for these items been given to you?

THE WITNESS: Yes, prior to every particular investigation that is made everything that surrounds or encompasses the requirements are gotten and reviewed before the investigation is made.

DR. BUCK: Do you participate at all in setting up procedures for quality assurance -- shall we say quality assurance procedures?

THE WITNESS: Only in a peripheral and supporting way. If there is some particular technology that we-- Let me use an example:

In the area of concrete testing, for example, I believe we have been used in a supporting role to hlep to assess or help to draw up specifications -- I'm not sure if it's Unit 3 or Unit 2 but it's that kind of thing. But it is not a general rule to have us draw up specifications.

DR. BUCK: But test procedures, if you have questions about test procedures or suggestions on them, I presume your contract allows you to make them and cooperate with Con Ed on test procedures.

THE WITNESS: That's right.

DR. BUCK: I think we talked mostly about component testing at this point. Are you going to get involved in systems testing? Or do you know that yet?

THE WITNESS: We really don't know that yet.

DR. BUCK: Do you do very much systems testing in plant for contracts of this nature? Do you get into the pre-operational tests of the components you already checked out and so on?

THE WITNESS: No. Generally U. S. testing has not gotten into that.

DR. BUCK: So your limited auditing, shall we say, will come when the components themselves are approved and on site. I am talking about components-- I'm talking about a pressure tank. When that pressure tank gets into the site, your auditing of the quality assurance basically ends at that point.

THE WITNESS: That's right, except for any check tests on it once it is installed in the system. We may be involved there, too.

DR. BUCK: But it doesn't get into the actual system or subsystem operation?

THE WITNESS: No, it does not.

DR. BUCK: Thank you.

Tom, do you want to examine-- Oh, another question.

What sort of records do you keep? How are they kept? How are they presented? To whom are they presented? Let's put it that way.

THE WITNESS: Each of our surveillance visits,

eb3 whether on site or in the plant of the prime, the nuclear steam system supplier or one of his contracting subtiers, would generate an inspection report which is addressed to Con Ed -- Mr. Grob, in particular -- and this calls out where we were, when were we there, who we talked to and what we looked at and then generally a conclusion as to whether we felt that the provisions of either the A specification or the codes encompassed or the purchase order have in fact been met and of course if they haven't been met we call that out there, too.

DR. BUCK: Is your inspector signing an acceptance or rejection on the same sheet?

THE WITNESS: No. We are not in an accept or reject position. We basically give our opinions as to whether or not specifications are being followed.

DR. BUCK: How do you do that?

THE WITNESS: Through our actual report. First, if it's a-- Well, if we find something that doesn't meet specification, that there is a discrepancy, usually a phone call is directed to Con Ed followed up by the written report.

DR. BUCK: What I'm trying to get at: Suppose you go out to Timbucktoo and inspect some equipment and you accept it all. Is there a form or record sheet or something which goes into Con Ed explaining exactly what your inspector looked at?

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THE WITNESS: I have to correct one thing. We don't accept anything per se at the time of our inspection.

DR. BUCK: Let me scratch out the word "acceptance" then. Suppose your inspector goes into a plant and inspects a group of items. Does he then send some sort of report explaining exactly what he looked at, what tests he checked and so on?

THE WITNESS: Yes.

DR. BUCK: Sent in to his manager or Con Ed? What is the flow of information?

THE WITNESS: From the actual inspector to the project manager on Con Ed Unit 3 -- our project manager -- and from there a report goes to Con Ed.

DR. BUCK: All right. So that Con Ed would have the complete record at the end of the project on what you had looked at or what your inspectors had looked at and where?

THE WITNESS: Yes.

DR. BUCK: Now you say you report-- You don't reject or accept, but if you find something that isn't meeting specifications, then you immediately report this to Con Ed directly?

THE WITNESS: That's right.

DR. BUCK: So that they still have the accept or reject in their hands rather than in your hands?

THE WITNESS: That's right.

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DR. BUCK: Let me ask Mr. Grob a question, if I may.

Somewhere in your testimony, I asked about a judgment situation as to who could change the specifications for the procedures that were put through and somewhere in here you said it went back to the generating organization for the specifications.

MR. GROB: The organization which generates these procedures or specifications, correct.

DR. BUCK: Where does it go as far as the level? Do you have to go back to some reasonably responsible people in this organization or are you just going to somebody on site from there?

MR. GROB: Within --

DR. BUCK: Not that they aren't responsible but I'm talking about somebody who will take responsibility for the company now.

MR. GROB: All right. Just to explain this project a bit, this is a turnkey project for which Westinghouse is the prime contractor to Con Ed. United Engineers and Constructors is an architect-engineer subcontractor to the Westinghouse Corporation. U. S. Testing Company is Con Ed's agent.

There are quality assurance procedures for this project prepared by United Engineers and Constructors, the

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Westinghouse Corporation, Con Ed Company, and U. S. Testing Company. The procedures prepared by Con Ed or by U. S. Testing Company are reviewed and approved by myself. The procedures prepared by United Engineers and Construction are forwarded to Westinghouse, who in turn, along with their own procedures, also forward these to me and I review these-- I don't specifically approve them. Should, by review by me and my staff, I determine that in some way a requirement of the application or a requirement of agreements of Con Ed and the Westinghouse Corporation do not appear to be satisfied, I would then inform Westinghouse that whatever is under review is not acceptable.

DR. BUCK: May I ask this: Since Westinghouse is the prime contractor, do you have an agreement with them that your auditors, in the form of U. S. Testing, can go into one of their suppliers' plants and do an audit?

MR. GROB: Yes.

DR. BUCK: So there is no conflict of prime and customer, right?

MR. GROB: Right.

DR. PIGFORD: Mr. Fuches, does U. S. Testing have any responsibility on Indian Point 2?

MR. FUCHES: Yes, we do.

DR. PIGFORD: Is it similar to that described here?

MR. FUCHES: Practically identical to what

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we have on Unit 3.

DR. PIGFORD: Could you give us an example of something where your company, through its testing, found it necessary to report in, as you have described, in effect some change?

MR. FUCHES: You mean where we might have found a discrepancy?

DR. PIGFORD: Yes.

MR. FUCHES: I don't think I could point out a specific. I can say that there have been items that have been found, of course, corrected.

DR. PIGFORD: Maybe Con Ed could give us an example.

MR. GROB: Yes, I will.

We, through the efforts of U. S. Testing, we have developed questions regarding material certifications for certain piping. We raised-- We told Westinghouse that we required that this situation be evaluated and that the records be traced so that we could assure ourselves that the materials required by the specification were indeed the materials that were to be provided -- that were provided.

DR. PIGFORD: I was hoping for an example in terms of a component. Is this attached to any particular component in the plant?

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MR. GROB: Is the piping attached to components in the plant?

DR. PIGFORD: I beg your pardon. I didn't hear that part of your answer. It was piping. Primary system piping?

MR. GROB: No. It involved some small sized stainless steel piping.

DR. PIGFORD: Yes. Mr. Fuches, is there any particular item of equipment or component in Indian Point #3 where specific -- I guess you wouldn't call it approval, but affirmative recommendation from your company is required before construction can proceed?

MR. FUCHES: No, I can't think of any that fall in that category.

DR. PIGFORD: Is there any specific item along the plant schedule of construction where someone from your organization is actually being there to witness a test that is required before the construction could proceed any further?

MR. FUCHES: Yes. There are probably numerous instances where components do require our visitation to witness either a final performance test or a hydrostatic test or some particular test that is called out in the drawing or specifications and without us being there, it would be a hold until we were there.

DR. PIGFORD: Could you give us an example?

MR. FUCHES: I think if I mentioned the steam

generator, I think that would fall in that category, would it not?

MR. GROB: Yes.

DR. PIGFORD: But apparently the construction can proceed without an affirmative or negative report from you on this; is that right, Mr. Fuches?

MR. FUCHES: Well, if -- maybe I ought to describe our role a bit differently. If a component is part of the nuclear steam supply system, or is one of the engineered safeguards or has anything to do with the critical structures, it would, during its manufacturing or erection phases, see a U. S. Testing Company inspector at least once during that run and in most cases, at a number of different points which we would consider with Con Edison to be critical points to check, the adequacy of the construction or manufacturer.

DR. PIGFORD: I understand that. You have given us an example of one where you apparently are required to be there. But my question is this:

Apparently a report from you on the results of your having been there and seeing what is happening is not actually required before they go ahead on further construction. Is that right?

MR. FUCHES: I don't think I can answer that question.

DR. PIGFORD: Is there someone who can?

MR. GROB: Your construction on such item, manufacture of such item, could proceed. The U. S. Testing report on such item, should they discover some problem, would be reviewed by Con Ed and we would not demand that construction stop. We would merely inform our prime contractor, Westinghouse, that what was involved was not acceptable to us.

DR. PIGFORD: Suppose the inspector had not submitted a report? Could you go ahead with construction?

MR. GROB: If the inspector had not submitted a report, could they go ahead with -- well, the inspector doesn't submit the report until he makes inspection and the construction is going on all the time, and I'm afraid I don't understand.

DR. PIGFORD: The trouble is, I don't understand why you don't understand.

(Laughter.)

That is not unusual, because I'm having trouble phrasing it in a proper language.

From the first question or second question I asked Mr. Fuches, I learned that there are no checkpoints along the way where construction can't proceed without an affirmative written report from his company. Is that your understanding, Mr. Grob?

MR. GROB: I think Mr. Fuches' testimony was that certain tests as such in certain areas of the construction of

the plant are required by the plant to be witnessed or audited by U. S. Testing Company and the Westinghouse Corporation is obligated to provide them with sufficient notice for them to be present and the test or what have you involved requires both Con Ed to be there and Westinghouse to notify us in time to be there, so in that sense, if for some reason we didn't get there, it might proceed on the scheduled time.

DR. PIGFORD: That is certainly helpful, and we have established that, haven't we, that he has to be there for certain things like the steam generator? Is that correct?

MR. GROB: Yes.

DR. PIGFORD: What I am now getting at is:

Is something more than just his presence required? Let me take a hypothetical example which I don't pretend to have any bearing to the people at U. S. Testing.

Suppose the man has an off day, and doesn't really watch, but he is there and nobody really realizes that he is not in his normal state of competence, and he does not submit a report.

Is there anything in your procedures that prevent you from going ahead without demanding that report for review?

MR. GROB: Oh, I would demand that report for review.

DR. PIGFORD: I understand that you would, but is there something in your procedure that would keep you from going ahead with that without demanding that report for review?

MR. GROB: There is nothing -- let me put it this way. Our procedures do not require Westinghouse Corporation or its subcontractors to stop work until Con Ed has received a report or has specifically given approval of what is in progress.

In other words, what I think the intent of the question is, is it specific approval by Con Ed that is required after these hold points before work can continue?

DR. PIGFORD: No, sir. The intent of my question is whether that report from that inspector has to be in hand and reviewed by you before you can go ahead.

MR. GROB: Well, . . .

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DR. BUCK: If the man is there witnessing the work, he is required to be there to witness the work, you can't wait to start the work until he puts the report in.

DR. PIGFORD: I guess we have to rely on the fact that the inspectors just don't have off-days, then.

MR. GROB: No. If, for example, the U.S. Testing Company were to witness a hydro test of a vessel, and I think the intent of your question is: Should Con Ed not receive a report of this test being witnessed, would perhaps this vessel be shipped or say the caps removed or other changes in its status from the time of the hydro test be made, unless Con Ed had receive such report.

DR. PIGFORD: Yes, sir, that is a good statement.

MR. GROB: All right. The caps could be removed if Con Ed had not received such a report. Con Ed would still require the report, would still review it, and if there were any areas of -- problem areas, would then indicate, should it be the case, that this component was unacceptable, which might require that another hydrotest be run.

DR. PIGFORD: There is something in your procedures that actually requires you to have that report and review it then before the plant finally goes into operation, is that correct?

MR. GROB: Yes.

DR. BUCK: I think we are probably a little bit mixed

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up here. I assume that the prime contractor has his own quality assurance people there who do the accepting or rejecting?

MR. GROB: That is correct.

DR. BUCK: And the U.S. Testing man is there as your audit on that thing only?

MR. GROB: That is correct.

DR. BUCK: One more question. Could you give me a quick rundown on the qualifications of your project manager for this operation, if youhappen to know them offhand.

I am sorry. I am talking to Mr. Fuches, but I am looking at the wrong man.

MR. FUCHES: Yes. I have some notes here that refresh my memory. The project manager on unit 3, also on unit 2, surveillance responsibility, is a graduate of MIT, S.B.M.E. He has taken civil engineering at Georgia Tech. He is a registered professional engineer in Massachusetts and Virginia. He was a field project manager on the MIT research reactor. He was a project engineer on the Wright-Patterson reactor. And he also did project engineering work on a fuel reprocessing plant for Italy. He was with Allic-Chalmers for a number of years, and I can't recall some of the -- the other companies he was with.

DR. BUCK: Thank you.

CHAIRMAN JENSCH: Could you tell us his name?

MR. FUCHES: Charles McDonald.

CHAIRMAN JENSCH: Thank you. Let me just ask a question or two on quality assurance.

Who writes the specifications? Did I understand you to say each department generates its own specs? Who writes them up?

MR. GROB: Specificatims are prepared by Westinghouse or its subcontractor, United Engineers and Constructors. These are specificatims for components, design specs.

CHAIRMAN JENSCH: What participation does Con Ed have in that phase of it?

MR. GROB: These specifications are forwarded to Con Ed for review.

CHAIRMAN JENSCH: Con Ed, as I understand it, has a field of responsibility for this project outside of that which Westinghouse has, is that correct?

MR. GROB: This project is a turnkey project, yes.

CHAIRMAN JENSCH: That includes everything including the generators?

MR. GROB: Yes.

CHAIRMAN JENSCH: Are there any components or parts to be supplied by Con Ed?

MR. GROB: No.

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CHAIRMAN JENSCH: Perhaps I misunderstood. Then the departments to which you refer as generating the specifications are Westinghouse departments, is that correct?

MR. GROB: That is correct.

CHAIRMAN JENSCH: Of course, Westinghouse has been in this business a little while, and I wonder, perhaps this is an unnecessary question, but there have been so many problems I understand in surveillance of construction and assembly and so forth due to the lack of clarity of specifications or lack of completeness of specifications, do you have any of those problems arising at this time so that you have to go back to your manufacturers and amend your specifications to include the changes in technology?

MR. GROB: Mr. Durfee will discuss this.

CHAIRMAN JENSCH: Will he give his full name.

MR. TROSTEN: He has been sworn.

Whereupon,

CHARLES GIBSON DURFEE

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

MR. DURFEE: My name is Charles Gibson Durfee, Jr., 8983 Eastwood Road, Pittsburgh, Pennsylvania.

Mr. Chairman, was the question related to technical specifications?

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CHAIRMAN JENSCH: Yes. As I understand it, there are a great many of these problems which have arisen in reference to the construction of facilities developing from a lack of clarity or lack of clearness -- I mean lack of completeness in the specifications for the components for the units that are sought for a project of this kind. How are those matters handled by Westinghouse? Can you tell us that?

MR. DURFEE: Well, I don't know specifically to what you refer.

In general, there is never a point in time, I suppose, when a technical specification has a 100 percent clarity. If questions arise, there is a mechanism by which suppliers come back formally to Westinghouse to ask for the intent of specifications. This is a formal procedure whereby an equipment specification can be revised to make clear a previously unclear requirement.

CHAIRMAN JENSCH: The reason for asking the question was this: How does U. S. Testing handle the situation with an unclear specification? How can it be sure that in its surveillance the product component will have the perfection sought for by Con Edison for this turnkey project?

MR. DURFEE: If questions arise -- not on the part of the supplier, as in my previous answer, but onthe part of U. S. Testing or Consolidated Edison -- the typical means of drawing that to the attention of Westinghouse would be by

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means of a letter from Consolidated Edison for consideration by Westinghouse engineering for correction or amplification of technical specifications as appropriate.

CHAIRMAN JENSCH: Now Idon't want to discuss any other cases or any other specific reactor projects, but assume that someone was making a reactor vessel under certain specifications and they had an arrangement for transportation to a site and it wasn't quite ready for installation, so the reactor vessel laid there a while and there might have been a sea atmosphere affecting someof the parts of maybe the openings on the pressure vessel where the welds occurred and somebody said: "It's your fault, not mine," and another fellow said: "Look at the letter. It doesn't say I have to do it."

What kind of completeness do you have to be sure there isn't a lot of finger-pointing that takes two years and everybody ends up with a worn thumb from pointing to the responsibility?

MR. DURFEE: What steps do we take to assure ahead of time that equipment specifications are complete and clear?

CHAIRMAN JENSCH: Yes, and that you don't get problems of uncertain responsibility for manufacture of a part of thisproject and its ultimate assembly of the completed unit.

MR. DURFEE: Before equipment specifications are issued, they are reviewed in draft form within Westinghouse

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by several departments, each with a different specialty.

For example, materials and process engineers review the specifications for cleanliness requirements and -- specification requirements, and for welding. The quality assurance department reviews it for inspectability and completeness of non-destructive testing.

Before an equipment specification is issued for us and for application of the purchase order, a comprehensive reviewis made to insure that it is clear and complete in these aspects.

CHAIRMAN JENSCH: Now having prescribed those specifications, do you also have arrangements made that in case installation isn't to be made of a component right away, who has responsibility during the storage time? Do you have arrangements to cover that type of situation?

MR. DURFEE: Well, it is a case by case contractual situation depending upon who is designated for storage of the equipment.

For example, it may be desirable for the supplier of the equipment to store the component in his shop prior to delivery to the site. That contractual requirement would be spelled out in our purchase order with the supplier. Otherwise the supplier would be given the specific shipping instructions in the purchase order, together with any other requirements for preservation in transit and so forth, and instructions

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given at the receiving point for proper location and storage initially.

CHAIRMAN JENSCH: Usually you have arrangements as to when the responsibility stops for a supplier and when you receive it into your responsibility -- say the pressure vessel which might have laid on its side at Indian Point 3; you have some provision to see it retains its high quality until you are ready to install it, is that correct?

MR. DURFEE: Yes.

DR. BUCK: Before we get off the subject, I would like to ask Mr. McCullough a couple of short questions.

I have a document here. I'm not quite sure where it came from but I believe it is a section out of a conference in 1968 -- was there such a conference? This document is a few pages out of that, I believe, and is entitled "Some Philosophical Comments on Accident and Hazard Evaluation" by C. Roger McCullough.

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DR. BUCK: That was my memory of where it came from. It had a great deal to do with meteorology and hazards of reactors and so on. I am sorry, I had this Xeroxed out of the thing without taking the title down. But do you remember vaguely --

DR. MC CULLOUGH: I remember vaguely such a thing. Could I glance at it?

DR. BUCK: Yes. Here.

DR. MC CULLOUGH: Yes.

DR. BUCK: In this, as I say, philosophical comments you made on this thing, there are a list of paragraphs in here which are numbered paragraphs preceded by an explanation, however.

"However, the basic research and applied research programs not to mention the engineering tests which are being planned apparently put this situation in excellent condition when they are completed and evaluated."

Then the next subtitle is, "How to Proceed." And it goes through several paragraphs here, but I would like to read one paragraph in particular. Paragraph 3 of this item, "How to Proceed."

"An emergency cooling system which would function rapidly in case coolant is lost from the core for any reason would avoid any further difficulty. It is necessary that this act fast since it is necessary that the core be kept cool

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under all conditions. Relatively small amounts of water are required since the heat of emission can be utilized in this cooling.

Presently core sprays, safety injection and core deluge systems are provided. As far as I know, at present there is no clear evidence they will perform as designed when they are required.

Tests to prove the efficiency and reliability of these systems are urgently needed." My question is this: I think you say yesterday a description of the spray system which is included in this overall system and the statements that were made concerning the tests that were going to be made on this system to prove the, shall we say. operability in time of need.

DR. MC CULLOUGH: I believe, if I am correct, the reference here is to emergency core cooling systems which are inside the reactor vessel.

DR. BUCK: It says here, "Presently core sprays -- safety injection and core deluge"-- you may be right here. I'm sorry, I read this wrong. It is core sprays you are talking about.

Well, let me ask this then --

DR. MC CULLOUGH: The discussion yesterday was on containment spray.

DR. BUCK: Another paragraph. "There must be a means

of reducing the pressure within the containment. The pressure suppression system is one such system which apparently serves this purpose very well.

If other pressure reduction systems such as coolers and sprays are used, there must be proof including tests that they will function under the accident conditions at any time during the life of the plant."

I am sorry, this is the paragraph I should have read in reference to yesterday's testimony. My question is still the same. Do you feel that the system tests that are capable of being made on this system are sufficient to basically guarantee operation under emergency conditions?

DR. MC CULLOUGH: Well, the discussion yesterday, in my opinion, didn't go into some of the details which will be necessary to be specified for deequate testing of the system.

DR. BUCK: Can you add some of those details?

DR. MC CULLOUGH: I am trying to remember the system -- obviously, you must be very sure how it functions.

There was some discussion about the way in which the sodium hydroxide would be proportioned with the boric acid in the circulating loop which was described in the diagram of this system.

Now, the reply, as I recall it, was that this would be proven during the preoperational tests or perhaps be proven

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in the preoperational tests of this system. I don't have the relative figures as pressure drops and so forth. Depending upon how these figures would come out would determine whether there is an instability, whether it is reliable for proportions or not.

So I have not made a judgment as to what has been said. I doubt that what has been said is adequate but I believe that there will be further specifications before we are through here.

DR. BUCK: Do you expect to make a judgment on this before this plant goes into operation?

DR. MC CULLOUGH: If I am still retained by Con ED, yes, sir.

CHAIRMAN JENSCH: We better find out about that.

(Laughter.)

Can Mr. Cahill take a try at that?

MR. CAHILL: Dr. McCullough will still be retained by Con Ed.

DR. BUCK: We just got a permanent job for you.

(Laughter.)

CHAIRMAN JENSCH: If we ever get out of the hearing.

(Laughter.)

DR. BUCK: Basically my question, due to the statements that are made here, I have been concerned about how to test and how this overall system -- not only the spray system

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for cooling but the conjunction of the cooling and the ion absorption, should really be tested. Apparently there is no way of going through a retesting if it would spray on. I haven't heard anybody come up with a bright idea how to do this.

MR. CAHILL: Except for the air flow.

DR. BUCK: That's right. So my question really is: Are you putting thought on it as to how to test this system so it is adequate and can be proven that it will work at the time of an emergency?

MR. CAHILL: I gave quite a bit of thought to the problem already and will continue to give it thought. Let me add that there is quite an extensive program on this spray system both at Oak Ridge and at Battelle Northwest Laboratories and depending upon the results of these tests which are in progress, this will give us a good handle on how sensitive this spray system is.

I should add, by the way, that according to present data iodine absorption is not critically dependent upon the PH of the system. What is critical is retention of the iodine.

In the initial stages the difference between absorption by water, boric acid or alkaline sodium borate is not very important.

DR. BUCK: Because there is so much Iodine there, you mean?

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MR. CAHILL: Because there is so little.

DR. BUCK: Before it really gets spread around. All right.

It was my understanding that straight water itself was practically useless as far as either absorbing or retaining the iodine.

MR. CAHILL: This is still not quite settled, but the data I have seen shows this pretty well as picking up the iodine but it doesn't hold it.

DR. BUCK: Well, I think you know my worry on this thing because if there is an accident, we are really dependent on the iodine being absorbed and not getting out of that containment.

MR. CAHILL: We certainly are. This is a critical system.

DR. BUCK: It is the one critical item that I see that I can't say to myself I know how to test it.

MR. CAHILL: I can't give you details on how to test it, but I do see some ways in which it can be tested with quite good assurance that it will work.

DR. BUCK: That is what I am after. It is that assurance that people are still thinking about it and doing something about it.

MR. CAHILL: It does require considerable detail for it.

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DR. BUCK: Thank you.

CHAIRMAN JENSCH: Would you give us some idea what the testing procedure should be to give the assurance?

MR. CAHILL: Well, we could start out really on testing any system. You should start with your signal. What signal requires the system to start. Then you should look at the reliability of that signal.

CHAIRMAN JENSCH: Can you translate that to this system and this particular arrangement?

MR. CAHILL: As I understand it, this system will be turned on by high containment pressure. I would look at the instrument which --

CHAIRMAN JENSCH: Is that an adequate signal, do you think?

MR. CAHILL: Yes. If the sensor is reliable, it is an adequate signal. I don't see any condition of high containment pressure where I wouldn't want to turn this spray on. In other words, when the containment pressure is high, you turn the spray on. Is that a satisfactory answer?

CHAIRMAN JENSCH: Do I understand you to say if that is a false signal and you spray this around, you have the instrumentation in there that might suffer and have to be rebuilt before you get back into operation?

MR. CAHILL: Sir, youhave a nasty clean up problem, but powerplants have had similar malfunctions -- I am talking

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about fossil plants now -- and they have cleaned it up and got the plant back into operation.

CHAIRMAN JENSCH: Excuse me for interrupting. Go ahead.

DR. PIGFORD: I want to end up with a concrete thing that we can rest on here in the record. I agree with you that if the sample sensor that generates the signal is reliable, it will turn it on. I fully agree. But have you examined the sample here and can you tell us in your professional judgment if this one is reliable and will turn it on?

MR. CAHILL: I have not seen the design of the sensor, so I have not examined it.

CHAIRMAN JENSCH: Can you do that before this hearing is over, so you can give us your judgment on that?

MR. CAHILL: Yes.

DR. BUCK: Do you see any possibility where the spray should be turned on without the high pressure?

MR. CAHILL: At the moment I can think of no case where you should turn the spray on without high pressure.

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CHAIRMAN JENSCH: Excuse me for interrupting. Since you are going to examine the system later, maybe we need not press you further with questions at this time because you perhaps can give a better answer when you see the design, would you not agree?

MR. MC CULLOUGH: Yes.

CHAIRMAN JENSCH: This is after our recess time --

MR. TROSTEN: Mr. Chairman, before we recess I would like to put Dr. Wrenn on to clarify the one aspect of his testimony -- there was a question asked by Dr. Pigford and the question was this:

He asked Dr. Wrenn whether further research might be advisable if it were going at that 16,000,000 curie level basis.

CHAIRMAN JENSCH: Could this go until tomorrow? We want to look at the transcript, too, because there was a question I propounded in that field and I would like to know the background before we proceed.

The clarification can wait, can't it? The witness will be here tomorrow, won't he?

MR. TROSTEN: Yes.

CHAIRMAN JENSCH: All right, we will defer that.

Counsel from New York State AtomicEnergy Council, do you wish to say something?

MR. SCINTO: I believe Mr. Silletti would like to

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say something.

MR. SILLETTI: Could the New York StateDepartment of Health be released from this hearing?

CHAIRMAN JENSCH: We can envision no immediate call although I hesitate to let any witness go. Will it be agreeable that if it became necessary to have a question or two that we can ask Mr. Scinto to contact you and it will be convenient to come back?

MR. SCINTO: May I comment? It may relate to your point.

Mr. Scinto will be assisted by other technical personnel tomorrow who may be able to respond to the question but if there were a question needing an answer from Mr. Silletti, we would not hesitate to contact him.

CHAIRMAN JENSCH: That gives us reasonable assurance. We will proceed on that basis.

MR. CONNER: Mr. Chairman, four days ago, when the hearing started, I asked if we could perhaps have some of our witnesses taken out of order and you told me it was not necessary.

Dr. Burley has a serious personal problem and we would like to request the Board, if it has any questions on iodine or filter efficiency type questions, would they kindly take it up first thing in the morning in the hope he could be excused sometime before noon, if possible.

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CHAIRMAN JENSCH: We certainly will try to do that, indeed, for a personal situation like that.

We would like to request the other witnesses stay because we never know when we might want to ask questions.

We will, however, try to accommodate Dr. Burley tomorrow. If not, it may be if this goes longer than that, we can arrange another time for his return.

MR. CONNER: Fine.

CHAIRMAN JENSCH: Any other item before we recess? Hearing none, let us recess at this time to reconvene tomorrow morning at 9:30.

(Whereupon, at 5:15 p.m. the hearing was recessed.)

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