ORIGINAL

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of:

PHILADELPHIA ELECTRIC COMPANY

(Limerick Generating Station,
Units 1 & 2)

Docket No. 50-352 OL
50-353 OL

Location: Philadelphia, Pa. Pages: 12,104-12,313

Date: Wednesday, June 20, 1984

Please return original + 2 copies to
Jack Whetstine, EP-439 - Distribution: TR 01
0/1

TAYLOE ASSOCIATES
Court Reporters
[illegible] I Street, N.W. Suite 1004
Washington, D.C. 20006
(202) 293-3950

Sim 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	:	
PHILADELPHIA ELECTRIC COMPANY	:	Docket Nos. 50-352
	:	50-353
(Limerick Generating Station, Units 1 and 2)	:	

Commonwealth of Pennsulvania
Courtroom No. 5
Old Federal Courthouse
Ninth and Market Streets
Philadelphia, Pennsylvania

Wednesday, June 20, 1984

The hearing in the above-entitled matter reconvened, pursuant to recess, at 9:00 a.m.

BEFORE:

LAWRENCE BRENNER, ESQ., Chairman
Atomic Safety and Licensing Board
Nuclear Regulatory Commission
Washington, D. C. 20555

RICHARD F. COLE, Member
Atomic Safety and Licensing Board
Nuclear Regulatory Commission
Washington, D. C. 20555

PETER A. MORRIS, Member
Atomic Safety and Licensing Board
Nuclear Regulatory Commission
Washington, D. C. 20555

Sim 2

APPEARANCES:

On Behalf of Philadelphia Electric Company:

MARK J. WETTERHAHN, ESQ.
NILS N. NICHOLS, ESQ.
Conner and Wetterhahn, P.C.
1747 Pennsylvania Avenue, N. W.
Suite 1050
Washington, D. C. 20006

On Behalf of the Commonwealth of Pennsylvania, Governor's Energy Council:

ZORI FERKIN, ESQ.
Governor's Energy Council
P. O. Box 8010
1625 N. Front Street
Harrisburg, Pennsylvania 17105

On Behalf of the City of Philadelphia:

HERBERT SMOLEN, ESQ.
MARTHA W. BUSH, ESQ.
Deputy City Solicitor
1500 Municipal Service Building
Philadelphia, Pennsylvania 19102

Pro se and on Behalf of Friends of the Earth in the Delaware Valley:

ROBERT ANTHONY
Box 186
Maylan, Pennsylvania 19065

On behalf of the NRC Staff:

BENJAMIN H. VOGLER, ESQ.
ANN P. HODGDON, ESQ.
Office of the Executive Legal Director
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

* * *

mm1

I N D E X

WITNESSES:	DIRECT	CROSS	REDIRECT	RECROSS	BOARD
(Resumed)					
B. W. BARTRAM) G. F. DAEBELER) G. F. GUARINO) G. D. KAISER) S. LEVINE) E. R. SCHMIDT) A. L. TOBLIN) R. WALLER)					
By Mr. Vogler	12,105				
By Ms. Bush				12,125	
By Judge Cole					12,108
By Judge Morris					12,112
By Judge Brenner					12,123
(Sworn)					
MYRON FLIEGEL) JOHN C. LEHR) (Resumed) SARBESWAR ACHARYA) REX G. WESCOTT)					
By Mr. Vogler	12,137				
By Ms. Bush		12,144			
By Mr. Wetterhahn		12,237			
By Judge Brenner					12,265
By Judge Cole					12,269
By Mr. Vogler			12,274		
By Ms. Bush				12,277	
By Judge Morris					12,279
By Mr. Wetterhahn				12,280	

RECESSES:	Page
Morning	12,136
Luncheon	12,194
Afternoon	12,225
Afternoon	12,303

LAY-INS:	Following Page:
Testimony of Witnesses Wescott and Fliegel; and,	
Testimony of Witness Acharya; and	
Testimony of Witness Lehr Regarding Responses to Contention City 15 Related to the Limerick FES.	12,141

Sim 1-1

P R O C E E D I N G S

JUDGE BRENNER: Good morning.

We are prepared to have the staff continue its cross-examination at this time.

Whereupon,

B. W. BARTRAM

G. F. DAEBELER

C. F. GUARINO

G. D. KAISER

S. LEVINE

E. R. SCHMIDT

A. L. TOBLIN

- and -

R. WALLER

were resumed as a panel on behalf of the applicant and, having been previously duly sworn, were further examined and testified as follows:

CROSS-EXAMINATION (Resumed)

BY MR. VOGLER:

Q Good morning.

Yesterday the panel was talking about the conclusions they had reached with respect to the contribution to risk using WASH-1400.

Do you recall the testimony?

(Panel nodding affirmatively.)

Sim 1-2

I would like to ask you this morning if you would reach the same conclusions if you used Reg. Guide 1.109 as opposed to WASH-1400, and that would be the conclusions to the risk.

A (Witness Kaiser) Before I answer, I think we would like to say a couple of things.

The first is that the ICRD 30 and the WASH-1400, those conversion factors in our opinion represent the best consensus available and, therefore, we should use them.

Secondly, generally when you are doing a PRA you should try to use the most realistic rather than old or pessimistic conservative numbers.

And, thirdly, we were trying to be as comfortable as possible with the air pathway calculations and, of course,

(Continued next page)

im 1-2

WASH-1400, those conversion factors we used in that case.

Bearing all of those qualifications in mind, even so, if we were to use the Reg. Guide 1.109, those conversion factors, it would make less than a factor of two difference to our calculation of the risk of latent cancer fatality and, therefore, any conclusions that we have stated would not be altered.

Q Thank you.

With regard to the study on the Schuylkill and Delaware Rivers in comparing them with the strontium 90 measurements that were taken in the New York City area can you describe the probability distributions of strontium 90 deposition on the Schuylkill and Delaware Rivers from which the CCDR's for concentration were used? How were they correlated with the New York City study?

A (Witness Toblin) The concentrations from the New York City tap water were correlated with the corresponding concentrations from both the Delaware and Schuylkill, and when I say corresonding I mean at the same time. So that if the concentration was "X" at New York City and if at the same time it was "Y" at Delaware, that was the kind of correlation that was done.

MR. WETTERHAHN: Thank you.

Mr. Chairman, that concludes the staff's cross.

JUDGE COLE: Mr. Toblin, did you make any

more statistical type correlation between the New York City tap water and the Schuylkill and Delaware River waters? Did you actually calculate a correlation coefficient?

WITNESS TOBLIN: Yes, I did. It was on the order of .5 or .6, something like that. I forget the exact number.

JUDGE COLE: And what did that tell you with respect to the correlation?

WITNESS TOBLIN: It tells me that they are fairly well correlated. Obviously they are not extremely well correlated. However, the analysis is not very sensitive to the correlation. If one were to assume that the concentrations were the same and the date clearly shows they are comparable, the changes in the results would be something on the order of 10 percent. So the sensitivity is not very great to that correlation.

JUDGE COLE: All right, sir. Thank you.

JUDGE BRENNER: I guess I didn't understand your very last statement. You said if one were to assume the concentrations were the same.

WITNESS TOBLIN: Right.

JUDGE BRENNER: Then the result would be valid, and I am paraphrasing.

WITNESS TOBLIN: The result meaning the risk analysis.

JUDGE BRENNER: Well, if you assume the

Sim 1-4

concentrations are the same, isn't that a correlation of one? You have lost me somewhere.

WITNESS TOBLIN: Assuming the correlation as performed now is not "Y" equal "X", when I say they are the same, the concentration in the Delaware would be equal to the concentration in New York City, rather than the form of the equations that were used here.

JUDGE BRENNER: All right. I think you just stated it the opposite way of the way I would have been thinking of it, but I understand now.

Does the Commonwealth have any follow-up questions?

MS. FERKIN: No, I do not.

INDEXXXXX

BOARD EXAMINATION

BY JUDGE COLE:

Q I have several questions, gentlemen.

One is with respect to the 7 percent of the city who could not be served by the Baxter plant. In one of the references yesterday, a letter, I guess it is Item 17 in the list of applicant references, it indicates there is just one district, and I believe they mention the Belmont High Service District; is that correct, and I believe yesterday someone also mentioned the Roxborough High Service District. Which is it? It is both the Roxborough and the Belmont High Service Districts, or is it just the Belmont High Service District that is the seven percent?

Sim 1-5

A (Witness Schmidt) The seven percent number was based on both of these districts. The source of information for Belmont High was the letter, the cited letter. The Roxborough High was a communication with the same gentleman who authored the letter who said that that might be a problem also. To have some flexibility in some of our numbers, we included Roxborough High. Belmont High is about a three percent. They are both about equal.

Q All right, sir.

Now what was the basis for the determination that they could not be served by the Baxter plant? Do you know that, sir?

A In terms of our analysis, it was the letter that we received. Belmont High is across the river and requires a pumping station while the others are fed by gravity. Beyond that I don't really know.

A (Witness Guarino) It is a physical thing where the well is high, that is the wet well that would feed the pumps, that would feed the Belmont high pressure area.

The elevation is such that they have got to get the water from the operation of the Belmont Water Treatment Plant. But looking over the plant, I believe it would be possible to run a line from the clear well and from the filtered water basins to the wet well and I think supply water to that area, but it would require some piping and

Sim 1-6

some work.

Q How much of a problem would that be, sir?

A It can be done. It would be a simple engineering problem. The only thing would be time, timewise. My guess is that on an emergency basis you should be able to put that thing together in a matter of a week or two, to run the line, pump, et cetera.

Q All right, sir.

Do they have any storage capacity in these districts presently?

A Yes, they do. At that particular plant they have about 50 million gallons of filtered water and it is covered. So that that would be available once again, and if they just used it for human consumption, et cetera, it should last a few weeks.

Q All right, sir. Thank you.

One question about the figure that was used for the ingestion of water. A figure yesterday of one liter per person per day was used for the calculation of the ingestion of contaminated water. Another figure yesterday used was 60 gallons per person per day for personal use, for washing, cleaning and cooking.

What is the basis for the ingestion of one liter per person per day, and let me tell you what my concern is. I would have thought that it might have been more considering

the fact that you brush your teeth and you cook with the water. Is it one liter that gets inside? What is the basis for your using that one liter figure?

A First of all, the one liter per day was based on Regulatory Guide 1.109 for average population consumption. What that represents is direct ingestion of drinking water. Normal adult requirements would be on the order of two liters per day, but for the average population they assume that in addition to water people will be drinking milk, soda and other sources of fluids besides just straight tap water.

Q So your use of that figure was dictated by a regulatory guide?

A That is correct.

Q All right, sir. Thank you.

Do you think that is a reasonable figure, sir?

A Yes, I do, because the remaining water that would amount to the 60 gallons would really result in more indirect exposure of individuals. My calculations indicate that the resulting doses, let's say due to bathing or whatever, would be at least two orders of magnitude lower than that associated with the direct ingestion of the water. Therefore, we consider the additional use of that water to be insignificant as a contributor of the dose.

JUDGE COLE: All right, sir. Thank you.

That is all I have. Thank you.

Sim 1-8

INDEXXXXX

BOARD EXAMINATION

BY JUDGE MORRIS:

Q Mr. Guarino, yesterday you talked about the time to adjust the water supply system as being a reasonable time. Do you recall that?

A (Witness Guarino) Yes, I do.

Q Could you characterize what you mean by reasonable?

A Well, I really wasn't sure how long they would take, and that was the best word I could use to try to convey the idea that I felt that if you really made an all-out effort to, for instance, recycle the water back to the plant if you were going to treat it to the softening process, and I think if you really made an honest effort that it could be done in enough time to produce a good water while you were using the stored water.

Q Does that mean within a week or within two days?

A Oh, I would say you are talking more in terms of a week or possibly two weeks to do that.

Can I have some clarification, please? Did you mean -- I just picked out one aspect of that, and that referred to the option to treat water.

Q I was thinking of two different things and that was one of them.

A All right.

Sim 1-9

Q The other being an adjustment of valve line-ups from one system to another.

A Oh, that is a much shorter period of time. That is something that can be done I guess in 24 hours.

Q Fine. Thank you.

Can you tell me whether or not the City Government has the authority to limit the commercial use of water in its system?

A Yes, they do.

Q Has that ever been invoked?

A Yes, it has. It was during the period of draught which was maybe three years ago where the Water Commissioner and the Mayor. I think the direction came from the Mayor and not the Water Commissioner, where they did put into practice conservation methods. I don't remember the details, but, for instance, forgetting about industry for a minute, you weren't allowed to wash your car and you weren't allowed to water the grass. I know it extended into industry, but I don't recall the details.

Q So it was more than just persuasion and it was actual exercise of authority?

A It was exercise of authority, although I must confess I don't recall anyone being punished for perhaps a violation. I think I gave my feelings about that yesterday anyhow. I don't feel that there was any real need for that.

Sim 1-10

Q Do you have any idea of what the curtailment amounted to?

A No, I don't. I don't know the numbers. But I say this, that in an emergency I do believe you could greatly curtail the use of water because you certainly have the authoring, and I would say the City has the ability to make sure that industry shut down. If the concern is human life and the health of the community, I would think that the City would have the ability to make sure that the industries that use a tremendous amount of water would be shut down for that period of time.

This does happen many times during the summer. Many times during the summer in Philadelphia the hydrens are opened, and when that happens some of the presures go down almost to zero, and when that happens industry does not have water. Some of the industries close for the day and go home.

end Sim
Mimi fols

Q Well, recognizing that the commercial use is substantially more than domestic use, would it be your opinion that something on the order of 50 percent of the water supply could be curtailed?

A I would say in an emergency situation such as we are talking about here, you should be able to cut the water consumption more than by 50 percent.

Q Thank you.

Mr. Levine, yesterday you spoke of the purpose of the analysis done by the Applicant. As I read the contention, it really claims that the draft Environmental Impact Statement and I'll extrapolate that to the Final Environmental Impact Statement was inadequate for the reasons expressed.

So is it correct that you really didn't address that problem but you did address the problem of risk?

A (Witness Levine) Well, it is our view that our whole effort in this exercise has been to satisfy the regulatory requirement about the environmental impacts of severe accidents and we have addressed that in SARA. We have addressed that further in the contentions, all of the contentions in that area in this hearing.

We have also addressed the environmental impacts of water contamination and we find that the air contamination is very small compared to other risks.

For instance, every year in the City of Philadelphia about 4500 people die of cancers. Our numbers are a factor of a million less than that from the airborne pathway. They are a factor of almost a hundred million less for the water pathway, so we have tried to address those risks in a simple way, in a comprehensive way. Certainly in SARA for the surrounding population, we have not extrapolated to just the City of Philadelphia to show what the impacts on Philadelphia are of air and water contamination and we find these risks very small compared to all other risks.

We have been asked a lot of questions about planning for emergencies, which has to be done. There is a requirement for that. There is a question of how far down in detail you go for risks that are vanishly small.

There is already emergency planning for the 10 mile EPZ based on severe accidents. The question is how much further do you go than that.

Q Really what the poor guy was trying to establish was that your analysis was completely independent of the creation of the Environmental Impact Statement and has nothing to do with the adequacy of that document.

A That is correct.

Q Thank you.

Yesterday there was also some discussion, the City wanted to find out something about the uncertainty in the water

pathway calculations which you did not do explicitly, I gather?

A THat is correct. We did not do it explicitly.

Q But you did state that they were substantially less and I think you used the figure six percent of the airborne pathway?

A On a point estimate basis, they are six percent of the airborne pathway.

Q If the uncertainty associated with the airborne pathway was some constant times that point estimate, what could you say about the similarity of an analogous constant for the water pathway?

A I would say they would be generally similar. There are I think some more uncertainties -- or different kinds of uncertainties in the water pathway model than the air pathway model that might change the numbers somewhat, but not by large factors.

Q Dr. Kaiser, you do agree with that?

A (Witness Kaiser) Yes, I do.

Q So is your conclusion that even though that constant might not be the same, maybe it is a factor of two, three different, something like that, because the point estimate for the water pathway is so small that it really does not make any difference?

A (Witness Levine) That is essentially correct.

Q Thank you.

JUDGE MORRIS: That is all I have.

JUDGE BRENNER: Redirect?

MR. WETTERHAHN: May I have one second, please?

End 2. JUDGE BRENNER: Yes, surely.

xxx

REDIRECT EXAMINATION

BY MR. WETTERHAHN:

Q Dr. Kaiser, earlier today you answered a question about the use of Regulatory Guide 1.109, dose conversion factors and you stated that would only increase the outcome by a factor of two, is that correct?

A (Witness Kaiser) Yes.

Q Were you referring only to the risk from the waterborne pathway as opposed to the total risk from all pathways?

A I was referring to the risk of latent cancer fatality from the waterborne pathway alone.

Q Mr. Bartram, you were asked about the dose conversion factor for WASH-1400 for strontium. I believe your response yesterday was 8.4 times 10^{-5}, is that correct?

A (Witness Bartram) That is correct.

Q What is a similar dose conversion factor for strontium in ICRP 30?

A The dose conversion factor based on ICRP 30 methodology was really derived from NUREG CR-0150, and that value is for the whole body 9.45 times 10^{-5} millirem per PECO curie ingested.

Q How close does that make them?

A They are within about 10 to 15 percent.

Q Is that good agreement?

A Yes, it is.

Q Okay, on page 22 of the testimony, it speaks to replacement water and you were asked questions about replacement water. Does that replacement water only refer to utilizing additional water from the Delaware to replace Schulykill water?

A (Witness Schmidt) I think it refers to any source of water. It could be the Delaware. It could be the Susquehanna for small areas. You can truck water in. It does not take too many trucks to bring in water for drinking needs.

Q Mr. Levine, there was talk about your bounding calculation using the 50 times the amount of strontium. If you were to use -- I'm sorry, strike that.

You were asked questions yesterday about a document entitled, "Reference 17," which is Exhibit 169 for identification, as to the Protective Action Guides. Did you consider these as to be limits which cannot be exceeded?

A (Witness Levine) No, Protection Action Guides are not limits. They are guidance to officials who have to act in emergency situations that could be created by severe nuclear power plant accidents.

There is an EPA document which was discussed yesterday which gives extensive philosophical guidance to the so-called "officer in charge of the accident" and all of the various factors that he has to consider in making decisions about whether protective action is needed or not or whether the risks involved in protective action will be greater than

those involved in the emergency and a balancing has to be made of these various factors before decisions are made.

So a Protection Action Guide, which was loosely referred to in some of the conversation yesterday, as standards or limits or something are not that at all. They are really guidance to people for -- to decide at what point you should start looking at whether you should do things or not.

Q If instead of assuming that you use 93 percent of the water from the Delaware and 7 percent from the Schuylkill, you did your calculations based upon consumption by people in the same proportion as the water is normally used, that is 55 percent from the Delaware and 45 percent from the Schyulkill River, if you did the calculations in that matter, would that change your ultimate conclusions about the severity of the risk from the waterborne pathway or the airborne pathway?

A No, the risks might increase by a factor of three to four but they would still be extremely small compared to other risks.

Q Dr. Waller, you mentioned -- you gave an estimate for making modification in plants in order to accommodate certain emergency measures such as a two-stage filtration.

Is there anything in your experience which gives you some insight into whether these are possible or not?

A (Witness Waller) Yes. The closest thing that we

can come to this kind of emergency operations is earthquake experience, particularly the earthquake in the Los Angeles area, I believe it was about 1971, where the water supply was severely disrupted and rapid emergency measure had to be taken including extensive repiping, surface repiping for distribution and to a lesser degree for treatment.

Also, in Japan the 1978 Sendai earthquake, which I inspected the effects of afterwards, there were several instances where repiping was necessary, rapid repiping.

None of these are the type of activities that one would want to do on a routine basis but certainly on an emergency basis they are feasible and they have been practices.

Q Thank you.

Mr. Levine, considering your testimony and your answers to questions, if you were to have included the risks from this waterborne pathway under consideration in the SARA document, would any of the conclusions therein have changed the result of such conclusion?

A (Witness Levine) No.

MR. WETTERHAHN: No further questions. Thank you.

JUDGE BRENNER: There are two areas where the witnesses gave their view as to change or lack thereof of certain assumptions and I want to understand at this stage a little better how the answer was arrived at, at least in a qualitative sense with perhaps some idea of the quantification

but not necessarily the detailed calculation.

EXAMINATION BY BOARD

BY JUDGE BRENNER:

Q One of them was the answer to Mr. Wetterhahn's question that if you assume the normal proportion of water usage, that is 45 percent coming from the Schuylkill, the risk would only increase by three or four times I believe was the answer.

What is it in the calculation that leads to that change of being three to four times, since actually you are increasing Schuylkill use by more than just three or four times? You have still got the Delaware component in there.

A (Witness Schmidt) There is a fraction of the risk which is due to the Delaware, so you are decreasing the Delaware consumption and that compensates to the extent the result in this factor of three to four very roughly the concentrations, if you look at the figures in our testimony, the concentrations in the Schuylkill are approximately 10 times greater than the Delaware.

Q Returning to the subject area of the correlation between the New York City concentrations, I guess it was you, Mr. Toblin, who told us the correlation was about .5 to .6, I believe he said?

A (Witness Toblin) Right.

Q You also said that if you assumed the perfect

correlation the result would only change by 10 percent or so, is that also correct?

A I didn't say the perfect correlation. What I meant to say was that if New York City water were exactly the same concentration as Delaware or Schuylkill water, as opposed to being a perfect correlation, which does not mean they are exactly the same, that answer would change by something on the order of 10 percent, the risk would change by.

Q Could you tell me why the change would only be 10 percent and I guess you will have to explain your use of the correlation, the use you made of the correlation even though you didn't make express use of the correlation factor in your testimony in order to help me understand that?

A Okay. The method of determining the water concentrations was to take deposition rates of Strontium-90 and cesium deposition rates, and compare those, and I should say correlate those with the corresponding -- or correlate them with the strontium and cesium concentrations in the water.

That correlation, which is described in Appendix 1, and specifically equation 1 there, is not the correlation we were referring to just now. The correlation we were referring to just now was the transfer of New York City data or the use of New York City data to describe Philadelphia data.

If one were just to take the New York City water,

take those concentrations as being representative of the water in Philadelphia and perform the correlations of equations 1, the results to the risk would not be very different, as I said, than if one were to try to determine analytically what the relationship between the New York and Philadelphia waters were.

BY JUDGE COLE:

Q As I understand it, you extended the database of the Philadelphia water by using its correlation with the New York City, which had a longer record?

A (Witness Toblin) Exactly.

JUDGE BRENNER: Any followup by the City?

MS. BUSH: Yes.

xxx

RECROSS EXAMINATION

BY MS. BUSH:

Q Mr. Guarino, I believe you spoke of 50 million gallons availability in the Belmont High service territory?

A (Witness Guarino) I am sorry?

Q Where did you draw that number?

A It is really not 15. I think the capacity of the pumping station is 15 but I believe that the Belmont High service uses about 11 million gallons a day.

It was wrong with 40; I checked my notes the same time you were checking yours. I got it from the same book. It is 40 million gallons and not 50.

Q Okay.

I believe there was a question to Mr. Bartram about the -- on redirect examination -- about the relationship between the ICRP 30 and the WASH-14.

JUDGE COLE: You mean WASH-1400.

BY MS. BUSH:

Q WASH-1400 conversion factors. In response to a question you agreed that there was a good relationships between the two conversion factors. Is there statistically significant similarity between the two?

A (Witness Bartram) The two sets of dose conversion factors agree very closely with one another. That is not only with Strontium-90 but Cesium-137, Iodine 131 and also for the various organs of the body, but as far as a statistical correlation, we are really dealing with a calculated number and it is just the calculational result that would be reflected in each dose conversion factor library set that in general are within 10 to 15 percent of one another.

Q Mr. Schmidt, I believe you were asked a question about the trucks -- bringing in the trucks to serve the Belmont High service territory, indicated that would not be problematic.

Have you made a calculation as to how many trucks would be required for normal usage for that area?

A (Witness Schmidt) If I remember, I was asked a

question about alternative sources of water.

Q Yes.

A And the statement we made in our testimony was intended to mean very general that depending on the situation that occurred, you could get water from a variety of places and supply that as necessary. I mentioned trucking as an option and I am told that typically people supply their emergency needs for situations.Where you need to have it by truck, you talk typically a gallon or so per person per day. This is just for drinking, cooking needs where you -- not other needs, and a gallon a day for 100,000 people is 50 truckloads, which is not a large amount of water.

Q So that would not deal with the problem of fire needs, for example?

A Fire needs can be supplied by the pumping station without any problem whatsoever, by the normal water supply.

Q But the contaminated water supply?

A Contaminated water puts fires out fine.

Q How about for hospitals and nursing homes and any cooling equipment or heating equipment that might need water associated with those facilities?

A I haven't looked at that but I would think that these can be accommodated.

Q Mr. Levine, I believe you were asked questions in redirect about the PAG levels. Do you recall that direct

examination?

A (Witness Levine) Yes.

Q Would you agree that the EPA also states that a Protection Action Guide under no circumstances implies an acceptable dose?

A That it does what?

Q Under no circumstance implies an acceptable dose?

A No, it does not. I agree it does not.

Q Mr. Guarino, yesterday you were asked questions in response to mine and the Staff's about the salinity problem and you made the distinction between New York City and Philadelphia and indicated that you felt that the salinity problem in the past had been created by New York consumption, not Philadelphia consumption.

Is there something unique about New York's use or their distribution of the water after usage that makes New York consumption more deleterious on the Delaware than Philadelphia?

A (Witness Guarino) Yes, there is. They have the ability to draw water before we receive it and in contrast to Philadelphia, they don't return the water to the Delaware. They return it to another river and that is the problem.

Q What river do they return it to?

A I think it is the Hudson. I believe it is the Hudson. They take it out of one drainage area and it is

returned to another river. It is out of the system and that is the reason why we have problems and that is the reason why I stated that New York is the one that can have the greatest impact on a draught or the salt line.

Q So does it go back into the Delaware River Basin?

A No, it doesn't.

JUDGE BRENNER: Ms. Bush, maybe you can help me, maybe I am the only one in the room -- I have just lost the thread of the relevance of some of these details on the so-called salinity problem to the City-15 Contention.

MS. BUSH: Sure.

JUDGE BRENNER: So I don't understand the relevance of these last few questions. Can you help me out?

MS. BUSH: What the proposal is, that the health effects will be a certain level on the citizens of Philadelphia because they will be able to consume water from the Delaware instead of the Schuylkill and my questions are as to the feasibility of the consumption, this level of consumption from the Delaware, given the fact that there are constraints on the use of the Delaware.

JUDGE BRENNER: You want us to postulate that in case of a radiological emergency and a potentially available water supply would not be used because (a) at the same time there happens to be the salinity problem and then the further assumption that (b) salinity is such a greater problem that

the water would not be used. Those are the two hurdles we have to cross, right?

MS. BUSH: No. I think the posture of this proceeding is licensing of the plant and we have not assumed that the plants are licensed, so we are not talking about emergency plans. We are talking acceptable environmental impacts. So I would be requesting the Commission to examine the environmental impacts in determining whether the plant should be licensed and one of the environmental impacts would be the effect on the region of the proposed feasible alternative water supply. So it is a slightly different perspective.

JUDGE BRENNER: We still have to cross at least one of those hurdles. All right, I think the relevance is tenuous at best of City-15 as written. I will leave it at that at this point.

You can try to convince me otherwise. If, upon reviewing the record, you think you have a disagreement with the testimony on that point, you might not so we may never get to it, but you have answered, given me your view, which was my question.

Do you have any further questions?

MS. BUSH: I have no further questions in that area.

JUDGE BRENNER: I was not objecting. I just wanted to get the thread while I still had the benefit of your presence here.

End 3.

BY MS. BUSH:

Q I believe, Dr. Kaiser, you indicated yesterday that you had some information that was not in the testimony that you calculated. I was going to ask to review it during the break and I didn't.

Do you recall that information?

A (Witness Kaiser) Are you referring to the risks of latent cancer fatality?

Q Yes.

A Yes, I do recall those.

Q Were those consequence values or were they probability and consequence values?

MR. WETTERHAHN: Objection. Improper recross. We are talking about something she should have done during cross examination, as admitted by counsel. I don't see why we have to get into this at this time and drag out this hearing.

JUDGE BRENNER: Clearly it is not proper followup given your own statement. If it is something you forgot to look at, I am reluctant to let it come out in this way. For efficiency also, if you would have had it in front of you we maybe could have gone through it. How long would it take?

MS. BUSH: I think it probably should take on -- maybe a factor of three times the times we spent on it already.

JUDGE BRENNER: Say that again.

MS. BUSH: I think it will take about three times as much time as we have spent on it already. I think the issue is, will it prejudice the company.

JUDGE BRENNER: I don't know what time we have spent on it already so I don't know what your basis is when you phrase it that way.

Give me a moment.

(Board conferring.)

JUDGE BRENNER: We are not going to allow the questioning. We have been reluctant in the past to cut you off, as you know, and it isn't solely on the technicality that it is improper followup. It is also our judgment that we have got enough on the record as to what was done by the Applicant's testimony.

If you had -- to the extent you have a basic disagreement with it, you have got enough in there to propose your own findings.

You could have brought forward your own witnesses, as I commented, and you chose not to for your own reasons. We know what they have done. We have got the results here. We have got the cross examination. You have asked about what they have done and knowing the subject area that you are getting into, we think it is collateral to our main determination that we need here on the merits of this contention.

So for all of those reasons, we will cut it off

at this point.

BY MS. BUSH:

Q My last area of cross examination is about the assumption or the opinion, it seems to be the opinion of the witnesses that have spoken on this question, that there would be normal or less than normal usage in the event of an emergency.

In comparing this to a situation where there is an appeal for conservation for draught conditions, are you making the assumption that the two situations are comparable or tell me how you have taken into account the difference in the situation here where people will have the impression that they will not have any water available at all after the usage of a certain level of noncontaminated water?

A (Witness Levine) We have not addressed that matter. What we have tried to do is show what the risks would be with normal usage, what the risks would be with some slight modifications to the water usage plan between the two rivers and we have then suggested various kinds of things that might be done to reduce those risks although they are vanishingly small.

We have not studied in any rigorous or detailed way what should be done. That is something that would have to be determined by the officials in place at the time of the accident.

Q And you are not -- are you, though, representing to the commission here that there would be normal or less than normal usage of water so that there would be water available for the people in the high service territory for a certain amount of time?

A We have calculated the risks as though all the contaminated water available from the Delaware and from the Schuylkill were being drunk by people at a slightly reduced ingestion rate than the normal ingestion rate. We have not taken credit for any of the factors which might reduce those risks. We have merely suggested that there are ways to reduce those risks.

In our view, there will be plenty of water available for all needs with effective emergency actions.

MS. BUSH: I have no further questions.

JUDGE BRENNER: Commonwealth, any followup on the last ground?

MS. FERKIN: No.

JUDGE BRENNER: Staff?

MR. VOGLER: The Staff has one question.

BY MR. VOGLER:

Q Mr. Levine, do you have a copy of the Staff's Final Environmental Statement?

A (Witness Levine) Yes.

Q May I direct you to page 5-93, the last sentence on

the top paragraph that is being continued over.

In response to questions from Judge Morris regarding your analysis, your panel's analysis and your analysis and his comments as to whether or not the FES or the impact statement, as he referred to it, as to whether or not you have an opportunity to compare that with your own study -- based on that last sentence in that top paragraph on page 5-93 of the Final Environmental Impact Statement, based on your assessment, your independent assessment, would you agree with the Staff's statement on that last sentence?

JUDGE MORRIS: Mr. Vogler, would you mind reading that so we have it in the record?

MR. VOGLER: I'm sorry. Would you like a copy of the FES?

JUDGE MORRIS: No. Just read the sentence.

BY MR. VOGLER:

Q The sentence is: "This water pathway would be of small importance compared to the results presented here for fallout onto land."

A (Witness Levine) Yes, we agree with that. I believe I said the same thing in many ways and others have said the same thing in many ways.

MR. VOGLER: Thank you.

Nothing further, Mr. Chairman.

MR. WESTERHAHN: Applicant has nothing further.

JUDGE BRENNER: Did you say nothing further?

MR. WETTERHAHN: Nothing further.

JUDGE BRENNER: What was that page of the FES, 5-93?

MR. VOGLER: Yes, sir.

JUDGE BRENNER: I don't know if that is one of the portions you previously designated in evidence and that we certainly did not get a precise --

MR. VOGLER: Yes, I believe it is.

JUDGE BRENNER: Be that as it may, the Staff has continued to ignore our request as to precise designations of the FES as we get to each contention. We've stopped reminding you, but if we are going to take it into account, if it becomes important in the findings -- all right, we have completed the questioning of these witnesses.

We can let all of you gentlemen go. For some of you, you have been here before and at least for the foreseeable future we won't see you again, and we thank you again for your presence here.

(Panel excused.)

JUDGE BRENNER: We will take a 15-minute break until 10:10 and come back with the Staff witnesses in place.

End 4. (Recess.)

JUDGE BRENNER: Staff can begin now.

MR. VOGLER: Mr. Chairman, the Staff calls Dr. Sarbeswar Acharya, Dr. Myron Fliegel, Mr. Rex G. Westcott and John C. Lehr to the stand.

We note that as the Board knows, Dr. Acharya and Mr. Wescott have been previously sworn in this proceeding.

JUDGE BRENNER: We'll welcome Dr. Fliegel and Mr. Lehr here by swearing them in now, if you two will stand and raise your right hand.

Whereupon,

MYRON FLIEGEL

and

JOHN C. LEHR

were called as witnesses on behalf of the Staff, and, having been first duly sworn, were examined and testified as follows,

And whereupon,

SARBESWAR ACHARYA

and

REX G. WESCOTT

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

DIRECT EXAMINATION

MR. VOGLER: The Staff would prefer, Mr. Chairman, to identify all of the testimony and move it in at the same time if that is satisfactory.

We will start with Dr. Acharya.

The Staff also notes that it has distributed to the reporter, the Board, and all the parties the corrections that have been made.

Q Dr. Acharya, do you have before you a document dated June 4th, 1984, entitled, "Testimony of Sarbeswar Acharya Regarding Mesponses to City Contention City-15 Related to the Limerick Fianl Environmental Statement?

A (Witness Acharya) Yes.

Q Consisting of some 14 pages?

A Yes.

Q Have you read this testimony? Did you write this testimony?

A Yes.

Q Have you reviewed it for corrections?

A Yes.

Q If you were testifying here today, would your testimony be the same as it is in this testimony?

A That is correct.

Q As corrected?

A That is correct.

Q Attached to your testimony, Dr. Acharya, is a statement of your professional qualifications consisting of two pages. Have you had a chance to review that?

A Yes, the same as before.

Q Do you agree with that?

A Yes.

Q Thank you.

Dr. Fliegel and Mr. Wescott, do you have before you a document dated June 4th, 1984 entitled, "Testimony of Rex G. Wescott and Dr. Myron Fliegel Regarding Responses to Contention City-15 Related to the Limerick Final Environmental Statement" consisting of 21 pages including references and four attachments, I believe?

A (Witness Fliegel) Yes.

Q Dr. Fliegel, have you had a chance to review this testimony?

A Yes, I have.

Q If you were testifying here today, would your testimony be the same as is in here as corrected?

A Yes, it would.

Q Mr. Wescott, would your answers to those questions be the same?

A (Witness Wescott) Yes, it would, as corrected.

Q As corrected?

A Right.

Q Also attached to the back of your testimony are the professional qualifications of Dr. Fliegel, consisting of a page and a third. Dr. Fliegel, have you had a chance to review that?

A (Witness Fliegel) Yes, I have.

Q Do you agree that it is true and correct?

A Yes.

Q Mr. Wescott?

A Yes.

Q Your professional qualifications the same?

A That is correct.

Q Dr. Lehr, do you have before you a document dated June 4th, 1984, entitled, "Testimony of John C. Lehr Regarding Responses to the City of Philadelphia Issue, City-15, Related to the Limerick Final Environmental Statement"?

A (Witness Lehr) Yes, I do.

Q Consisting of 14 pages plus reference, plus two tables?

A Yes.

Q Have you had an opportunity to review this?

A Yes, I have.

Q If you were testifying here today, would your testimony be the same as it is corrected in this document?

A Yes, with one addition.

Q One addition?

A Yes, one additional correction.

Q Where is that?

A First page. The title of the branch in which I am employed is incorrect. It should be the Environmental and

Hydrologic Engineering Branch, not Hydraulic.

Q We will check that with the reporter, Environmental Hydrologic and Engineering Section -- are you referring to A-1?

A Yes, I am.

JUDGE BRENNER: I think it is Hydrologic instead of Hydraulic.

BY MR. VOGLER:

Q With regard to your professional qualifications which are attached, consisting of two pages here, have you had a chance to review that?

A (Witness Lehr) Yes, I have.

Q Do you agree with it? Is it true and correct?

A Yes.

MR. VOGLER: Mr. Chairman, the Staff would like to move and bind in the record the testimony of Dr. Acharya, Dr. Fliegel, Mr. Wescott and John C. Lehr.

JUDGE BRENNER: All right. In the absence of any objection, we will admit those documents so identified and corrected into evidence and bind them all into the transcript at this point as if read.

(Documents follow.)

xxx

Lay-in

June 4, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PHILADELPHIA ELECTRIC COMPANY	)	Docket Nos. 50-352
	)	50-353
(Limerick Generating Station, Units 1 and 2)	)	

TESTIMONY OF SARBESWAR ACHARYA REGARDING RESPONSES TO CITY CONTENTION CITY-15 RELATED TO THE LIMERICK FINAL ENVIRONMENTAL STATEMENT

Q1. Dr. Acharya, please state your name, address and position with the U. S. Nuclear Regulatory Commission.

A1. My name is Sarbeswar Acharya. My business address is U. S. Nuclear Regulatory Commission, Washington, D. C. 20555. I am the Senior Radiological Engineer in Section A of the Accident Evaluation Branch, Division of Systems Integration within the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission.

Q2. Have you prepared a statement of your professional qualifications?

A2. Yes. My statement is appended to this testimony.

Q3. Please state the purpose of your testimony and identify your responsibilities therein.

A3. The purpose of my testimony is to respond to the City of Philadelphia's admitted Issue CITY-15 with respect to contamination of open water bodies (and the City's water supplies sourced therefrom) that could occur as a result of fallout subsequent to an

atmospheric release of radioactivity in severe reactor accidents that were analyzed in the Limerick FES. Basically, my efforts were concentrated at the "front" and "back" ends of Dr. Fliegel's and Mr. Wescott's evaluation. Their evaluation is provided in their separate testimony.

Q4. What is Issue CITY-15?

A4. CITY-15 provides:

> The DES does not adequately analyze the contamination that could occur to nearby liquid pathways, and the City's water supplies sourced therefrom, as a result of precipitation after a release. A reasoned decision as to environmental impacts cannot be made without a site specific analysis of such a scenario.
>
> The DES addresses at great length releases to groundwater (DES at 5-34 et seq.), but gives only a cursory and conclusory discussion of contamination of open water (DES at 5-33). This issue is of crucial concern here as the two major water bodies at and near the facility are the City's only water supplies. The City also has open reservoirs within its boundaries which could be contaminated through precipitation. For an issue of such great importance, insufficient consideration has been given here. The mandate of NEPA to take a hard look at environmental consequences has been ignored.

Q5. Please summarize your work related to what you call the "front" end.

A5. I provided the following items to Dr. Fliegel and Mr. Wescott for their use in the fallout and water contamination analysis:

a) selection of a severe accident release category from those listed in FES Table 5.11c;

b) a rationale and procedure for using the CRAC code for estimates of the quantities of radionuclides that would be initially deposited on the open water bodies in the site-region and their adjoining catchment (watershed) areas by atmospheric fallout from the selected release category; and

c) a methodology for using the age-specific dose conversion factors, drinking water usage parameters and age-distribution in the general public for calculation of dose from water contamination.

Q6. Which release category did you select, and what is the basis for such selection?

A6. I selected the release category II-T/WW whose specifications are shown in FES Table 5.11c. A description of II-T/WW is given in Appendix H of the FES.

For a detailed probabilistic risk analysis of liquid pathway contamination one would use all of the release categories shown in FES Table 5.11c with their probabilities shown in FES Table 5.11d. Instead of following this approach, however, a much simpler and reasonably bounding type of analysis was performed by selecting one of the release categories from those listed in FES Table 5.11c which involve relatively large quantities of radionuclides in an atmospheric release, and artificially assigning it a probability

which is the sum of the probabilities of all release categories (the sum of the probabilities in FES Table 5.11d is approximately 9 x 10^{-5} per reactor year). This same bounding approach was undertaken by the staff for study of atmospheric fallout on the Great Lakes in AND ON THE WATER BODIES OF THE INDIAN POINT SITE the Fermi-2 FES (NUREG-0769, Addendum 1, March 1982). The reason for selecting release category II-T/WW is that the quantities of radionuclides in the atmospheric release associated with it are amongst the highest values for all the release categories in Table 5.11c.

Q7. What is the basis for adopting the CRAC code for estimation of initial deposition by atmospheric fallout?

A7. The atmospheric dispersion model of the CRAC code has the capability of calculating concentrations of radionuclides deposited on the ground below the traveling radioactive plume (in terms of curies per square meter of the ground surface, Ci/m^2) due to the effects of dry and wet deposition processes (collectively known as the process of atmospheric fallout) on the particulate radioactive matter in the plume. If any part of the ground plane is covered by an open water body over which the plume would pass, the radionuclide concentrations in curies per square meter (Ci/m^2) on the ground plane by fallout can be recognized as the initial radionuclide input (Ci/m^2) into that open water body surface.

The dispersion model of the CRAC code also has the capability of calculating the area in square meters (m^2) that would be covered by

the plume (cloud area) as a function of distance from the reactor. At any given distance, deposition on the ground plane over the area that is directly below the cloud can be calculated by multiplication of the cloud area (m^2) and the ground concentration (Ci/m^2) appropriate for that distance.

Therefore, the CRAC code can be ~~adopted~~ USED for calculations of initial deposition on the ground and the open water bodies in the Limerick site region subsequent to an atmospheric release from a reactor accident.

Q8. How was the CRAC code used for calculations of ground contamination due to initial deposition by atmospheric fallout?

A8. For the CRAC code analysis the Limerick site region is spanned by 34 spatial intervals, beginning at the site and extending up to 500 miles from the site. Ground concentrations of radionuclides (only those of importance to the liquid pathway contamination study of Dr. Fliegel and Mr. Wescott) and the cloud areas over these spatial intervals were calculated only for the selected release category II-T/WW on a conditional basis; that is, conditional on the occurrence of the postulated release.

Since a reactor accident could occur at any time of the year, 91 different accident start times uniformly distributed throughout a one-year period were used to derive probability distributions of radionuclide concentrations and cloud areas for each spatial

interval. For each start time, a string of consecutive representative historical hourly meteorological data following the start time ~~were~~ was used for the plume dispersion and fallout calculations. The sampling scheme and the meteorological data used are the same data as used in the Limerick FES for probabilistic analysis of severe accidents. Results from use of the 91 samples of post accident meteorological conditions were 91 different estimates of ground concentrations and the corresponding cloud area for each spatial interval. These estimates provided the basis for deriving probability distributions of the products of these items due to variations of meteorological conditions.

Q9. What was your involvement regarding use of age-specific radiological dose conversion factors, age-specific drinking water usage, and age-distributions in the general population?

A9. I advised Dr. Fliegel and Mr. Wescott in the use of these data following NRC's Regulatory Guide 1.109 "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision I, October 1977.

Q10. Please describe your work related to what you call the "back end".

A10. I have drawn several conclusions from the analysis of Messrs. Fliegel and Wescott. My general conclusions are:

a) A wind direction which would cause a high deposition of radionuclides on one (Schuylkill or Delaware) watershed would generally preclude a high deposition on the other watershed;

b) Strontium-90 (Sr-90) would largely dominate the radiological significance of Philadelphia water supply contamination from an atmospheric release of the type II-T/WW.

Q11. Please provide a perspective regarding contamination of the Schuylkill River conditional upon occurrence of the release category II-T/WW.

A11. For the first year average Sr-90 concentration probability distribution in the Schuylkill River:

a) The probability of not exceeding the 10 CFR Part 20 limit on concentration for unrestricted area use (1 MPC (maximum permissible concentration) which is 300 pico-Curie/liter or 300 pCi/l for Sr-90) is 14%; and

b) The probability of not exceeding 1/3 MPC is less than 5%.

On the other hand, for the average Sr-90 concentration in the Schuylkill five years after the initial contamination:

c) The probability of not exceeding 1 MPC is 65%; and

d) The probability of not exceeding 1/3 MPC is less than 20%.

An assessment of Dr. Fliegel's and Mr. Wescott's analysis shows that for Sr-90 concentrations in the Schuylkill:

e) The probability of not exceeding 1 MPC ~~during the first~~ after the initial runoff (up to two months) is 50%, but there is a 99% probability that the concentration would fall below 1 MPC 20 years after the accident; and

f) The probability of not exceeding 1/3 MPC after 30 years is less than 50%, but there is a 99% probability that this concentration would fall below 1/3 MPC 53 years after the accident.

All probability estimates include the probabilities of wind blowing into the 16 direction sectors of the compass centered at the Limerick site.

Q12. What is your conclusion about usability of the Schuylkill river for drinking water after contamination from the TI-T/MI release?

A12. According to 10 CFR Part 20.106(e), the allowable level of contamination in unrestricted areas for a population group beyond which radioactive releases would certainly be controlled is 1/3 MPC. However, from the preceding discussion, there is less than a 50% chance that the Schuylkill River contamination would fall below 1/3 MPC after 30 years. Therefore, the Schuylkill River as a source of drinking water given the occurrence of a severe accident and a II-T/WW type release would have a high probability for interdiction for a long period of time.

~~However, some point of time during the period of interdiction when Sr-90 concentrations in the Schuylkill River would fall to about 1/3 MPC, it is possible that use of Schuylkill water fo drinking would be considered.~~

Q13. What are the estimates of radiological exposure to the population of Philadelphia from drinking contaminated Schuylkill water?

A13. During the period of interdiction in which use of Schuylkill water for drinking would be denied, there would be no radiological exposure to people from the Schuylkill drinking water pathway.

Dr. Fliegel and Mr. Wescott's estimates of population exposures that would result from drinking Schuylkill water without any decontamination after the Sr-90 concentration falls to 1/3 MPC are 1.8×10^6 person-rem whole body dose and 7.2×10^6 person-rem bone

dose for all time (assuming only half of the Philadelphia population is served by Schuylkill drinking water).

However, the above estimates may be only hypothetical because water containing Sr-90 concentrations at 1/3 MPC may not be allowed for drinking. On the other hand, if use of Schuylkill water for drinking would be permitted only after Sr-90 concentration in the river would fall to the current EPA standard of 8 pCi/l in drinking water, then the residual population exposure resulting from such use for all time would be 8% of the above estimates; namely, about 1.4×10^5 person-rem whole body dose and 5.8×10^5 person-rem bone dose.

Q14. Please provide a perspective regarding Delaware River contamination analogous to that for the Schuylkill River, but conditional upon the release category II-T/WW.

A14. Dr. Fliegel and Mr. Wescott's analysis provides the following perspective.

For the first year average Sr-90 concentrations in the Delaware:

a) the probability of not exceeding 1 MPC is 98%;

b) the probability of not exceeding 1/3 MPC is 85%;

c) the probability of not exceeding 15 pCi/l is 50%; and

d) the probability of no contamination is 38%.

Dr. Fliegel and Mr. Wescott's analysis also shows that for Sr-90 concentrations in the Delaware:

e) The probability of not exceeding 1/3 MPC ~~during less than~~ AFTER the ~~first two months~~ INITIAL RUNOFF is 95%, but there is a 99% probability that Sr-90 concentration would fall to 1/3 MPC within 7.5 years after the accident.

Q15. What is your conclusion regarding the usability of the Delaware River for drinking water after contamination from the II-T/WW release?

A15. There is a very high probability that the Delaware water, if contaminated at all, would be interdicted for a period of less than two months (based upon consideration of interdiction until Sr-90 concentrations fall to 1/3 MPC).

Q16. What is your assessment of radiological exposure from use of contaminated Delaware water conditional upon II-T/WW?

A16. During this short period of interdiction in which use of Delaware water for drinking would be denied, there would be no radiological exposure to people from the Delaware drinking water pathway.

Dr. Fliegel and Mr. Wescott's estimates of population exposures that would result from drinking Delaware water without any decontamination after the Sr-90 concentration falls to 1/3 MPC are 1.8×10^6 person-rem whole body dose and 7.2×10^6 person-rem bone dose for all time (assuming that only half of Philadelphia population is served by Delaware drinking water). These estimates

are the same as those presented for the Schuylkill River under similar conditions.

As stated earlier, the above estimates may be only hypothetical because water with Sr-90 concentrations at 1/3 MPC may not be allowed for drinking. On the other hand, if use of Delaware water for drinking would be permitted only after Sr-90 concentration in the river would fall to 8 pCi/l, then the residual population exposures resulting from such use for all times would be about 1.4×10^5 person-rem whole body dose and 5.8×10^5 person-rem bone dose.

Q17. What situations could result in higher estimates of population exposures than you presented before?

A17. The earlier estimates of population exposures are either for Schuylkill contamination or for Delaware contamination. It is highly unlikely that both rivers will be severely contaminated at the same time. However, in the highly unlikely situation of severe contamination of both rivers at the same time, the Delaware river may be the source of drinking water for the whole city (Philadelphia) after an initial period of about two months. This may be possible BY RESTRICTING THE ~~via restriction of~~ use of Delaware water only for the purposes ~~other than~~ of drinking as effected by an appropriate drinking water distribution management plan. Under these circumstances the earlier estimates of population exposures would be doubled, but have only a very small likelihood.

Q18. What are the estimated risks associated with Philadelphia drinking water contamination?

A18. The risks of population exposure from Philadelphia drinking water contamination due to II-T/WW are derived from multiplication of the probability of II-T/WW (2×10^{-6} per reactor year) and the estimates of residual population exposures for all time after Sr-90 concentrations fall to 8 pCi/l. The results are 0.3 person-rem whole body dose per reactor year and 1.2 person-rem bone dose per reactor year from II-T/WW. Conservatively, using the sum of probability of all release categories in FES Table 5.11c (which is 9×10^{-5} per reactor-year), the results would be 13 person-rem whole body dose per reactor year and 52 person-rem bone dose per reactor-year associated with all Limerick severe accidents. These results are conservative because not all release categories in Table 5.11c would result in levels of water contamination as high as those from II-T/WW. A risk of 13 whole body person-rem per reactor year to the population of Philadelphia via the drinking water pathway contamination is small compared with the risk

Q19. What principal forms of health effects and their risks may result from drinking water contamination discussed earlier?

A19. Radiation doses associated with drinking water for a year contaminated with 8 pCi/l of Sr-90 would be much less than 1 rem to the critical organ; namely, the skeletal bone. Doses delivered to an individual at this rate would not result in early health effects. Estimates of latent cancer fatality due to 1.4×10^{5} person-rem whole body dose over all time is 8 cases excluding bone cancer, and bone cancer fatalities due to 5.8×10^{5} person-rem bone dose are

of 160 whole body person-rem per reactor year to the Sum population via the air and the ground pathways contamination estimated from the FES Figure 5.4-[illegible]

4 cases. The risks of these cancer fatalities are about 7×10^{-4} (excluding bone cancer fatality) per reactor year and about 5×10^{-4} bone cancer fatalities per reactor-year from all severe Limerick reactor accidents. These are small by comparison with the estimates of risk ~~shown in FES, Table 5.11h~~ of cancer fatalities of 9×10^{-3} per reactor year derived from FES Figure 5.4L from air and groundwater pathways contamination.

Q20. Does this conclude your testimony?

A20. Yes.

PROFESSIONAL QUALIFICATIONS
Dr. SARBESWAR ACHARYA
U.S. NUCLEAR REGULATORY COMMISSION

I am Sarbeswar Acharya, the Senior Radiological Engineer with the Accident Evaluation Branch, Division of Systems Integration, Office of Nuclear Reactor Regulation. I have served on the Commission staff since January of 1977 in several capacities. My assignments have included assessments of radiological consequences to man and the environment of normal and accidental releases of radionuclides from nuclear power reactors, mathematical and computer modeling thereof, assessment of the generation and transport of radioactivity in reactors themselves resulting from accidents, and technical monitoring of Commission-funded confirmatory research and technical assistance contracts for modeling of external and internal radiation dosimetry to calculate age-dependent radiological dose conversion factors. I am presently responsible for developing and applying improved methods of assessing accident risks of reactor operation for use in Environmental Impact Statements. I have participated in accident risk assessments in virtually all nuclear power reactor Environmental Impact Statements since 1980, and aided in formulation of the procedure for the staff implementation of the Interim Policy Statement on "Nuclear Power Plant Accident Considerations Under the National Environmental Policy Act of 1969." I performed the technical analysis for the staff assessment of accident consequences and risks of the Indian Point reactors, and presented expert staff testimony on the subject at the Indian Point ASLB hearing in February 1983.

Prior to joining NRC in 1977, I was employed by the Bechtel Power Corporation for about 3 years. During this period I developed computer models to evaluate the effectiveness of containment sprays containing chemical additives for radioiodine control under accident conditions in pressurized water reactors, developed computer models for assessing decay heat loads in spent fuel pools for design of cooling systems, developed assessment methodologies for evaluating doses to control room operators and the offsite population from accidental releases of radioactivity, and performed nuclear fuel-cycle economic analysis. During the 1970-71, 1971-72, 1973-74 academic years I taught physics and mathematics at Hawthorne School in Washington, D.C. During 1972-73 I was a post-doctoral research fellow at North Carolina A&T State University doing research in molecular physics, and teaching physics and mathematics to science and engineering students.

My academic training consists of undergraduate courses at Utkal University in India during 1948-52 in physics, mathematics, chemistry and biology leading to a B.S. degree in 1952 with emphasis in physics. During 1952-57 I studied at the University of Delhi in India receiving an M.S. degree in physics in 1954 and engaged in graduate-level research in physics. From 1958 to 1966 I taught physics at undergraduate and graduate levels at colleges affiliated to the Utkal University. From 1967 to 1970 I studied and taught physics and related mathematics, and performed research at the University of Maryland. In 1971 I received a PhD from the University of Maryland, with emphasis in theoretical praticle physics and quantum field theory. I have taken

several specialized training courses since receiving my PhD in such areas as nuclear power plant design and operation, professional engineering registration, system reliability, health physics and radiation protection, mathematics and statistics, probabilistic risk analysis, and nuclear reactor safety.

I am a member of the American Nuclear Society and the Health Physics Society.

June 4, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PHILADELPHIA ELECTRIC COMPANY	)	Docket Nos. 50-352
	)	50-353
(Limerick Generating Station, Units 1 and 2)	)	
	)	

TESTIMONY OF REX G. WESCOTT AND DR. MYRON FLIEGEL
REGARDING RESPONSES TO CONTENTION CITY-15
RELATED TO THE LIMERICK FINAL ENVIRONMENTAL STATEMENT

Q1. Please state your names, your positions and the nature of your work at the Nuclear Regulatory Commission (NRC)?

A1. My name is Myron Fliegel. I am the Leader of the Hydrologic Engineering Section in the Environmental and Hydrologic Engineering Branch, Division of Engineering, Office of Nuclear Reactor Regulation. My duties include supervision of the professional work of the hydraulic engineers in my section and subsequent review of their technical evaluations. A statement of my professional qualifications is attached.

My name is Rex G. Wescott. I am a hydraulic engineer in the Hydrologic Engineering Section. My duties involve preparation of the hydrologic engineering sections of the staff's safety evaluation report and environmental statements. Technical evaluations performed include: radionuclide transport in ground and surface waters, site flooding potential, cooling water availability and other

hydrologic issues associated with nuclear power plants. I have testified previously in this proceeding concerning hydrologic issues in regard to the supplemental water supply system and to a cooling tower collapse due to blast overpressures. A statement of my professional qualifications is bound into the transcript following Tr. 3490 and Tr. 9045. Another copy is attached to this testimony.

Q2. Please state the purpose of your testimony.

A2. The purpose of our testimony is to respond to the City of Philadelphia admitted Issue CITY-15 with respect to contamination of nearby liquid pathways and the City's water supplies sourced therefrom that could occur as a result of fallout subsequent to an atmospheric release of radioactivity in severe reactor accidents that were analyzed in the Limerick FES.

Our testimony deals with the liquid transport aspects of this contention. It draws upon the separate testimony of Dr. Acharya and of Mr. Lehr.

Q3. What is the specific nature of your testimony?

A3. Our testimony concerns the deposition and runoff in surface water bodies of radioactivity released to the atmosphere as a result of a severe reactor accident at the Limerick Generating Station.

Discussion of the methodology used to model deposition on land and surface water bodies is contained in Dr. Acharya's testimony.

Our testimony presents the resulting probability distributions of long term concentrations of Strontium-90 (Sr-90) in drinking water that would result from this radioactive fallout.

Our testimony also addresses the maximum short term consequences in regard to drinking water contamination that may result from radioactive fallout subsequent to an atmospheric release of radioactivity in a very severe reactor accident at the Limerick Generating Station.

We are jointly responsible for all of the following testimony.

Q4. Briefly describe the Schuylkill and Delaware Watersheds.

A4. The Schuylkill watershed has an area of almost 1,900 sq miles at Philadelphia and an average flow of about 3,000 cfs (2.7×10^{12} liters/year). Existing storage reservoirs control the flow from over 20% of the watershed. In addition, there are desilting basins on the main stem of the Schuylkill River for control of sediment load.

The Delaware watershed has an area of almost 7,781 square miles at Philadelphia, and an average flow estimated to be over 12,000 cfs (1.07×10^{13} liters/year). Storage reservoirs control flow from about 18% of the watershed. Freshwater flow at Philadelphia is regulated by the Delaware River Basin Commission to meet flow objectives at Trenton during drought periods.

Q5. How are these watersheds oriented with respect to one another?

A5. The long axis of the Schuylkill Basin runs in a northwest to southeast direction with the farthest point in the watershed about 50 miles to the northwest of the Limerick site. The long axis of the Delaware Basin runs north-northeast to south-southwest with the farthest point in the watershed about 160 miles north-northeast of the Limerick site. Because the watersheds are oriented in different directions relative to the site, a wind direction which could cause a high deposition on one watershed generally would preclude a high deposition on the other watershed.

Q6. Please describe the models and methodology used to estimate the amount of radionuclides that could be deposited on the Schuylkill and Delaware River Basins as the result of an accident.

A6. As described in Dr. Acharya's testimony, the ground deposition of various radionuclides, as a function of distance from the plant site, was calculated by the CRAC code. The CRAC run made for this calculation used actual meteorological data for the site (the same data used in the Limerick DES/FES) to determine dispersion and deposition of the radioactive "cloud" resulting from a release category II-T/WW. The pattern of dispersion and deposition for a given radionuclide is dependent on the meteorologic parameters at the starting time of the accident and the period thereafter during which the plume passes over the site region. By starting the analysis of the accident at many different times over the year, many

estimates (91) of radioactive deposition within any given distance were determined.

Q7. How were the results from the CRAC deposition model applied to the watersheds?

A7. The area around the plant was divided into 16 equal sectors each containing a 22.5 degree arc. For each of these sectors the probability of the wind blowing to it was determined from meteorological data. For each sector, the distance from the plant to the boundaries of the watersheds was determined. Using the CRAC output, and the location of the watersheds relative to the site, the amount of deposition in the watersheds for various wind directions and meteorologic dispersion conditions was determined.

Q8. How were probability distributions for these various depositions determined?

A8. Each deposition has a probability of occurrence associated with it. Given the accident, the probability of occurrence is equal to the probability of the associated starting meteorological condition multiplied by the probability of wind blowing in the proper direction. The depositions were rank ordered from highest to lowest, and the probability of nonexceedance for a given deposition was determined as the sum of the probabilities of occurrence of all depositions lower than that given deposition.

Q9. What is the nonexceedance probability?

A9. The nonexceedance probability is the probability that a given deposition will not be exceeded after the accident (on which the probability distribution is based) has occurred. The nonexceedance probability is equal to one minus the exceedance probability.

Q10. What are the cumulative probability distributions for depositions of Sr-90 on the Schuylkill and Delaware Watersheds?

A10. The cumulative probability distribution for depositions of Sr-90 on the Schuylkill and Delaware watersheds is shown in Attachment 1.

Q11. Briefly, describe what the probability distribution in Attachment 1 shows?

A11. The curve marked Schuylkill watershed shows the non-exceedence probability of a given deposition in that basin given the accident. Thus, the curve shows that there is a 99% chance that less than 160,000 curies of Sr-90 would be deposited and a 52% chance that less than 80,000 curies would be deposited following a category II-T/WW release. Similarly, for the Delaware watershed, there is a 99% probability that less than 140,000 curies would be desposited and a 50% chance that less than 5,000 curies would be deposited. There is about a 40% probability that there would be virtually no deposition in the Delaware basin following the accident.

Q12. Describe the model used to calculate the amount of a radionuclide which could be washed off the watersheds?

A12. The radionuclide runoff model consists of three basic terms. One term describes the initial washoff (within a month or two after deposition) as a fraction of the total radionuclide deposited. Another term describes the annual washoff (primarily due to erosion) as a constant fraction of the total radionuclide inventory available for transport during the year. A third term accounts for radionuclide losses such as from radioactive decay. The pertinent terms and equations are shown in Attachment 2.

Q13. What are some of the assumptions and limitations of the model?

A13. The model assumes that the initial washoff is not dependent on when the accident occurs and that the fraction assumed for annual washoff stays constant and does not vary from year to year. The model is limited to determining radionuclide transport over a period of years.

Q14. Do these assumptions significantly limit the usefulness of the model to predict the total amount of Sr-90 washed off from the watershed into the river?

A14. No. Studies on watersheds in the United States of washoff of Sr-90 deposited by atomic weapons tests in the 1950's and 60's (Ref. 1) have shown the initial washoff of Sr-90 to be only a few percent of the total deposition. Hence, the total amount of washoff is relatively unaffected by changes in the initial washoff coefficient. Also, although the annual washoff rate due to soil erosion would be expected to increase in wet years, the runoff would also increase,

reducing the proportion of the downstream flow actually used for drinking water. For abnormally dry years, although the proportion of downstream flow used for drinking water will increase, we would expect the amount of Sr-90 washed off to decrease. In conclusion, we expect the time averaged concentration levels not to be significantly affected by the occurrence of abnormally wet or dry years.

Q15. Has this modeling approach been used before to calculate drinking water doses from airborne releases?

Q15. Yes, a very similar approach was used by Dr. Richard Codell of the Staff to determine drinking water dose from a hypothesized atmospheric release at the Indian Point Plant (Ref. 2). This approach has also been described in detail by Helton, Muller and Bayer (Ref. 3) as part of a study performed by Sandia National Laboratory.

Q16. How were the model coefficients determined for the model which you used?

A16. The model coefficients were chosen after a review of the coefficients determined for similar models in other watersheds. In our opinion, the most reliable coefficients were those determined by Dr. Codell for the New York City water supply. Dr. Codell used monthly average measurements of Sr-90 in the New York City tap water and corresponding monthly measurements of Sr-90 deposition over the watersheds in the 1950's and 60's to determine coefficients for washoff into the New York water supply reservoirs. After adjustment

for drainage area and runoff, Dr. Codell's coefficients indicated that the fraction of Sr-90 initially washed off is 1.9% and the fraction of remaining Sr-90 eroded off each year is .84%. Dr. Codell also determined that losses of Sr-90 in the watershed, from other than radioactive decay, accounts for over 75% of the Sr-90 that is deposited but never washed off. Radioactive decay accounts for the remainder of the "lost" Sr-90. Based on these results, we chose 2% for the fraction of initial washoff and 1% for the fraction of annual washoff. For conservatism, we assumed that all "lost" Sr-90 would be due to radioactive decay only.

Q17. Why do you consider these parameters applicable to the Schuylkill and Delaware Watersheds upstream of Philadelphia?

A17. Quarterly measurements of Sr-90 were taken in the Schuylkill and Delaware Rivers in the 1950's and 60's. A review of these measurements showed approximately the same concentration of Sr-90 in the Schuylkill and Delaware Rivers as was recorded for the New York City tap water. We therefore concluded that the transport of Sr-90 in the Schuylkill and Delaware Watersheds was very similar to the transport of Sr-90 into the New York City reservoirs, and that the use of similar model coefficients was justified. Also, a study by Menzel (Ref 1) for eight regions in the United States including the Northeast showed the fraction of initial washoff varying from .59 to 2.17% and the fraction of annual washoff varying from .17 to .75%. Hence, the coefficients determined from Dr. Codell's study are in close agreement with those determined for other watersheds.

Q18. Were radionuclides other than Sr-90 considered in the washoff model?

A18. No, because of the relatively slow rate of washoff only the long lived radionuclides such as Sr-90 and Cesium-137 (Cs-137) will contribute significantly to total population dose from drinking Because of the higher ion exchange capacity of Cesium as compared to Strontium, a much smaller quantity of Cesium would be washed off every year from the watersheds even though more Cs-137 is likely to be deposited from the hypothesized atmospheric release. Based on the amount of Cs-137 assumed released, the runoff coefficients which would be applicable to Cesium, and the dose conversion factors from Regulatory Guide 1.109, we conclude that CS-137 would contribute less than 10% to the total dose for various probabilities. The other radionuclide considered for population dose estimates was Sr-90.

Q19. What are your estimates of the concentrations of Sr-90 in the Schuylkill River, Delaware River, and untreated and uninterdicted Philadelphia water supply for the first year following the accident as a function of non-exceedance probability?

A19. The concentrations of Sr-90 in the various watersheds are shown in Attachment 3.

Q20. What is the significance of the cumulative probability distribution of concentrations?

A20. Although the Schuylkill River is likely to be highly contaminated, the Delaware River has only a 2% chance of being above the 10 CFR

Part 20, Appendix B, Table II concentration of Sr-90, which is 300 pico curies per liter. The Delaware River has a 38% probability of not having any Sr-90 from the accident and there is a 50% probability that the concentration in the Delaware River following the accident would be less than 15 pico curies per liter (15 pCi/l). Therefore, it is highly probable that the Delaware River would remain a safe drinking water source after the accident.

Q21. How long would it take for the Schuylkill River concentrations to diminish to the 10 C.F.R. Part 20 limit for Sr-90?

A21. There is a 50% probability that the concentration of Sr-90 in the Schuylkill River would be below the 10 C.F.R. Part 20 limit after, at most, the initial washoff period (1 to 2 months). For the most severe cases, it could take as long as 20 years for concentrations to recede to the 10 C.F.R. Part 20 limit. There is a much lower probability (13%) that the concentration of Sr-90 in the Schuylkill River will be below 1/3 MPC (100 pCi/l) after the initial washoff period. It could take as long as 53 years for the concentrations to recede to 1/3 Maximum Permissible Concentration (MPC). The cumulative probability distributions of time for the Schuylkill River to reach MPC and 1/3 MPC are shown in Attachment 4.

Q22. What is the significance of these concentration levels and recession times in regard to population dose from drinking water?

A22. For our evaluation of radiological impacts, we assumed that the maximum concentration at which human consumption of water will be

permitted is MPC, although consumption might only be allowed at concentrations well below this. The population dose will then be dependant on the concentration limit chosen for permitting consumption. Whatever the concentration at which human consumption is allowed, it may be achieved by treatment, by dilution with "cleaner" water, or by waiting for the water sources concentration to come down to the desired level. We also assumed that unrestricted use of water will be allowed for concentrations at or below the EPA limit of 8 pico-curies per liter. Therefore, the dose to the population of the City will consist of an annual dose from drinking water at a steady concentration of Sr-90, which has been achieved by water treatment or dilution (if required), and a residual long term dose from drinking water during the time that water drops below the concentration until it recedes to essentially zero for a given concentration between MPC and the EPA limits.

If, for example, the concentration of Sr-90 is maintained at the EPA limits (8 pCi/L), then the immediate dose to the population will consist of a constant dose over the period at which the river is above this concentration, and the water must be treated to meet the limit. In addition, a residual dose will be contributed by drinking the water after the concentration in the river has fallen below the EPA limit and removal of Sr-90 has been discontinued.

For purposes of comparison, we have calculated the annual and residual doses for concentrations of Sr-90 at MPC, 1/3 MPC, and the EPA limits. In that the concentration of Sr-90 from one source is likely to be different from the concentration from the other source,

the population doses are calculated for the population normally served from a single source (.8 million people).

Q23. What would be the annual dose to people from ingesting water at concentrations of 1 MPC, 1/3 MPC, and the EPA limits?

A23. The annual dose to people from ingesting water at a concentration of 1 MPC is 1.6×10^5 person-rems (whole body) and 7.2×10^5 person-rems (bone) per source. The annual dose from ingesting water at a concentration of 1/3 MPC is 6.4×10^4 person-rems (whole body) and 2.4×10^5 person-rems (bone) per source. The annual dose from ingesting water at the EPA limits is 5×10^3 person-rems (whole body) and 1.9×10^4 (bone) per source.

Q24. What would be the long term residual doses to people from ingesting water once it has receded to concentrations of 1 MPC, 1/3 MPC, or EPA limits before treatment?

A24. The long term residual dose to people from ingesting water which has receded to 1 MPC is 5.4×10^6 person-rems (whole body) and 22×10^6 person-rems (bone) per source. The residual dose from ingesting water which has receded to 1/3 MPC is 1.8×10^6 person-rems (whole body) and 7.2×10^6 person-rems (bone). The residual dose from ingesting water which has receded to the EPA limits is 1.4×10^5 person-rems (whole body) and 6×10^5 person-rems (bone).

Q25. How were these population doses determined from the deposition of Sr-90 on the watersheds and the concentration in the rivers?

A25. The population dose from drinking water is a function of how many curies of Sr-90 are actually ingested by people. The number of

curies ingested is a function of the number of curies transported by the river during the period of ingestion and the fraction of the river water that is actually ingested.

Q26. How was the amount of Sr-90 transported by the rivers determined?

A26. Using the previously described runoff model, the fraction of Sr-90 that runs off after the initial deposition and the remaining fraction that erodes off every year may be calculated. Taking into account radioactive decay and integrating this expression over infinite time, the fraction of the initial deposition of Sr-90 that eventually finds its way into the river is estimated. For Sr-90, this fraction was determined to be approximately 31% for both the Delaware and Schuylkill River Basins.

Q27. How was the fraction of total flow ingested determined?

A27. The average flow in the Schuylkill River at Philadelphia was determined to be approximately 2.7×10^{12} liters/year from long term flow records. The average freshwater flow in the Delaware River Estuary at Philadelphia was estimated to be about 1.1×10^{13} liters/year. Average drinking water use from each of the rivers was determined using Table E-4 of Regulatory Guide 1.109 (Ref. 4). The total drinking water use from each of the rivers was determined to be 2.7×10^{8} liters/year. Therefore, the fraction of flow used for drinking water was .01% for the Schuylkill River and .0025% for the Delaware River Estuary.

Q28. How was the dose conversion factor determined?

A28. The age and usage weighted dose conversion factor used was the whole body dose conversion factor for Sr-90 as determined from Tables E-11 through E-13 of Regulatory Guide 1.109. The composite dose conversion factor for an assumed distribution of adults, children and teenagers was determined to be 2.21×10^{-3} millirem/pico curie of Sr-90 ingested for the whole body dose and 8.89×10^{-3} millirem/pico curie for the bone dose ingested.

Q29. What is the effect of radionuclide deposition on water supply reservoirs and open storage tanks or basins?

A29. Although deposition of radionuclides on open water bodies can result in immediate contamination, the total amount of radioactivity entering the water supply in this manner will be very small in comparison to that entering the water supply as washoff from the upstream watersheds. Also the City of Philadelphia is located such that a heavy deposition on the reservoirs within the City ~~will~~ is likely to not coincide with ~~a heavy deposition on~~ high concentrations in the Schuylkill or Delaware ~~watersheds~~ rivers. Therefore, replacement of the contaminated water with relatively clean water prior to residential distribution would be expected.

Q30. Did you make estimates of effects or consequences for time periods less than 1 year?

A30. Yes, we looked at what river concentrations could be for periods less than a year. We used the deposition on the watersheds calculated with the CRAC code as discussed previously.

Q31. How did you calculate river concentrations?

A31. River concentration is the amount of a nuclide, in Curies, running off the land into the river or depositing directly on the river divided by the total river flow during the period of interest. Measurements of Sr-90 runoff have been made for various river basins as discussed previously. Typical values are a few percent; i.e., it was found that of the Sr-90 deposited on a watershed only a few percent is removed by initial runoff.

Q32. What assumptions and parameters were used in your calculations?

A32. We confined the analysis to the Schuylkill River basin. Because of its lower flow, concentrations would be higher for a given deposition probability than in the Delaware River. This is seen in the cumulative probability distribution curves of river concentration for the two rivers (Attachment 3). We also looked only at the case of maximum deposition in the Schuylkill basin. The maximum deposition in the basin determined using the CRAC code was about 162,000 Curies of Sr-90. Our estimate of concentrations is based on this assumed deposition.

We looked at several time periods and made different assumptions on Sr-90 runoff.

Q33. What is the significance of using a deposition of 162,000 Curies of Sr-90 in your assessment of concentrations?

A33. This quantity of Sr-90 is essentially all of the Sr-90 assumed to be released in the accident sequence considered. A probabilistic assessment of the amount of Sr-90 that would be deposited in the Schuylkill River basin shows that there is less than a 1% chance that it would all be deposited in the basin. There is about a 50% probability that less than half of the Sr-90 would be deposited in the Schuylkill basin. Thus, our analysis of the consequences of all of the Sr-90 being deposited in the Schuylkill River basin is a worst case analysis, and all of our results should be viewed in this context.

Q34. Please discuss your results.

A34. We considered a number of cases. First we considered situations with average Schuylkill River flow. We assumed that 2% of the Sr-90 ran off. This runoff percentage is consistent with measured data for runoff of Sr-90 deposited in many watersheds as a result of fallout from atmospheric weapons testing. We considered the runoff to occur in time periods of a month, a week, and a day. The resulting Sr-90 concentrations ranged from less than 15,000 pCi/l for runoff in a month to about 440,000 pCi/l for runoff in a day.

Q35. How do these concentrations compare to drinking water standards for Sr-90?

A35. The maximum allowable concentrations of various nuclides in unrestricted areas are given in 10 CFR Part 20, Appendix B, Table II. These concentrations are typically used for normal operation rather

than accident conditions. Additionally, 10 C.F.R. § 20.106 allows concentrations to be averaged over periods up to one year. Nevertheless, we thought it would be instructive to compare these concentrations with those we calculated above. The Table II concentration for Sr-90 is 300 pCi/l. The Sr-90 concentrations discussed above range from about 49 times this value for the case of runoff in a month to almost 1500 times this value if runoff were to occur in only one day.

Q36. What about time periods shorter than one day?

A36. For short time periods, the flow in a river and the concentration of a pollutant entering the river as runoff is limited by the response time of the river system. For short time increments, the entire drainage system will not have had enough time to transmit flow and pollutants downstream to the point of interest. For the Schuylkill River this would be the case with time periods less than a day. It is probably also true for time periods somewhat longer than one day, i.e., the shortest time period that all of the Sr-90 runoff (assumed to be 2 percent of the deposition) can flow past the Philadelphia intake is more than one day. The one day time period is a conservative bound.

Q37. Do you conclude that the effects on drinking water would be worse if runoff occurs relatively rapidly?

A37. No. Clearly the concentration of Sr-90 would be higher for rapid runoff. However, what would probably happen is that during the

period of initial runoff, drinking water would not be withdrawn from the Schuylkill. Quick runoff would shorten the time period during which the Schuylkill would not be used for drinking water supply. Because of this, rapid runoff would probably be the more desirable condition.

Q38. Is it possible to have significantly more than 2 percent of Sr-90 runoff?

A38. Yes. Experimental data have shown initial runoff of over 10 percent of deposited Sr-90 on bare plots. We considered the situation where the deposition occurs during a storm in which the ground is already well saturated and there is significant runoff. We assumed 50 percent of all the soluble nuclides would run off and that this would occur in a time period of only one day. We believe that these are extremely conservative assumptions; they are used primarily to bound the problem.

Q39. What assumption did you make about Schuylkill River flow for this scenario?

A39. Clearly, the assumptions we made regarding the high nuclide runoff would be appropriate only during conditions of high river flow. We used the average annual flood flow for this assessment.

Q40. What were your results?

A40. For this scenario, i.e., 50 percent of the deposited nuclides running off in one day during an average annual flood, we estimated the concentration of Sr-90 to be about 950,000 pCi/l. This is over

3,000 times the 10 CFR Part 20 limit for this nuclide. Other nuclides would also be well above their 10 C.F.R. Part 20 limits.

Q41. Would this therefore be a worst case situation?

A41. It would be in terms of high concentration in the river. We have intentionally made very conservative assumptions in order to bound the problem. This scenario of rapid runoff of half of the deposited nuclides, while leading to high river concentrations and thus, high doses to individuals who drink the water, may be more desireable, given an accident, than the more likely scenario of only a small amount of initial runoff. The high runoff scenario would flush a relatively large fraction of the nuclides from the river system during a short period of time when, almost certainly, drinking water would not be withdrawn from the river. Since a smaller percentage of nuclides would remain in the river basin, the total long-term population dose would be smaller for this scenario.

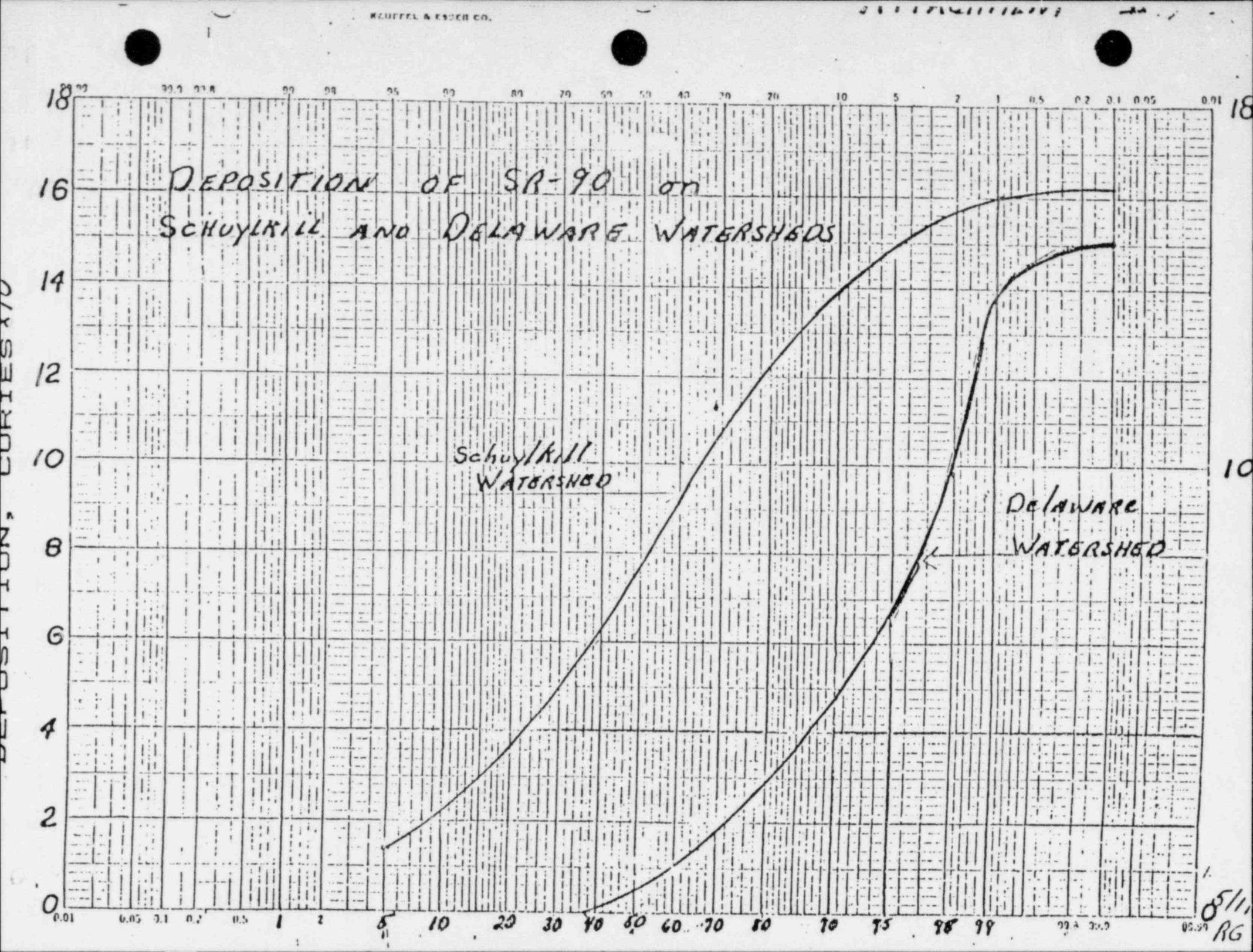
REFERENCES

1. R.G. Menzel, "Land Surface Erosion and Rainfall as Sources of SR-90 in Streams," Environmental Quality, Vol. 3, No. 3, 1974, pp. 219-227.

2. R.B. Codell, "Potential Contamination of Surface Water Supplies by Atmospheric Releases from Nuclear Plants" paper submitted to Journal of Health Physics, 1984.

3. J.C. Helton, A.B. Muller, and A. Bayes, "Contamination of Surface Water Bodies After Reactor Accidents by Erosion of Atmospherically Deposited Radionuclides," paper submitted to Journal of Health Physics, 1984.

4. U.S. Nuclear Regulatory Commission, "Regulatory Guide 1.109 - Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 C.F.R. Part 50, Appendix I," Rev. 1 Oct. 1977.


DEPOSITION OF SR-90 ON SCHUYLKILL AND DELAWARE WATERSHEDS
SCHUYLKILL WATERSHED
DELAWARE WATERSHED
DEPOSITION, CURIES X 10
0
2
4
6
8
10
12
14
16
18
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99

RADIONUCLIDE RUNOFF MODEL

$$W = \lambda_a \chi_o + \lambda_b \chi(t)$$

where:

W = annual washoff

χ_o = initial deposition of radionuclide

λ_a = fraction of initial deposition washed shortly after deposition

$\chi(t)$ = amount of radionuclide remaining in watershed at time t after initial washoff

λ_b = fraction of remaining deposition washed off per year (assumed to remain constant)

$$dx/dt = -(\lambda + \lambda_b)\chi(t)$$

where:

dx/dt = rate of change of radionuclide after initial washoff

λ = decay constant for radionuclide

$$\chi(t) = (1 - \lambda_a)\chi_o \exp[-(\lambda + \lambda_b)t]$$

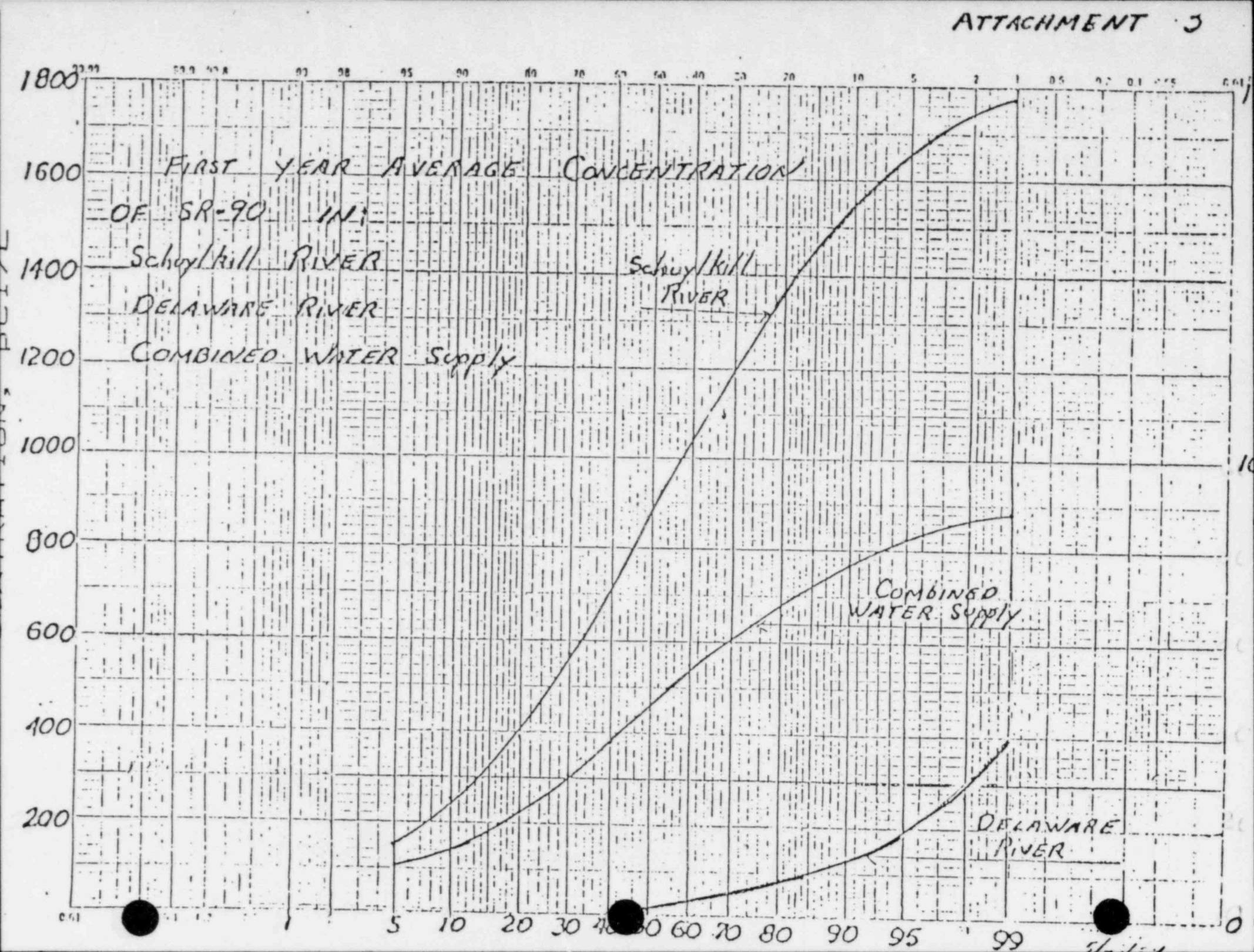
FRACTION OF DEPOSITION WASHED OFF OVER INFINITE TIME

$$W(\infty) = \lambda_a \chi_o + \int_0^\infty \lambda_b \chi(t)$$

$$W(\infty) = \frac{(\lambda_a \lambda + \lambda_b)\chi_o}{(\lambda + \lambda_b)}$$

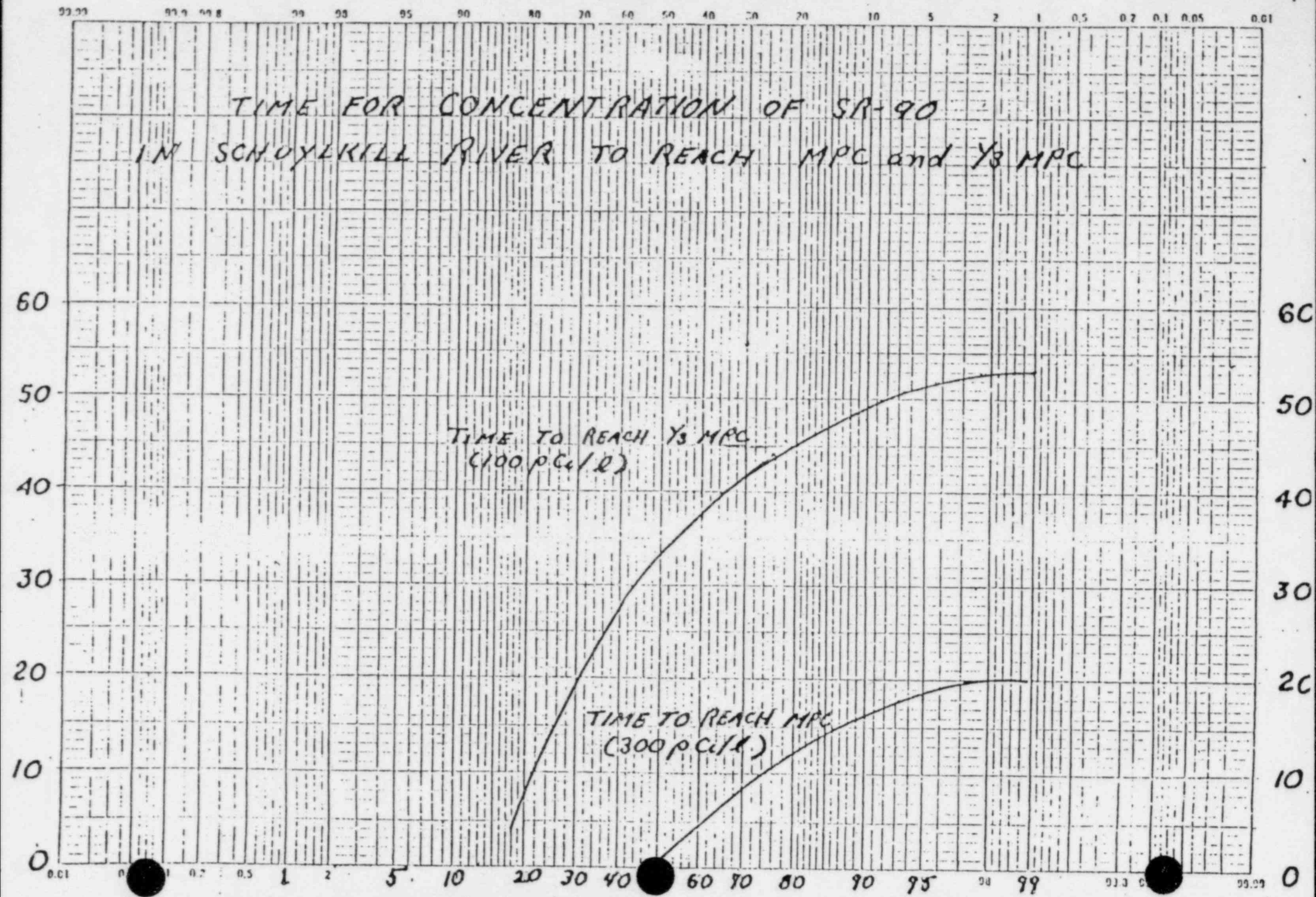
where $W(\infty)$ = the total amount of radionuclide washed off over an infinite time period

ATTACHMENT 3



KEUFFEL & ESSER CO.

ATTACHMENT 7.



Professional Qualifications of
Rex G. Wescott, Hydraulic Engineer
Hydrologic Engineering Section
Environmental and Hydrologic Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

I am a hydraulic engineer in the Hydrologic Engineering Section, Environmental and Hydrologic Engineering Branch, Division of Engineering.

My formal education consists of a B.S. in Physics received from Clarkson College of Technology in Potsdam, New York in 1970, an M.S. in Engineering Science received from Clarkson College in 1974, and approximately 27 graduate credit hours in hydraulics, advanced fluid mechanics, and coastal engineering from Polytechnic Institute of New York and Rutgers University. My graduate study at Clarkson College consisted primarily of courses in surface and subsurface hydrology, water resources engineering, and systems analysis.

My present employment with NRC dated from 1978 when I was employed as hydraulic engineer with the Office of Standards Development. In 1981 I joined the Office of Nuclear Reactor Regulation, Hydrologic and Geotechnical Engineering Branch. My responsibilities in the licensing review of nuclear facilities is in the area of flood vulnerability, adequacy of water supply and surface and groundwater acceptability of effluents.

From 1975 to 1978 I was employed as a Civil Engineer with Ebasco Services, Inc. in New York, New York. I was responsible for conceptual designs of dams, reservoirs, and spillways; preparation of SARs and ERs for nuclear power plant projects; and for studies and reports in other various water-related projects.

From 1973 to 1975 I was employed as a staff engineer with Woodward-Cylde Consultants, Inc. in Clifton, New Jersey. At Woodward-Clyde my responsibilities were very similar to those which I had at Ebasco Services.

I am a registered Professional Engineer in the State of Maryland and an associate member of the American Society of Civil Engineers.

Myron H. Fliegel
Hydrologic Engineering Section
Environmental and Hydrologic
Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

Professional Qualifications

I am the Section Leader of the Hydrologic Engineering Section, Environmental and Hydrologic Engineering Branch, Division of Engineering, Office of Nuclear Reactor Regulation.

My formal education consists of study in physics and mathematics at the City College of New York where I received a B.S. in physics in 1965 and study in geophysics and oceanography at Columbia University where I received a Ph.D. in physical oceanography and limnology in 1972. I have had courses in oceanography, coastal engineering, marine geology, fluid mechanics, ocean acoustics, data analysis, seismology, geophysics, geology, hydrology, advanced physics and mathematics, and engineering management.

I have been the Section Leader of the Hydrologic Engineering Section since February, 1981. I supervise and review the evaluations of hydrologic aspects of nuclear facility sites performed by members of my staff.

My employment with NRC (formerly AEC) dates from August 1974 in the area of hydrologic engineering, physical oceanography, and limnology with the Office of Nuclear Reactor Regulation and for consultation on siting of materials utilization facilities and on environmental matters. My responsibility in the licensing review of nuclear facilities is in the areas of flooding vulnerability, adequate water supply and surface and ground water acceptability of effluents. In addition, I participate in the development of the technical bases for safety guides and standards, and research identification and analysis in these areas of interest.

From 1972 to 1974, I was a Staff Scientist (later Research Associate) at Lamont-Doherty Geological Observatory of Columbia University. I was in charge of the data analysis in connection with a large scale oceanographic effort being conducted in the Arctic. I was responsible for organizing the data, writing and debugging all the computer programs and I participated in the design and procurement of equipment and the evaluation of the data.

From 1965 to 1972, I was a Graduate Research Assistant at Lamont-Doherty Geological Observatory of Columbia University. My dissertation work, which began in 1968, involved a study of the thermal behavior of, and internal waves in, one of the Finger Lakes of western New York. I organized the experiment, procured and set up the equipment, collected and digitized the data, wrote and debugged the computer programs, analyzed the data and evaluated the results. Previously, I was involved in an experiment to measure and analyze deep ocean temperatures and currents near the Pacific Ocean floor off the California coast.

I have published in Limnology and Oceanography, the Journal of Marine Geodesy, the Journal of Geophysical Research and the Journal of Physical Oceanography. I have presented papers at meetings of the American Geophysical Union and the American Society of Limnology and Oceanography.

I am a member of the American Association for the Advancement of Science, the American Geophysical Union and the Society of Sigma Xi.

June 4, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PHILADELPHIA ELECTRIC COMPANY	)	Docket Nos. 50-352
	)	50-353
(Limerick Generating Station, Units 1 and 2)	)	

TESTIMONY OF JOHN C. LEHR REGARDING
RESPONSES TO CITY OF PHILADELPHIA'S ISSUE CITY-15
RELATED TO THE LIMERICK FINAL ENVIRONMENTAL STATEMENT

Q1. Mr. Lehr, please state your name, address and position with the U. S. Nuclear Regulatory Commission.

A1. My name is John C. Lehr. My business address is U. S. Nuclear Regulatory Commission, Washington, D. C. 20555. I am the Senior Environmental Engineer in the Environmental Engineering Section of the Environmental and Hydraulic Engineering Branch, Division of Engineering within the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission.

Q2. Have you prepared a statement of your professional qualifications?

A2. Yes. My statement is appended to this testimony.

Q3. Please state the purpose of your testimony and identify your responsibilities therein.

A3. The purpose of my testimony is to respond to the City of Philadelphia's Issue CITY-15, with respect to drinking water treatment by the City of Philadelphia and the removal of

radioactive contamination of open water bodies (and the city's water supplies sourced therefrom) that could occur as a result of fallout subsequent to an atmospheric release of radioactivity in severe reactor accidents that were analyzed in the Limerick FES. My testimony provides a description of the water treatment and distributing facilities of the City of Philadelphia, their sources of raw water supply, and the water treatment unit processes currently employed. It also discusses the information available on the effectiveness of various drinking water treatment processes in removing the radionuclides strontium-90 and cesium-137 from raw water; the likely ability of the existing treatment plants of the City of Philadelphia to remove these radionuclides from the intake waters; compares the likely effluent concentrations with applicable EPA Maximum ~~Containment~~ Contaminant Level (MCL) set by the ~~Clean~~ Safe Drinking Water Act, based on the Staff's estimated influent concentrations; and discusses possible mitigative measures, if needed.

Q4. What does CITY-15 provide?

A4. CITY-15 provides:

> The DES does not adequately analyze the contamination that could occur to nearby liquid pathways, and the City's water supplies sourced therefrom, as a result of precipitation after a release. A reasoned decision as to environmental impacts cannot be made without a site specific analysis of such a scenario.
>
> The DES addresses at great length releases to groundwater (DES at 5-34 et seq.), but gives only a cursory and conclusory discussion of contamination of open water (DES at 5-33). This issue is of crucial concern here as the two major water bodies at and near the facility are the City's only water supplies. The City also has open

reservoirs within its boundaries which could be contaminated through precipitation. For an issue of such great importance, insufficient consideration has been given here. The mandate of NEPA to take a hard look at environmental consequences has been ignored.

Q5. What are the sources of raw water for the City's water treatment plants?

A5. Approximately one half of the City's water requirement is supplied by the Delaware River. The remainder is supplied by the Schuylkill River. All water withdrawn by the City from the Delaware River is treated at the Samuel S. Baxter Plant, which pumps water from the river at a location above the outlet of Pennypack Creek. Water withdrawn from the Schuylkill River is treated either at the Queen Lane Plant or the Belmont Plant. These plants both withdraw water from the river pool formed by the ~~Fairmont~~ Fairmount Dam. The Queen Lane Plant is located on the east side of the Schuylkill River, while the Belmont Plant is located on the west side of the river. All withdrawal locations are within the city limits.

Q6. What are the capacities of these water treatment plants?

A6. The 1982 values given by the City for raw water pumping, water treatment and filtered water pumping capacities are given in Table 1, which follows this testimony. The 1982 information supplied by the City indicates that the Water Department distributed an average of 345 million gallons per day to 1.69 million people and industry within the City limits. This information also indicates that an additional 11 million

gallons per day were conveyed to the Bucks County Water and Sewer Authority for distribution in lower Bucks County.

Q7. What water storage capacity exists within the City's water treatment and distribution system?

A7. The filtered water storage capacities for the various in-plant basins and the other system basins, reservoirs and standpipes as of 1982 are given in Table 2. The total filtered water storage capacity as of 1982 amounted to about ~~1.323~~ 1.121 billion gallons. In addition, treatment plant retention capacity of untreated and in process water as of 1982 was ~~124.1~~ 86.2 million gallons at the Belmont Plant, 201 million gallons at the Queen Lane Plant and 216 million gallons at the Baxter Plant, for a total of about ~~541~~ 503 million gallons.

Q8. What areas of the City are normally served by these treatment facilities?

A8. The City's information indicates that the Baxter Plant normally provides water to the area of the City east of Broad St. The Queen Lane Plant normally serves the area west of Broad St. and east of the Schuylkill River. The Belmont Plant serves the area of the City west of the Schuylkill River. Flexibility in the system exists such that the entire City area, except for an area west of the Schuylkill River known as the "Belmont High Service District," may be served by the Baxter Plant, provided it is fully available, based on an

average daily demand. The demand of the Belmont High District is about 12 million gallons per day.

Q9. What modes of treatment are used by the three City water treatment plants?

A9. All three plants use similar treatment process sequences. These consist of natural sedimentation, chemical addition, flocculation, sedimentation, disinfection, rapid sand filtration and final chemical addition. Initial chemical addition at the plants, following natural sedimentation, consists of prechlorination and carbon addition as needed for taste and odor control and addition of flocculating chemicals, consisting of ferric chloride and lime at the Baxter and Queen Lane Plants and alum and lime at the Belmont Plant.

Final chemical addition consists of flouride for reduction of dental decay, chlorine or chlorine dioxide and ammonia for maintenance of a disinfecting residual in the distribution system; in addition, zinc phosphate and lime are added as needed for corrosion control in the distribution systems from the Queen Lane and Belmont Plants.

Filtered water from the Baxter Plant that is stored in the Oak Lane Reservoir and from the Queen Lane Plant that is stored in the Roxborough Filtered Water Basins is rechlorinated prior to entering the distribution system.

Effects of Normal Water Treatment on Radioactive Contaminants

Q10. Please state which radionuclides you have addressed with regard to drinking water treatment by the City of Philadelphia and explain why you have addressed them.

A10. I have addressed only the removal of strontium-90 and cesium-137 because, as stated in the testimony Dr. Fliegel and Mr. Wescott, the Staff believes that only the long lived radionuclides, such as strontium-90 and cesium-137, would contribute significantly to the total population dose from drinking water. It was concluded that all other radionuclides would contribute far less than 10% total dose from this pathway.

Q11. Have drinking water treatment processes generally in use been shown to be effective in removing these radionuclides?

A11. Removal, in terms of percent of the total activity in the intake water, by municipal treatment plants has been found to vary depending on the radionuclide or combination of radionuclides being considered and on the treatment processes used.

In a study of three municipal treatment systems using flocculation sedimentation, disinfection and sand filtration, Bell et al. (5) found only moderate removals of total activity associated with radioactive fall-out from nuclear test detonations. Measurements of the activity in the effluent from the sand filters indicated the following ranges of removal:

Plant	Observed Activity Removal Range, %
Lawrence, Mass.	13-75%
Cambridge, Mass.	34-52%
Rochester, NY	0-65%

In another study of dissolved strontium in municipal water supplies of some 60 cities across the United States, Alexander et al. (6) found similar removals compared to the previous study when examining systems using coagulation as treatment. Higher removals were found for systems using coagulation followed by softening, using lime and soda ash or using ion exchange softening only. The strontium-90 removal percentages were as follows:

Treatment	Sr-90 Removal, %
Alum or ferrous sulfate	10-31
Alum or ferrous sulfate, plus lime	10-75
Alum or ferrous sulfate, plus lime and soda ash	10-85
Alum or ferrous, plus lime and phosphate	10-70
Softening only (phosphate, ion exchange)	69-76

The City of Philadelphia was included in this study. The results of the indicated treatment of alum and lime flocculation followed by chlorination for a tap water blended from two treated source waters indicated a removal of as much as 44% of the strontium-90.

In a study of water treatment system removal of a very low level of strontium-90 in the raw water (i.e., about 10 pCi/L), Schultz (7) found removals of from 0-24%. This system used natural sedimentation, flocculation with alum or ferrous sulfate, chlorination and sand filtration.

Q12. Is there other information available on the removal of the specific radionuclides of concern to the Staff by water treatment unit processes?

A12. Yes. There have been many laboratory and small scale pilot plant studies on cesium-137, strontium-89, and strontium-90 removal. These studies have investigated coagulation, sand filtration, coagulation followed by sand filtration and softening by lime and soda ash.

Q13. What do these studies indicate regarding removal of these radionuclides by coagulation?

A13. A summary of the literature results is given below.

Straub (3) reports that coagulation has been shown to be capable of removing 97-100% of particulate radioactivity, but only 4-81% of soluble radioactive material. For cesium-137, laboratory studies by Eliassen et al. (1) using jar tests with alum and ferric chloride as coagulants demonstrated removals of 0-37%. In another laboratory study by Lacy (2), using a fission product mixture containing 50% cesium-137 and 10% strontium-90, with ferric chloride and limestone as

coagulants, activity removal was higher, being attributed to the high cesium content of the mixture, but still only reached 51-59%. The addition of turbidity in the form of clays aided somewhat in cesium removal. Laboratory studies reported by Straub (3) showed removals of 35-65% for 100 mg/l added turbidity. High removals, 87% and 98% were achieved, but with very high added turbidities of 750 mg/l and 5000 mg/l, respectively.

Strontium removal by coagulation alone using alum coagulant was very low, 0-6% (Straub, et al., 4). Adding 100 mg/l clay turbidity increased coagulation removal only to 57% (Straub, 3). Laboratory studies by Lauderdale, as reported by Straub (3), using phosphate coagulation with lime produced removal of about 98%. This process may be useful in removing fission product mixtures that contain strontium as one of the more hazardous constituents.

Q14. What do these studies indicate regarding removal of these radionuclides by sand filtration?

A14. The laboratory studies of high rate filtration cited by Straub (3) produced low removals, 1-13%, of strontium by sand/fitration and low to moderate removals, 10-70%, of cesium. These removals were associated with retention of activity by straining of already formed floc not removed during sedimentation or by absorption on the biological life in the Schmutzdecke (Downing, et al., (8)).

Q15. What do these studies indicate regarding removal of these radionuclides by the combined treatment?

A15. The studies by Straub (3 and 9) indicate moderate removal of strontium-90 and cesium-137 when in a mixture of radionuclides. The percentage removals are given below:

Radoinuclide	Removal, % Coagulation/Sedimentation	Sand Filtration	Overall
Mixture, containing: 35% Sr-90, Y-90	61	17-23	68-70
Mixture containing: 27% Cs-137	21	76	81
27% Sr-90, Y-90	10	18	26

Q16. What is your conclusion with regard to the ability of the water treatment plants of the City of Philadelphia to remove these radionuclides from the water withdrawn from the Schuylkill and Delaware Rivers?

A16. The combination of drinking water treatment processes currently employed by the City of Philadelphia will likely not result in a high degree (i.e., over 90%) of removal of the radionuclides of strontium, cesium from the intake water, based on my review of the laboratory and municipal treatment plant study results cited above.

Q17. Do you conclude that a high level of removal of these radionuclides would be required in the event of an accident at the Limerick Generating Station of the type considered in this testimony?

A17. Yes, but only for strontium radio-isotopes. However, a high degree of removal may be necessary only by the Queen Lane and Belmont plants.

Q18. What is the basis for your conclusion?

A18. The bases for my conclusion are the Staff's conclusion that only strontium-90 would contribute significantly to population dose, the Staff's probability distribution concentrations of strontium-90 for the Schuylkill and Delaware watersheds and the U.S. Environemntal Protection Agency Maximum Contaminant Level (MCL) for strontium-90 in community water systems under the Safe Drinking Water Act (40 C.F.R. § 141.16(b)) of 8 pCi/L.

Based on the Staff's estimated first year average activity concentration due to strontium-90 of 155 pCi/L in the Schuylkill River (which is estimated to only have a 5% chance of not being exceeded) removal by the water treatment plant would have to amount to 94.8% or more to meet the EPA MCL at the point at which the water enters the distribution system. Removals of greater than 98% would have to be achieved for Schuylkill River activity concentrations due to strontium-90 with a 50% or less chance of exceedance (i.e., 877 pCi/L or more). By contrast, the estimated strontium-90 related activity in the Delaware River with a 50% probability of exceedance (i.e., 15 p.Ci/L) would require only a 46.7% removal. Removal of 76.5% or more of the activity in the Delaware River water due to strontium-90 would be required only for activity concentration due

to strontium-90 in excess of 34 pCi/L, which the Staff estimates to have a 40% or less probability of occurrence.

Q19. In your opinion, do the existing City of Philadelphia water treatment plants have the capability to reduce these activity concentrations to within the EPA MCL for strontium-90 activity?

A19. Based on my review of the laboratory and municipal treatment plant study results cited above and the present designs of the Belmont, Queen Lane and Baxter water treatment plants (using coagulation, sedimentation and sand filtration), reduction of this activity to the MCL would not be expected for the Queen Lane and Belmont plants for virtually any of the first year average post accident estimated activity levels. For the Baxter plant, required removals to comply with the strontium-90 MCL Delaware River first year average post accident activity levels, with a 40-50% probability of exceedance, are possible.

Q20. What would this situation mean, in your opinion, in terms of the continuity of the Philadelphia drinking water supply?

A20. Until the strontium-90 activity concentration in the Schuylkill River decreases to a level at which the treatment processes used by the Queen Lane and Belmont plants could deliver water within the EPA limit or until modifications are installed at these plants that can treat water with higher influent strontium-90 activity levels, the Baxter plant could provide for the water needs of the City, with the exception of the Belmont High Service District (Aptowicz, (10)).

(Note that the 1982 rated peak capacity of the Baxter plant was 423 MGD, while 1982 average distribution to the City and Bucks County was 356 MGD). Water delivery to the Belmont High Service District, with a 1982 average demand of about 12 MGD, would have to be by emergency means, such as tank trucks or emergency water pipeline construction.

Q21. What alternatives do you believe would be available to the City either under the EPA MCL requirement or under a strontium-90 activity concentration limit above the EPA MCL that may be approved by the City of Philadelphia, the Commonwealth of Pennsylvania and the U.S. Environmental Protection Agency?

A21. Aside from reliance on the Baxter Plant and emergency measures, as stated in my previous response, alternative treatment methods, such as lime-soda softening, could be employed to improve the removal of strontium-90 activity from the influent water. However, modifications to the treatment plants, likely to involve new construction, would be necessary if the treatment capacity is to remain the same.

The following alternatives can normally be considered when a potable water supply is threatened with contamination or interruption: water rationing, use of stored or bottled water, construction of temporary or permanent pipelines from the points of use to a safe and adequate supply, dilution by a known safe water supply, delivery of safe water by auxiliary means (e.g. tank truck) or use of special decontamination equipment or procedures. The Staff has not made any

analyses of the technical or economic aspects of the use of any of these alternatives for the City of Philadelphia in the event that the present water supplies are rendered temporarily or permanently unusuable by an accident at the Limerick Generating Station of the type discussed by Dr. Acharya in his testimony.

REFERENCES

1. "Studies on Radioisotope Removal by Water Treatment Processes," Rolf Eliassen, Warren J. Kaufman, John B. Nesbitt and Morton I. Goldman, in Journ. AWWA, 8/51, pp. 615-37.

2. "Removing Radioactive Materials from Water by Coagulation," William J. Lacy, in Wat. & Sew. Wks, 10/53, pp. 410-11.

3. Low-Level Radioactive Wastes, Conrad P. Straub, USAEC, 1964.

4. "Studies on the Removal of Radioactive Contaminants From Water," Conrad P. Straub, Roy J. Morton and Oliver R. Placak, in Journ. AWWA, 10/51, pp. 773-792.

5. "Passage of Nuclear Detonation Debris Through Municipal Water Treatment Plants," Carlos G. Bell, Jr., Harold A. Thomas Jr., Barnet L. Rosenthal, in WASH-275, "Sanitary Engineering Conference, Baltimore Maryland, April 15-16, 1954" USAEC.

6. "Strontium and Calcium in Municipal Water Supplies," George V. Alexander, Ralph E. Nusbaum and Norman S. MacDonald, in Journ. AWWA. 7/54, pp. 643-54.

7. "Removal of Low Level Radioactive Wastes By A Sanitary Water Treatment Process," N.B. Schultz, ORNL Report No. K-C-785.

8. "Observations On The Removal of Radio-Isotopes During The Treatment of Domestic Water Supplies: II. Radio-Strontium," A.L. Downing, A.B. Wheatland, and G.E. Eden, in Journ Inst. of Water Egnrs., 7/53, pp. 555-72.

9. Report of the Joint Program Of Studies On The Decontamination Of Radioactive Waters, ORNL Report-2557, Oak Ridge National Laboratory, Public Health Service.

10. Letter: Mr. Bruce S. Aptowicz, Manager, Water Operations, Water Dept. City of Philadelphia to Mr. Robert E. Martin, U.S. Nuclear Regulatory Commission, April 23, 1984.

Table 1. City of Philadelphia Water Treatment System Capacities

Plant	Raw Water Pumping Station Capacity	Plant Water Treatment Capacity		Average Treated Water Output, 1980	Filtered Water Pumping Capacity
		Rated	Peak		
Belmont	140	78	108	64	
Queen Lane	200	120	150	98	
Schuylkill River	340	198	258	162	248
Baxter	480	282	423	215	
Delaware River	480	282	423	215	606

Note: All values in million gallons per day.

Table 2. Water Treatment System Filtered Water Storage Capacity

In-Plant Filtered Water Retention Capacity:	
Belmont	~~78~~ 40
Queen Lane	90
Baxter	193
Total:	~~284.8~~ 323
Other System Filtered Water Retention Capacity:	
Roxborough Filtered Water Basins	28.6
Open Reservoirs	747
Standpipes	22.5
Total:	798.1
Grand Total:	~~1082.9~~ 1121.1

Note: All values in millions of gallons.

PROFESSIONAL QUALIFICATIONS

JOHN C. LEHR

U.S. Nuclear Regulatory Commission

I am currently employed as Senior Environmental Engineer in the Office of Nuclear Reactor Regulation, Division of Engineering, in the Environmental Engineering Branch. I have the responsibility for the independent review and analysis of the proposed site, alternative sites, site selection methodology, station construction, and design and operation of those features of nuclear power plants as they may affect natural water resources, existing water quality and use, water quality and usage goals as established by the responsible agency and other impacts on the aquatic environment. In this capacity, I have prepared the abiotic aquatic impact sections for NRC environmental impact statements (EIS) on numerous construction permit and operating license applications. For operating license applications, I have provided the technical specifications in the area of water quality and chemical discharge limitations and monitoring requirements. I have provided the technical expertise in the NRC overview function of contractor prepared EIS's in the area of abiotic aquatic impact assessments, including the need for mitigative actions and establishment of coordination with state and regional EPA offices. In the above capacities, I have been responsible for the water quality related aspects of NRC licensing actions for over 70 applications. I have also been responsible for the water quality related sections of several NRC NEPA alternate site investigations of proposed nuclear power plants, including the Seabrook Units 1 and 2 plant. I have provided written testimony and served as an expert witness at NRC licensing hearings on a variety of subjects dealing with aquatic impacts relative to power plant siting, construction and operation.

I have acted as a consultant to other NRC branches and provide analyses of water quality problems through technical assistance requests, particularly to the Division of Operating Reactors on matters pertaining to assessment of chemical effluent impacts and changes in abiotic effluent limitations and water chemistry monitoring programs for operating plants.

I have served as the coordinator and principal investigator in an in-house study to determine actual releases of residual chlorine from operating nuclear power plants. In addition, I am the Division technical representative on several inter-office NRC Research Review Groups. As such, I am responsible for defining and coordinating research needs in the area of abiotic aquatic environmental concerns and for providing the technical guidance for on-going research programs in this area. Examples of research activities governed by these review groups are asbestos in cooling tower waters, residual chlorine and chlorination by-products in power plant discharges in fresh and marine waters and investigation of the occurrence of pathogenic organisms in power plant cooling waters.

I have been designated as the in-house technical originator responsible for development of Environmental Standard Review Plans addressing staff NEPA reviews of site water quality, plant water uses, plant chemical and sanitary wastes, water quality related impacts of plant operation, abiotic aquatic monitoring and chemical treatment system alternatives. In a related activity, I have participated as a member of the Standard Environmental Technical Specifications Task Group responsible for the abiotic aquatic monitoring sections of the McGuire Units 1 and 2 and the Three Mile Island Unit 2 ETS.

I have participated in technical conferences with and coordinated water quality related activities with the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, and other Federal, State and local agencies regarding implementation of the National Environmental Policy Act, the Federal Water Pollution Control Act and its amendments, the Toxic Substances Act, the Safe Drinking Water Act and the memoranda of understanding between the NRC and EPA and COE.

I have also developed expertise and been designated as the responsible technical specialist in the areas of sound level prediction techniques for power plants and their transmission lines and techniques for estimation of community response to environmental sound levels, as influenced by power plant construction and operation. I have been responsible for sections of NRC environmental impact statements addressing these areas for several proposed and operating nuclear power plants. I have also provided written testimony and served as an expert witness at NRC licensing hearings for noise impacts related to nuclear power plant construction and operation.

I have a Bachelor of Science degree in Mechanical Engineering from Drexel Institute of Technology (1969) and a Master of Science degree in Environmental Engineering from Drexel University (1972) specializing in water associated problems in the environment. My academic background includes studies in water chemistry, domestic and industrial waste treatment, and water resources management.

From 1969 to 1972, I was employed as a mechanical engineer at the U.S. Army Frankford Arsenal, Philadelphia, Pennsylvania. I was assigned as Project Manager of materials handling, and pollution control efforts for the Small Caliber Ammunition Modernization Program. I participated in the development of solid and liquid waste management and noise control programs for metal parts manufacturing facilities.

MR. VOGLER: Staff tenders the witnesses for cross examination.

We can put the references in now. I would like to note -- I would like to do that in a few moments. I would like to note that almost all of the references, Mr. Wetterhahn, were submitted by you and I did not think it was necessary to repeat those.

JUDGE BRENNER: Just proceed with what you had planned to do. It is not necessarily a requirement that references --

MR. VOGLER: I had not planned on doing it. I had not planned on submitting the references.

JUDGE BRENNER: You have done what you had planned to do?

MR. VOGLER: That is correct.

JUDGE BRENNER: And of course, Mr. Vogler, you are free, depending on the use made during cross examination, for you or any other party for that matter to mark one of the references as an exhibit, either in whole or in part or either for identification or in evidence, depending on the use made.

MR. VOGLER: That is correct.

JUDGE BRENNER: Do you want to pick a page or two in the FES that you want to designate as being particularly pertinent to this contention, if any?

MR. VOGLER: I would like to -- we determined 10 days ago that there was nothing new to put into the record on the Board from the FES and I was advised today that Dr. Acharya may have a section or two in the FES that you would like to point out that would be particularly pertinent to this contention.

I also understand that that has already been -- the section is already into evidence, is that correct, doctor?

WITNESS ACHARYA: Last time I did identify the sections of the FES. This time I won't go outside of those sections. I can specify a few pages, namely FES Table 5.11(c), FES Figure No. 5.4(i), FES Figure No. 5.4(l) and FES Table No. 5.11(h), FES Table No. 5.11(d). That is all that occurs to me at this time.

JUDGE BRENNER: Thank you.

What about that section that includes page 5-93 that was previously referred to?

MR. VOGLER: Yes, we are discussing that at the table now. I would also point out for the Board, I think we would start at about 5-92 and continue on to 5-93 to make that a continuing paragraph and may be comprehensible or more easy to understand.

JUDGE BRENNER: We recognize that this was previously in evidence. We have already told you what the object was for these more precise identifications in the

particular context of individual contentions where the organization of the FES lends itself to that kind of designation, so now we have got that.

All right, is there anything further from the Staff?

MR. VOGLER: No, sir.

JUDGE BRENNER: Applicant, cross examination. Do you want to go first?

MR. WETTERHAHN: I thought the order was --

JUDGE BRENNER: We had been going with the City first, which everybody agreed to on the other contention. It was not necessarily the traditional order followed in all hearing. I preferred it because I think more realistically it reflected the situation of a potential, or party with the most potential disagreement going first on cross examination and I thought it worked out.

Do you want to go first, then, Ms. Bush?

MS. BUSH: I have no objection to going first.

JUDGE BRENNER: Why don't you go first, then, for the reason I just indicated?

CROSS EXAMINATION

xxx BY MS. BUSH:

Q Is it correct that all of the sectors around the plant touch the Schuylkill watershed?

A (Witness Wescott) Yes. That is correct.

Mary fols.

Q And which sectors would touch the Delaware watershed?

A Okay, the sector due east would touch the Delaware watershed. Part of the sector below that, which would be east-southeast -- these are 16 sectors -- would touch the Delaware watershed. The one directly north of east -- that would be east-northeast -- touches it. North-northeast touches it. Due north touches it and a small part of north-northwest touches it.

End 5.

Sim 6-1

Q You didn't note northeast. I take it that would also ---

A (Witness Wescott) No, northeast also. Excuse me.

Q Is the CRAC output in five mile divisions within each sector?

A What CRAC output are you referring to? Do you mean the CRAC output that we actually used for these calculations?

Q Well, yes. Let me ask that first.

A Okay. We used an intermediate output from the CRAC. What we used was the deposition and the width of the cloud determined for 34 separate distances from the center and these vary in accordance with meteorological conditions. I think Dr. Acharya may be able to go into a little more detail about actually how these are determined.

Q So each sector had 34 separate distances in it?

A That is correct.

Q Then how many miles did you go out and how many miles did those 34 sectors cover in separate distances?

A (Witness Acharya) It went out to 500 miles.

Q Okay.

A (Witness Fliegel) They went out past the boundary of the watershed.

6-2

Q Now did you assume, in other words, that the watershed is coterminous with the land exposed in each of those areas?

A (Witness Wescott) The watershed is made up of the land exposed.

Q And how did you differ the deposition if you were looking at water than you do when you are looking at land other than by limiting the sectors, or was there not any other way?

A (Witness Fliegel) The amount of area covered by free water is a very small percentage of the area of the watershed. We didn't specifically consider that. It comes out in the model when considering how much of the deposition becomes direct runoff, and part of that will be the nuclides that actually fall on open water.

Q Now I believe you took one accident sequence or one accident source term and examined that; is that correct?

A That is correct.

Q And that accident source term was the one with the lowest probability and the severest consequences of the ones that were done for the FES?

A (Witness Acharya) That is not necessarily the lowest probability. There are other sequences which have got much lower probability. The sequence which had

6-3

the cesium and strontium presence were amongst some of the highest, but not necessarily the highest.

Q So there were some source terms or accident -- would the word be accident source terms that you looked at in the FES that compared to II-T/WW had lower probabilities and also higher consequences in terms of strontium, cesium and iodine?

A Much lower probability, but not much higher strontium and cesium release presence.

Q Now you referred to Table 5.11C, which is 576 in the FES. How can we determine from that table the relative amounts of release of strontium for these various release categories, or can we?

A Yes, we can.

JUDGE BRENNER: Can we borrow a copy of the FES which we will return at the end of the day if there is an extra one.

(Counsel Vogler handed the Board a copy of the FES.)

WITNESS ACHARYA: Simply look at the column called Barium/Strontium in that table. These are the absolute values of the presence of the core inventory.

BY MS. BUSH:

Q So that number in the column that you designated, the Barium/Strontium, would be a number, whichever one is

Sim 6-4

the highest number there in the column, or those numbers designate the strontium levels?

A The presence of the core inventory strontium that could be associated with the release.

A Okay. Now the values that are shown on Attachments 2 and 3 to Mr. Wescott's testimony, those all assume that an accident has occurred; is that correct? Excuse me, Attachments 3 and 4.

A (Witness Fliegel) That is correct. We did our calculations and probabilities with the assumption that the accident has occurred. We have not factored in in these charts the probability of the accident occurring.

Q On my Attachment 3, the left-hand seems to have something that was Xeroxed that is off the page. Should that be the same as ---

A It is the same number that is on the right-hand side.

Q Should it be deposition curies times ten as it is on Attachment 1 or not?

A Are you talking about Attachment 3?

Q Yes.

A And you are saying that you can't read the left-hand side?

Q There appears to be something that might have been on the far left-hand side of the page. I see the bottom

Sim 6-5

of some letters, and on Attachment 1 there is a statement of deposition curies times ten to the something. Oh, I see, it is ten to the fourth. In other words, in Attachment 1 you should muliply the left-hand column times ten to the fourth?

A (Witness Wescott) On Attachment 1 ten to the fourth is correct times curies.

Q Okay.

A In Attachment 3 it should be concentration pico curies per liter and not multiplied by anything.

Q Okay. Then Attachment 4?

A That should be time in years.

Q Now you state in paragraph 13 that model assumes that the initial washoff is not dependent ---

MR. WETTERHAHN: Excuse me. Could we have an identification of which paragraph 13?

MS. BUSH: Yes. I am going through the Westcott testimony. It says page 7 of that testimony.

MR. WETTERHAHN: Thank you.

BY MS. BUSH:

Q You indicate that the model assumes that the initial washoff is not dependent on when the accident occurs. How does that variable of when the accident occurs affect the results? Are you talking if it might be raining or not raining or what? What do you mean by that statement?

Sim 6-6

A (Witness Wescott) Yes, that is correct, raining or not raining, snow cover and vegetation. All of them could be variables that affect washoff.

Q What period of time did you review for determining your health effects?

A Well, we used a infinite time. We used a model which we could integrate analytically, in other words, from zero to infinity to come out with an exact solution to it. So we actually took in the total amount of curies that would come out of that watershed and be consumed by people.

Q Now you state that cesium 137 in paragraph 18 is less than 10 percent to the total dose and the various possibilities. Is that number based on looking at your whole time period of analysis and would the contribution be different if we looked at say a month period of time?

A (Witness Fliegel) It is based upon the fact that cesium gets bound up in the soil to a much greater extent than strontium does, and that is based upon actual data from nuclear test fallout, measured fallout and then measured concentrations.

An analysis was done in the City of New York for their water supply and based upon the nuclear test data and the actual measured calculations the conclusion was that a relatively small amount of cesium comes out.

Sim 6-7

Q Taking into account that property of cesium, if you looked at a period of a month would cesium continue to be 10 percent of the total dose?

A (Witness Wescott) We didn't look at the period of one month, the reason being that we looked at long-term doses. Our feeling was that the main dose contribution would be from the long-term and not the short-term, the one-month or any of the radionuclides which would be decaying let's say over a matter of a few days.

So basically we were concerned with what would be there over the long-term, and in that regard the holdup of the cesium was a factor that led us to conclude that it would be an insignificant contributor.

Q Do you not know if you looked at a shorter period, do you have any sense what contribution cesium would make? Would it still be in the order of 10 or 20 percent?

A (Witness Fliegel) It would still be a small percent. As to the actual number, I don't know.

Q Do you have anything further to state on that, Mr. Wescott?

A (Witness Wescott) No. I didn't make a calculation of that over one month.

Q Do you think it could be up to 40 or 50 percent?

MR. VOGLER: Mr. Chairman, the staff objects. They have said they don't know.

Sim 6-8

JUDGE BRENNER: They didn't go so far as to say they don't know. So we will allow that question to give the cross-examiner a reasonable leeway to ascertain what might be ascertainable.

WITNESS FLIEGEL: Our conclusions are based upon a total population dose, and most of the total population dose will be incurred over a long period of time. The initial runoff, during the period of initial runoff, we won't have a large population dose. So we played around with making some assumptions about what happens during an initial runoff period and it is further on in the testimony, but that is just to show what concentrations might be if you made some very conservative assumptions. But in terms of population dose, the initial runoff will be a small contributor to the population dose.

BY MS. BUSH:

Q What accounts for the differing contributions to risk or the probabilities of consequences associated with the two rivers?

A (Witness Fliegel) The different directions that the two rivers are in, and so when looking at the meteorology and the wind directions, the probability of seeing the wind making a large deposition on the Schuylkill will be different than the probability of seeing a wind direction that results in a large deposition in the Delaware.

Sim 6-9

In addition, the average flow in the Delaware is larger than the average flow in the Schuylkill so that there is more dilution in the Delaware.

A (Witness Wescott) I think one of the applicant's witness, oh, yes, Dr. Kaiser, also mentioned the fact that the Schuylkill surrounds the site, which of course is a factor along with what Dr. Fliegel said, and that some deposition will always take place in the Schuylkill. In other words, if you ever have deposition in the Delaware, you will always have deposition in the Schuylkill, and that is another reason that accounts for the difference in the probability distributions.

(Pause.)

Q Now you talk in Answer 21 about the period of time that it takes the initial washoff of one to two months and then the 20-year period for the concentrations to recede to 10 CFR Part 20 limits.

These time factors are a function of the rain process and the water just washing out the concentrations?

A (Witness Fliegel) The strontium 90 that is deposited on the watershed comes out in three different ways. An initial amount washes off, and based upon data in the literature, we estimated that two percent would initially wash off.

In addition, a certain amount of strontium 90

Sim 6-10

will come out slowly, and we assumed one percent would be coming out angrily, and that is also based upon data in the literature.

There is a third thing that happens to the strontium 90, and that it "disappears," and it disappears through radioactive decay and it disappears by getting bound up in the groundwater and not winding up in the rivers.

Based upon data in the City of New York, it as concluded that roughly three times as much strontium 90 as decays disappears for other reasons, and that is it probably winds up in the groundwater and in the sediments and doesn't go down the river.

We ignored that factor. So our analysis is conservative. With that model we then, based upon the amount of strontium deposited on the watershed, calculated how much would be coming off and how long it would take on a probability graph to get below certain specified levels.

Q For the initial washoff period of one to two months, then would that be pr marily the washoff from rain?

A Yes.

Q Now the health effects that you showed in your Attachments 3 and 4 ---

A Excuse me, Attachments 3 and 4 don't speak to health effects.

Q The health effects that you discuss in your

Sim 6-11

testimony in Question 23 and 24 assume interdiction of the water supply or no consumption of contaminated water until it reaches the levels that are designated there, either 1 mpc or 1/3rd mpc; is that correct?

A Or the EPA limit, that is correct.

Q Now that assumption in turn is in reliance on Mr. Lehr's testimony as to the feasibility of various interdiction avenues?

A That is based on the assumption that if a water supply were contamirated, the appropriate authorities would take measures to restrict the use of a contaminated water supply.

Q Now you state in paragraph 29 that it is not likely that both the watersheds would have high contamination and the reservoirs that are in the city limits. Is this because of the distance of the reservoirs from the plant?

A And the directions.

Q What do you mean by that, the directions?

A If you look at the orientation of the City of Philadelphia with respect to where the plant is, if the wind were blowing from the plant to the City of Philadelphia, it wouldn't result in a high contamination of the watersheds.

A (Witness Wescott) Okay, there were two things that I had in mind in this particular question and answer, or the most important thing I think is the short-term

Sim 6-12

contamination of the rivers.

If you are trying to refill reservoirs and the reservoirs you are going to be refilling are basically your raw water storage reservoirs or your reservoirs that are holding water in various stages of treatment, your finished water is going to be basically in covered reservoirs. So that is not going to be a problem.

So what we had in mind was that the only initial contamination of the river is going to be what falls directly on the water body or what falls on large reservoirs.

Now your large reservoirs in the Schuylkill River are north of the plant, in other words, in a different direction than Philadelphia. So basically the only deposition that you are going to get directly on the water surface itself is going to be in that stretch of the river downstream of the plant. Now that is a relatively short stretch, and the contamination that falls directly on that is going to be gone within probably a couple of days at the most in time to refill the reservoirs before you start getting the longer-term washoff off of your draining basin.

As far as the Delaware is concerned, a direction which puts deposition on the reservoirs in the city precludes deposition on the Delaware River upstream of the intake. So your Delaware River is certainly going to be clean if you have contaminations of your reservoirs.

Sim 6-13

So basically you have two sources. You are always going to have the Delaware available to refill these reservoirs and you are probably going to have the Schuylkill available if you have strong deposition on the raw water reservoirs at the treatment plants.

Q I believe you said the reservoirs are north of the plant, and you meant north of the city? Did you mean north of the city?

A No. What I was talking about was your large storage reservoirs in the Schuylkill River, and not your city reservoirs.

Q I see. You mean like the river itself, the Fairmont backup?

A Yes, but not Fairmont. I mean like Maiden Creek and large dams.

Q Dr. Acharya, I believe you discuss in your testimony in paragraph 5 your contribution to the analysis in terms of age distribution assumptions. What assumptions did you make for age distribution for Philadelphia?

A (Witness Acharya) The age distributions of the population of the United States in general is provided in Regulatory Guide 1.109. The breakdown is like this: Children, 18 percent; teenagers, 11 percent; and adults, 71 percent.

Q What would be the age categories that those three

Sim 6-14

cover, what chronological ages?

A What do you mean?

Q Is the 18 percent category age zero to 12?

A I do not recall exactly. It is stated, however, in Reg. Guide 1.109.

Q Would the health effects be greater if you have a larger percentage of young population, the conversion factors?

A There could be small variations.

Q There could be small what?

A If the actual age distribution will be different from the ones that we have assumed, there could be small changes around the estimates that we have provided, but we don't expect it to be substantially different.

Q Was my statement correct that the dose conversion factor is broken down by age because younger ages have a greater health effect for a given dose, or do you know?

A You cannot say that generally with respect to all radionuclides. That may be radionuclide specific.

Q And would some radionuclides be the other way, that the older the population ---

A That is right.

Q Now you talk about the selection of the particular release category II-T/WW in paragraph 6. Does that probability number or the probability associated with that

Sim 6-15

source term or release category only become important in the analysis at the last stage where, for example, in the end of your testimony you discuss translating that into a risk number, or does it enter into the calculation at any earlier point?

A The way we have done this is we did the analysis conditional upon the occurrence of the accident just for the sake of simplicity of the analysis and then brought in the probability of the accident. Actually the probability of the accident should be carried out simultaneously. As one is doing the conditional analysis, one should always be bearing in mind what is the probability of the accident in the first place.

Q In this particular analysis that you did here through the period of the analysis when you were doing the work, did that variable affect any of these numbers or results that you talk about other than the fact that it defined this strontium that was released until you got to the end of the testimony and you then folded it in when you talked about the risk? In other words, did it become relevant at any point before that or affect any of the numbers that you have presented, the three pieces of testimony presented?

A Well, the way we did it, it did not, but, however, in calculating the deposition even from that single release

Sim 6-16

category that we chose, in the CRAC run we could have thrown in as input the probability of II-T/WW, and that probability would have been carried on all along and that would have shown in the attachments of Messrs. Wescott and Fliegel's testimony.

Q So, for example, we could take the probability of that release category and fold that in, so to speak, with the other probability and consequence values that are in Mr. Wescott's testimony?

A Yes.

Q Now if we had looked at other release categories, would the numbers that Messrs. Wescott and Fliegel protrayed, they, too, would have been different if we had looked at another release category in terms of the probability of the consequences similar to what they presented?

A Both the probability and relative magnitude of the consequences, yes.

Q Now you are saying that a few of the release categories that were examined for the FES would have had initially a lower probability of occurring, but they would have had a larger strontium source term. I believe you testified to that earlier, did you not?

A Right.

Q Now would that difference only affect the consequence value in the type of numbers that Mr. Wescott showed, or would it also affect the probability of the

Sim 6-17

consequences?

A Both.

Q All right now if we looked at the release categories where there were higher probabilities of the accident per se, but a smaller amount of strontium released, if we had numbers like that, as the Westcott testimony presented, would the probability and the consequences both be smaller in those situations?

MR. WETTERHAHN: Objection. The question is not comprehensible. She postulated something with higher probability and then said could the probability be lower.

JUDGE BRENNER: It is comprehensible and you just stated it, but whether or not we would assume an equal answer, I don't know, but we will leave it up to the witnesses.

WITNESS ACHARYA: I would request that you repeat the question.

BY MS. BUSH:

Q Okay. We have been talking previously, have we not, of the type of analysis that we had, the intermediate stage that Mr. Wescott gave where he had assuming an accident and then he presented the probabilies of certain consequences; is that correct?

A (Witness Acharya) That is right.

Q Now the last scenario I asked you about was a

Sim 6-18

release category that was a higher probability release category than II-T/WW. Do you understand that?

A Yes.

Q And assume further that that release category had also a smaller release of strontium. Do you follow that?

A That is correct.

Q Now would that probability and consequence, in other words, on the whole would the probabilities be lower and the consequences be lower compared to the II-T/WW cases, or can you know?

A Well, the consequences would be lower because that is your assumption, that you have a lower amount of releases, but I cannot say offhand about the probability. At a certain region of the curve the probability could be higher and at certain other parts of the curve the probability could be lower.

end Sim
Mimi fols

Q So you are saying by definition the consequence would be lower?

A That's correct.

Q But you couldn't tell about the probability?

A I didn't say I couldn't tell. I said in some parts of the probability versus concentration curve, at a certain part of the curve you could have high probability, at certain other parts of the curve we will have a low probability because the probability is determined by the probability of the accident as well as the probability of the meteorological conditions as well as the wind conditions.

A (Witness Fliegel) Can I add something on that?

Q Certainly.

A In looking at the various accident sequences, one measure of which accident to take is by looking at the combination or the product of the probability of the accident and the consequences in terms of concentration in the river body.

The accident that was chosen had the largest combination; that is, you might be able to find an accident that would give you more deposition, but it would be a lower probability accident.

Or there might be a higher probability accident but would release less strontium, but when you factor in both factors together, this is the most significant accident and

that is why it was chosen.

Q My question was about the assumption, can you if you are trying to take -- you do have various probabilities of release categories or of accident types, once you assume that, and you are looking at another -- thinking about another scenario that has a smaller consequence, if you are looking at the assumption that the accident occurs, what are the probabilities associated with various consequences? How do you know they are lower?

A (Witness Acharya) Keep the probability of the accident aside.

Q Correct.

A Consider an accident in which you have lower fractions of the strontium or whatever, then if you calculate the probability versus the conservatism, the probability coming from the wind direction and the meteorology, the probabilities of the different layers of concentration for this case will be lower compared to what has been shown for II-T/WW level.

Q You said keeping the probabilities of release category itself aside, that the probabilities which are the wind directions, meteorological conditions, you said they would be lower?

A Right. The probability of the concentration.

Q Of the same concentration?

A Right.

Q Because the consequence is lower?

A That is correct.

Q So you could have -- your probabilities in fact would be the same in each case because you are having the same weather condition?

A No. If you look at a particular concentration level --

Q I meant the cause of the probabilities is the same, taking the accident aside, because it is the same weather condition and wind direction?

A Yes, but since you have got some lower quantities in the release, if you are looking at a particular level of concentration, it depends on what the concentration level is. You may not be able to see that concentration.

Q Because not at much would have been released --

A That's right, so when you are looking for a probability to attach to the concentration that is either zero or very small, that could be.

Q I believe your testimony was earlier that the wet and dry depositions, the results of those cases are combined in terms of consequences. All of your analysis -- you average together I guess the effects of wet and dry deposition?

A We add them. That is the model of either CRAC or CRAC II or WASH-1400. The way the particulate matter that is released would be deposited on the ground, it is controlled

by these physical processes which are collectively known as the fallout processes. So they are carried out simultaneously.

Q And any weather meteorological conditions that would contribute to wet deposition are averaged in with all of your --

A No, they are carried out in the framework of the model, the same model that is used in the FES.

Q I didn't hear the first part -- they are carried out what?

A In the same model that is used in the analysis of the airborne pathways in the FES.

Q So the consequence results that we have and have assumed a sampling of weather conditions, some of which may have rain in it or not?

A That's right.

Q Now, wet deposition would result in more contamination initially?

A That is near the reactor, you mean?

Q No, say in the water?

A Well, if there is rain, certainly it will bring down more radionuclide -- where that occurs, that will take place. Where rain occurs, more radionuclide will be washed down but we do not know whether it will result in more -- I would request that you would repeat the question.

Q Would wet deposition of rain at the time of the

accident result in more contamination of the water, higher concentrations in the water?

A Not necessarily. It will depend upon how long the rain would last. If it is for a short time, only a small area around the reactor will have higher concentration. That may lead to local higher concentration in the river at the water site, but that would also mean the depletion of the particulate matter from the plume, so less will be available for deposition in the far out distances.

Q So if it rains further out, when the plume had reached the further distance --

A Then it would bring most of it down. If it rains further out, it will bring still most of it down.

Q On page 7, on the top of page 7 in your testimony, Dr. Acharya, did you have any particular level in mind when you said a wind direction which would cause a high deposition of radionuclides on one et cetera?

Did you have any particular level --

A No, I did not.

Q Now -- it has been the previous testimony, has it not, that there is 100 percent chance of both rivers being contaminated, both watersheds being contaminated, is that right, or if the Delaware is contaminated, there is a 100 percent chance that they both will be?

A (Witness Fliegel) I think the statement was that

if the Delaware was contaminated, there would be some deposition in the Schuylkill.

Q Do you know the likelihood of contamination of the Delaware, assuming the Schuylkill has been contaminated?

Do we have that here?

A (Witness Wescott) In order to do any type of joint probability distribution, you have to really define what you mean by contamination. In other words, what level. I think what you are looking for is given that the Delaware is contaminated to a certain level, what is the probability that the Schuylkill is contaminated to another level?

We attempted to answer that question but there are so many variables involved.

For example, what levels of contamination are meaningful?

We abandoned it because we just really were not getting any meaningful results out of it good enough to really draw conclusions.

Q Did you examine the Iodine-131 question and what proportion of consequences that contributes or risks that it contributes in the short term?

A (Witness Fliegel) We considered that in the short term, if a river or water supply was highly contaminated, measures would be taken to preclude the public from using that water supply for drinking water, and since Iodine-131

has a relatively short half-life, it was our conclusion that it would be a minor contributor to risk.

Q So, your focus on Strontium-90 and not looking at iodine or cesium was in reliance on the interdiction or the keeping of people from consuming the water for the short period of time?

A Consuming contaminated water.

Q Contaminated water.

What period of time did you assume that the water would not -- any contaminated water would not be consumed? Or did you think it specifically about that?

A We looked at allowing consumption at various levels of contamination but in any event the Iodine-131 disappears after a couple of months.

Q So you were making the conclusion that for that two-month period, the water would not be consumed, contaminated water?

A If it were contaminated above a level that was determined to be too high to allow public consumption. We haven't guessed what that level would be. We made a couple of suppositions at what it might be but we can't tell you what it would be.

Q You made some suppositions as to Iodine-131?

A No, we used primarily strontium, because strontium persists for a long period of time.

Q So basically your analysis of the environmental impacts was focused on the longterm effects, not the short term effects?

A The long term effects of ingesting water that is contaminated below a level at which people would be allowed to drink but above a background level.

Q Eight picocuries?

A That was one of the levels we looked at.

Q So your environmental impact analysis basically assumed that the emergency planning measures would be adequate to keep people from consuming any water until it got to those three standards that you looked at.

A That the authorities would take the measures necessary to preclude populations from drinking highly contaminated water, yes.

Q Now you talk about, in paragraph 11, the 300 picocuries as the maximum permissible concentration?

MR. VOGLER: Whose paragraph 11 -- Wescott, Fliegel or Acharya?

MS. BUSH: Dr. Acharya.

JUDGE BRENNER: Is there a question?

MS. BUSH: Yes.

BY MS. BUSH:

Q How does the 300 picocurie per liter that you derive from 10 CFR Part 20 compare in picocuries to four millirems and 50 millirems, or can you make that translation?

A (Witness Acharya) No, at this point in time I cannot make it.

Q Does the 300 picocuries per liter translate into millirems?

A The assumption in 10 CFR Part 20 is that at the MPC level no matter what the radionuclide is, by using the contaminated water, that level would result in about 500 millirems per year to a person.

Q Did you calculate the probability of exceeding, say, one-third the MPC in one month or two months?

A I guess we have that here. That is on page 8 -- excuse me. That question is for one month?

Q Yes.

A I guess Dr. Fliegel and Mr. Wescott may address that.

A (Witness Fliegel) If the question is did we calculate the probability of exceeding MPC or one-third MPC within the first month, the answer is no, we did not.

Q Did you calculate that for any period within the

first month? Any shorter period than a month?

A No.

Q Do you have calculations that show how long before the probability of not exceeding 15 picocuries per liter is 95 percent?

A I don't think we understand the question.

Q The one MPC is 300 picocuries per liter, is it not?

A For Strontium-90, yes.

Q For Strontium-90. For Strontium-90, for 15 picocuries per liter over eight picocuries per liter, either level, do your calculations show you or do you have available to you calculations that would indicate the probability of not exceeding either of those levels of concentration for strontium in the Schuylkill at a level of 95 percent probability?

A I don't understand where the 95 percent probability comes in.

Q Well, I am trying to get a number in the sense of -- like you use 14 percent or 5 percent or 65 percent. Perhaps I am not stating it correctly, but that kind of probability level.

A Okay. If you are referring to Acharya's answer A-11, that comes from Westcott and Fliegel's testimony, Attachment 3, and that is just simply reading that chart and if you look at Attachment 3 to our testimony and look at the

curve for the Schuylkill River, which is giving a probability distribution of concentration, and you look at the concentration in picocuries per liter, 300 picocuries per liter is one MPC. And if you run across that horizontally --

Q Could you go back a minute? I didn't follow that. Attachment 3?

A Attachment 3. The upper curve is a probability distribution of the first year average concentration of Strontium-90 in the Schuylkill River. The axis on the left shows concentration in picocuries per liter. The 1 MPC level is 300 picocuries per liter.

If you look at the line on the left, between 200 and 400, that represents 300 picocuries per liter. If you go across that horizontally until you intersect the curve and then carry that line down, that turns out to be about 14 percent and what that is saying, that given this accident there is a 14 percent probability of not exceeding 300 picocuries per year on a first year average.

And if you give me a different level, we can look at it on the left hand coordinates and run across and get the probability for that level.

Q How about 8 picocuries per liter?

A We didn't carry it down that far. But by extrapolating the curve given the accident, it is highly probably that you will exceed 8 picocuries per liter in the

Schuylkill.

Q Do we know in what time frame that would happen?

A This is a first-year average. It will vary during that first year and it will be dependent upon weather conditions, how the deposition occurred, what the flow in the river will be.

Q Dr. Acharya states on page 8, paragraph (f) the probability of not exceeding one-third MPC after 30 years is less than 50 percent. There is a 99 percent probability that this concentration will fall below one-third MPC, 53 years after the accident.

Can you tell me the probability of not exceeding 8 picocuries per liter after 53 years, after 30 years?

A That was taken from Attachment 4 and Attachment 4 shows two curves, the probabilistic distribution of the time to reach MPC and the time to reach one-third MPC given the accident.

We don't have on that curve the time to reach other concentrations. Clearly, we can extrapolate between one-third and one MPC by looking between the curves but values outside the curves are difficult to extrapolate.

Q In paragraph 17, Dr. Acharya, are you stating that there would be -- if there were a two month interdiction of the Delaware it would then reach the one-third MPC level?

A (Witness Acharya) I don't recall making a statement

on the period of interdiction.

Q In the answer to 17, you are talking about the Delaware River may be the source of drinking water for the whole city after initial period of about two months.

This may be possible by restricting the use of the Delaware water only for the purposes of drinking --

JUDGE BRENNER: Ms. Bush, we have the testimony but it is difficult, I think, to get it in the transcript unless you stay closer to the microphone and read a little bit slower maybe.

WITNESS ACHARYA: Would you please repeat the question again?

BY MS. BUSH:

Q Are you talking there about interdiction of the Delaware for two months until it gets to a one-third MPC level?

A (Witness Acharya) What I am talking about here is trying to respond to questions under what circumstances the estimate of the population exposure would be, would be higher than provided in the earlier part of the testimony.

Here I am stipulating that what could happen in case both rivers are contaminated simultaneously, though it may have low probability -- contaminated simultaneously to an acceptable level, then I go on to say the Delaware River has a high probability to return to one-third MPC, has a high

probability to return to below one-third MPC within two months whereas it may not happen for the Schuylkill.

New BU

Now since the Delaware has got the capability to serve most of the City's population drinking water needs, then there I am assuming that the Delaware water could be used and then in that case since there is some residual contamination in the Delaware water, my earlier assumption was that the Delaware water would serve only 50 percent of the City.

Now assuming that it will serve 100 percent of the drinking water needs, the population exposure will be doubled.

A (Witness Wescott) We would like to add a little bit to that. With our wash off model, two percent of what is originally deposited runs off immediately, within a short period of -- we estimate one or two months based on other research.

Over the first year, one percent of the remainder runs off. So these first-year averages, the large component of these first year averages are what immediately washes off.

What Dr. Acharya is saying is that when we looked at this, the calculations as to how long it would take to reach the one-third MPC, we realized that for 95 percent of the time, for the depositions on the Delaware, that may be the first year average -- may be over one-third MPC, but that is only because the initial wash off concentration is so high.

Once that initial wash off concentration is gone, then the concentration of the river as a whole is back down below one-third MPC, even though the first year average may be above one-third MPC is the reason for this statement.

Q The estimate there of the population exposure would be doubled, would only have a small likelihood. That doubling effect doesn't take into account the initial one or two month period where there is the two percent wash off, or does it?

A (Witness Acharya) It does not take into account of any dose that would be incurred by drinking at much higher contamination levels. No, we said earlier we are not accounting for that.

Q Do you know -- have a notion of how much of an increase it would be in terms of exposures if you did take that into account?

A Yes, I have that. We have said here in the testimony that even drinking of the water contaminated as high as one-third level, one-third MPC level, would be hypothetical but -- and that is why we calculated the dose, assuming that allowing of the drinking -- allowing the drinking of the contaminated water will be when the contamination would fall below 8 PCI per liter.

JUDGE BRENNER: I'm sorry, I missed that whole phrase.

Dr. Acharya, let me suggest you step back from

the microphone a little bit and speak louder and slower. Try it again. I just missed that. I'm sorry.

WITNESS ACHARYA: We have provided the estimates of the dose assuming that the drinking would be resumed when the contamination level would fall to one-third MPC; however, we said that that is hypothetical because we assumed that the contamination level at that level may not be allowed for the drinking water.

Now if that -- that will be hypothetical. However, one can make a preliminary estimate as to how much would be the population exposure in the following manner.

For instance, yesterday we saw the exhibit that has been provided by the Applicant regarding the PEMA PAGs, level 1, 2 and 3. The PEMA PAG Level 3, which is 8,000 -- rather 1,000 times the EPA level allowed for one month drinking -- that would be the uses in the initial period.

Then, as stated therein, that is the qualification for the PEMA PAG Level 3, that by drinking at that level for one month, the individual dose would be 330 millirems to the person, to a person.

And if you multiply that with the half a million people that are served by each of the rivers, then that translates to 2.7×10^5 personrems. And if that initial period of one month will be followed by the uses for one year at the PEMA Level 2, which is 12 times the EPA limit, as

stated as a qualification for the PEMA Level 2, the dose and individual would incur for one year is 50 millirems and assuming that that is the situation when one of the rivers is contaminated which serves half of the City's people, then from there the half of the City's people would incur a dose of 4×10^4.

Now do the following. That is, the first month population exposure is 2.7×10^5; then that is followed by the one-year dose, which is 4×10^4 population rem; then add that to the longterm population exposure that we have calculated at the EPA level -- that is your PEMA Level 1. That is, on page 12 we have 1.4×10^5 personrem. When you add the two elements that I just talked about here, they add up to 4.5×10^5 personrem.

And if you compare this with the dose we have provided at one-third MPC, our one-third MPC dose is bounding this. This is only 25 percent of our one-third MPC dose.

Q Now do we know that -- have you done an analysis that we know what level of contamination we would have for that second month?

A I don't have it this moment, but in the second month, after you have already used up the PEMA Guide 3 in the second month, that is the month following that, you are higher than PEMA 2. I don't know what will happen. I would assume that people will not be allowed to drink that.

Q Oh, so we don't know whether in this first month whether we would be at that PEMA 3 Level? You are assuming that people wouldn't be allowed to drink it unless it were at that PEMA 3 Level and the same for the second month except for the PEMA 2 Level, is that correct?

A That's right. Well, now, I may go beyond -- that our analysis assumes that we won't allow -- we did not assume any drinking unless it is below EPA limits.

End 8.

T9MM/mm1

Q Now, on page 13, Dr.Acharya, you are talking about the estimated risks associated with the drinking water, and you talk about the results are 0.3 person rem, whole body dose per reactor year, et cetera. Now that is not -- it is not .3 person rem whole body dose, is it?

It is .3 probability person rem whole body dose, to be more precise?

A I think I have been very precise there. It says the reserves are .3 person rem, whole body dose per reactor year. Per reactor year, when I say in the place "per reactor year" that includes the probability of the accident.

JUDGE BRENNER: Off the record.

(Discussion off the record)

JUDGE BRENNER: Back on the record.

BY MS. BUSH:

Q So, in your opinion, agencies that would be reading the FES or any member of the public, when they see a risk number of .3 person rem whole body dose per reactor year, they will know that that is not a level of consequences , that is a probability consequence number?

A (Witness Acharya) We have some conditional numbers before that. In the framework of risk analysis we just don't state the conditional values and stop there. We do point out what is the probability-weighted number. That is the risk.

Q My question is, if you take a number like the .3 person

mm2

rem whole-body dose per reactor year, and you say that is the results with the deonomination person rem whole body dose per reactor year, doesn't that imply that you are talking about a person rem whole body dose, not that you are talking about person rem whole body dose times probabilities?

A The preceding line implies that, where I am quoting the probabilities, implies that together with the conditional person rems, which are bigger numbers, like 1.4×10^{-5} to get to the probability. I don't think any reader will have any misleading perspective.

Q So you are saying, because of the context here where the prior sentence says "the probability that is associated with that person rem whole-body dose that is folded into that, they can --

A Besides that, in our FES we have several tables in which we have got the risk -- that also has got the risk of the person rems. It is in a very similar fashion that this number .3 person rem per reactor year is correct.

Q You are saying that you have tables that have the risk numbers in it? I didn't quite hear you.

A Yes, in the FES. Say, for instance Table 5.11(h). We have got tabulation of risks of various categories. They were probability weighted concentration magnitudes. They were the areas under the CCDFs.

mm3

So, in whatever way one would look at those numbers there, in the same way one would look at this number hee.

Q Would you agree,Dr.Acharya, that it is not unusual in risk aversion to demand lower risk as the potential consequences increase? That is, as the stakes get higher?

A I cannot speak to that.

Q You don't have an opinion on that?

A No.

Q Therefore, can I infer that that was not an elemen that you considered in doing the FES?

A You may conclude so.

Q Does the CRAC deposition rate model account for only two rates, wet and dry deposition, and has no dependence on the rainfall?

A That's why it is called the wet deposition. The effect of rain is what we call the wet deposition.

Q So, it has two deposition rates wet and dry, or it has one?

A It has two. And the dry deposition rate is continuously taking place whether there is rain or no rain. And that is enhanced by whatever deposition rate could be associated with the rain when the rain occurs.

Q When you say "enhanced," what do you mean?

A They are added.

mm4

Q They are added?

A Dry deposition rate is added to the wet deposition rate to determine the total deposition rate where, and whenever there is rain.

Q Is wind direction in the CRAC model considered to be independent of other atmospheric phenomenon, such as stability and rainfall?

A Wind direction you meant?

Yes.

Q Are these variables in terms of practical events, likely to be correlated?

A Please say it again.

Q Is it likely that you would have a correlation between stability and rainfall -- excuse me, rainfall and wind direction?

A Correlation between --

Q Wind direction and rainfall?

A Wind direction and rainfall? I don't understand what you mean.

Q When you have -- are you likely to have a stable wind direction and have rainfall at the same time?

A Stable wind direction? What --

Q One wind direction instead of a variable going back in different directions, back and forth in different directions?

mm5

A Neither of them are unusual.

Q Would it be likely that if you had rainfall you would have a kind of meteorological condition where the wind would be going steady in one direction?

A That's too long a sentence. Say it again, please.

Q If you have meteorological conditions where there is a storm and there is rain, is it likely that you would also have wind direction that is not of a high variance level. I don't recall the word that was used, but it wouldn't be going back and forth a lot, it would be going in one direction.

Variance, I guess.

MR. WETTERHAHN: Objection.

MR. VOGLER: Staff objects. Witness is confused.

JUDGE BRENNER: That's the witness's problem.

MR. WETTERHAHN: The question is incomprehensible without definition of what a storm is. That is an imprecise term in radiological terms. The record will be without --

JUDGE BRENNER: She doesn't have to be perfectly precise for purposes of trying to get at the quesiton in different ways if the witness can understand. And it is okay to start off somewhat qualitatively, which is what she started to do.

I'm going to let her proceed and pursue it, if

mm6

the witness can't answer it, we will see where it goes.

WITNESS ACHARYA: When there is rain, the wind direction may stay the same for a certain period of time and change later. Or, in a very highly turbulent situation like during a thunderstorm activity, the wind directions could be very highly variable. And our CRAC model, or CRAC 2 model, our assumption is the plume travels -- the wind direction persists.

BY MS. BUSH:

Q The wind direction what?

A In our CRAC or CRAC 2 model, we have only constant wind direction assumptions for any start time.

Q So, you always assume a constant wind direction?

A Yes, that is our model.

Q So when you have rainfall, you will be assuming a constant wind direction?

A For all situations, whether there is rain or no rain.

Q Mr. Lehr, I would like to turn to your testimony, now if I might, please.

JUDGE BRENNER: Ms. Bush, I don't think you are going to finish Mr. Lehr before the lunch break. As I look you have two pages of your plan for him.

MS. BUSH: Yes.

JUDGE BRENNER: We can break now or let you

mm

proceed a little bit and let you stop at a convenient point in a few minutes.

MS. BUSH: Why don't we proceed for a while.

JUDGE BRENNER: Okay.

Stop at a convenient point in about ten minutes or so.

BY MS. BUSH:

Q You indicate that you have utilized -- on page 3 of your testimony, bottom of the page:"The 1982 information supplied by the City, that indicates the Water Department distributed an average of 345 million gallons per day to the 1.69 million people and industry within the City limits."

Did you attempt to look at any historical data to determine whether that was a normal year, low or high for the year?

A (Witness Lehr) No, I did not.

Q Do you have available to you what the peak usage was in 1982?

A I believe there is information either in Mr. Aptowicz's letter or in the attachments to it, that peak usage rates sometimes approach 700 million gallons a day.

Q Now further you indicate in question 7, total "filtered water storage capacity as of 1982 amounted to about 1.121 billion gallons" is your revised figure.

mm8

Is that correct?

A Yes.

Q Would you agree that there is a certain level of pressure or what is called "head" neededto distribute the water in the system?

A Yes. Part of the water in the system flows by gravity, and some is pumped.

Q Now, I would like to discuss the capacity of untreated in process water as of 1982. First, for the Belmont plant.

And I think the discussion might be facilitated if you would turn to the water bookle from the Water Department that is part of one of Applicants' exhibits.

JUDGE BRENNER: You mean the one that was reference 14, how water from Philadelphia is treated and distributed?

end T9

Sim fols.

Sim 10-1

MS. BUSH: Yes, Applicant's Exhibit 166.

JUDGE BRENNER: Okay.

BY MS. BUSH:

Q Now you have I guess a revised figure here of 86.2 million gallons for the Belmont plant; is that correct?

A (Witness Lehr) Yes.

Q Can you tell me how you derived the 86 value in reference to I think page 15 of Applicant's Exhibit 166?

A I don't have that exhibit. I assume you mean this 1982 brochure. It was also attached to Mr. Aptowicz' letter; is that correct?

Q Yes, how water in Philadelphia is treated and distributed, page 15. Do you have that exhibit in front of you?

A Yes, I do. Would you repeat the question.

Q Now the two sedimentation basins are 72 million gallons total capacity; is that correct?

A According to this document, yes.

Q Now have you added the four sedimentation basins at 14.2 million gallons capacity to derive your total of 86?

A 86.2, yes.

Q Did you visit the Belmont plant?

A Yes, we did.

Sim 10-2

Q Do you recall that the four sedimentation basins feed into the rapid sand filter beds through a weir, that is through an overflow mechanism? Do you recall that?

A We visited the plant and saw the layout and the flow path was explained to us and the filtration follows the sedimentation, yes.

Q Can you recollect how the water went from the four sedimentation basins into the 26 rapid sand filter beds? Is that a gravity process?

A I don't recall.

Q Does your utilization of the 14.2 million gallon capacity from the four sedimentation basins make the assumption that that capacity is not needed to keep the process going?

A I am sorry. Would you repeat that?

Q Have you assumed that the water can be drawn totally out of the four sedimentation basins, the ones that are right before the rapid sand filtration beds?

A Well, I am aware that some of that capacity may not be available because they have built of a sediment perhaps there, but a small amount. Those basins are part of the normal flow path of the treatment facility.

Q Have you made an assumption of the availability of this water for consumption in any way in your analysis?

A Only to the extent that it is included as part of the production capacity of the plant as reported by the

Sim 10-3

City.

Q You are not purporting in your testimony or in your analysis that that water also would be available for consumption, or are you?

A I am indicating in my testimony that that is water that would already be in the plant and will have been removed from the river and would be there at say the time of an accident.

Q But you have not reviewed the particulars of whether that water is available in terms of the current state of affairs for consumption?

A I don't see why it wouldn't be available.

Q In making that conclusion then, you are saying that certain adjustments, if necessary, could be made to make it available?

A Well, it is available in the plant and then could be routed to the distribution system. I don't know whether you mean is it contaminated. Is that your point?

Q No. My concern is whether in terms of the hydrology of the plant, of the current layout of the plant it is water that is constantly kept at that level or is it water that can be drawn down?

JUDGE BRENNER: Ms. Bush, you are getting a little circular. It is not all your fault, but the problem is you got an early answer in this line of questioning that

Sim 10-4

he didn't know when you asked him about whether all that would be available and whether it was gravity flow and so on. So now you are asking him about adjustments and you are confusing him because I suspect you are talking about pumping adjustments on the implicit assumption in your question that it is gravity flow. But his previous answer was he didn't know.

If you want to try a stab at asking him to assume if it is gravity flow whether his assumptions would be valid and, if so, why, you can try that, or whether he remembers particularly that there is a weir at that point. But you won't get there from here the way you are going given his previous answer. You have something in your mind which he has not testified to, although you asked him about it.

BY MS. BUSH:

Q Do you recall whether there was a weir there that fed between the four sedimentation basins in the fast sand filtration beds?

A (Witness Lehr) Yes, I believe there is.

Q And do you recall whether currently the water is fed from the four sedimentation basins to the rapid filter beds by the weir or weirs?

A The water leaves the sedimentation basins and then goes to the sand filtration.

Sim 10-5

Q And does it leave the four sedimentation basins from the upper level of the sedimentation basins to the sand filtration?

A I already said I don't know whether that is by gravity or not. It obviously gets over the weir that way, and then whether it is collected and pumped to the sand filter or goes by gravity, I don't recall.

Q Did you actually see the weirs?

A We say the sedimentation basins. We did not go down and inspect them, no.

JUDGE BRENNER: We are going to break for lunch at this point. Why don't you figure out how you are going to proceed on this if you want to. Again, you know, you had plenty of witnesses available if you wanted to bring one in to talk about it. I told you just before and gave you the not so subtle hint that we will give you a little leeway on asking him to make an assumption and then you can proceed from there and see what happens under certain limited assumptions regarding the flow of that water.

We will come back at 1:35.

(Whereupon, at 12:05 p.m, the hearing recessed, to reconvene at 1:35 p.m., the same day.)

T11MM/mm1

AFTERNOON SESSION

1:35 P.M.

JUDGE BRENNER: Good afternoon. We are back on the record. I see Mr. Smolen is here. Welcome back.

MR. SMOLEN: Your Honor.

JUDGE BRENNER: We had expected to continue and finish with this other issue, then go with the emergency planning. Is that still what the other parties plan to do?

MR. WETTERHAHN: Yes, sir.

MR. VOGLER: Yes.

JUDGE BRENNER: I heard you might have a schedule problem today, Mr. Smolen, which we will accommodate if we can. Is that no longer a problem?

MR. SMOLEN: No longer a problem.

Whereupon,

DR. SARBESWAR ACHARYA

DR. MYRON FLIEGEL

REX G. WESCOTT

JOHN C. LEHR

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

JUDGE BRENNER: Ms. Bush, in that case you can continue your cross examination.

CROSS-EXAMINATION (Continued)

BY MS. BUSH:

Q Mr. Lehr, if I can direct your attention to the

mm2

bottom of page 4 of your testimony.

A (Witness Lehr) Yes.

Q Now, you state there that the Delaware River essentially could serve all of the areas that are currently served by the Schuylkill, but for the Belmonth High Service District, "provided it is fully available," do you not?

A Yes, I do.

Q Now you further state in that sentence that that assumption is based on average daily demand.

Is that correct?

A That's correct.

Q Would you agree that for that to occur in terms of the service of all but the Belmont High Service territory from the Delaware, one would have to have no major distribution lines out for maintenance?

A Yes. That is what is the opinion of Mr. Aptowicz in his letter to us, the caveats with regard to the Baxter plant serving various of the City normally served by the Belmont and Queen Lane plants.

Q Do you agree with that caveat?

A Yes.

Q Would you agree that the valves -- certain valves would have to be changed in order to redirect flows?

A That is my understanding.

mm3

Q And do you agree that all valves must be operational or be made operational in order for that plan to work?

A I don't know whether all valves would have to be made operational in order for that to work.

Q Do you know whether currently all valves that are necessary for that operation are in good repair? Do you know?

A No, I donot.

Q Would you agree with the statement made by Mr. Optowicz that the Baxter facility must be fully in service for this plan to work?

A I guess that would depend on the demand of the system, and how much of the City you are serving with the Baxter plant.

Q As to whether all of the Baxter plant would have to be operational?

A Yes. As I understand, at this time there is some excess capacity at the Baxter plant.

Q Would you agree that -- is your statement then that there may be some excess capacity to imply that there could be some significant equipment out for maintenance at the Baxter plant, and those areas could be served by the Delaware.

A That's not a proper characterization. The excess capacity in the Baxter plant refers to the demand placed on

mm4

it by its normal service area. The statement that some -- you say significant portions of the plant.

Q Equipment?

A Significant pieces of equipment, excuse me. I can't answer. I don't know.

Q Are you stating that you don't know whether Mr. Aptowicz' statement that no significant equipment out for maintenance as a caveatto the emergency plan, is correct?

Or, are you saying you don't know, you don't have an opinion of whether that is correct or not?

MR. WETTERHAHN: Objection. The witness has merely stated he relied on the representation of City official.

JUDGE BRENNER: Let's find out in direct answer to this question if that is the case. Because in some cases he said that is his understanding; in answer to some other questions he said that is what the letter says. So, it is not always clear what his understanding is based on. And a cross examiner is allowed to pin it down if it may be important to the City later.

Mr. Lehr, do you recall the question?

WITNESS LEHR: No, would you restate it?

BY MS. BUSH:

Q Are you stating that you disagree with Mr. Aptowicz' statement that the emergency plan would work if no significant equipment is out for maintenance at the Baxter

mm5

plant?

A (Witness Lehr) No, I do not disagree with Mr. Aptowicz' statement. My earlier statements were that since receiving his letter, and our visit to the Baxter plant, we learned of some excess capacity there with respect to its demand, and so there could possibly be some leeway there with regard to the capacity of that plant versus the demand that might be placed on it, trying to serve areas normally served by Belmont and/or Queen Lane.

Q Does that last statement about excess capacity -- are you by making that statement also drawing the conclusion that it would not be necessary for all of the significant equipment to be online for the plan to work?

A No, I am not making that conclusion.

A (Witness Fliegel) I would like to clarify a point here. The discussion and this paragraph is based upon the assumption that water would be consumed at normal rates.

Quite obviously, if there was a shortfall, we assume that it would be made up not by denying people the use of drinking water, but by denying other uses of water.

Q If I could just stay on this track for a minute, Mr. Lehr, do you agree with the statement that for all of the area to be served but the 7 percent of the City's consumption, in order for that plan to work, you would need

mm6

to have no significant equipment out for maintenance at the Baxter plant?

A (Witness Lehr) The 7 percent of the City is not in my testimony.

Q Yes, I understand that.

A I don't disagree with the statement made by Mr. Aptowicz that significant equipment would have to be -- all significant equipment would have to be in place.

Q Would you agree that the line that runs across the Schuylkill River from the East Park pumping station into the High Service territory would have to be in service for -- into the West part of the City to be operational for this plan to work?

A The line from the East Park reservoir does not serve the Belmont High Service District.

Q It serves the area currently served by the Schuylkill, that is not the High Service Territory, does it not?

A The portion of the Belmont facility that services that, yes.

JUDGE BRENNER: Ms. Bush, I am confused. You probably know more about the water system than I do, but when you say High Service Territory, did you mean Belmont?

I believe there is also Roxboro, for example.

MS. BUSH: Yes, I shouldn't have said either one.

mm7

I meant the part that is currently served by the Schuylkill, that is not either of the High Service Territories.

JUDGE BRENNER: I'm sorry, could you turn the mike towards you and say again what you just said?

MS. BUSH: I misspoke. I meant to say the part of the City that is served by the Schuylkill that is neither of the High Service Territories.

MR. VOGLER: Mr. Chairman, perhaps the witness wants to change his answer on the basis of what you now understand, or are you satisfied with what you previously said?

WITNESS LEHR: I would like to clarify.

There are two plants that serve areas from the Schuylkill River as a raw source. There is the Belmont Plant and the Queen Lane Plant. And the Queen Lane Plant also serves -- provides service to areas east of -- as my testimony indicates -- east of Broad Street and west of the Schuylkill River. And they do that from other filtered water basins, not necessarily East Park.

Q Are you familiar with the line that goes over the Schuylkill river that distributes water?

MR. WETTERHAHN: Objection. I know it is a fine line between the contention we have before us and emergency planning, but we are getting into specific lines.

The witnesses have already admitted that equipment would have to be in place. If he is trying to determine

mm8

what specific equipment, I think we are beyond the scope of the contention.

MR. VOGLER: Staff joins in that insofar as it relates to emergency planning.

JUDGE BRENNER: We are going to overrule the objection because it might help give us a context on the value of the witness' testimony in terms of measures that might be taken which, after all, was testimony put in here by the Applicant and the Staff.

Now I think it is fair to say that the witnesses have walked away from it to a lesser or greater extent under cross examination, or at least attempted to clarify the context in which it was used. But I am not sure the Staff context has been clarified the same as the Applicants' context.

In fact, to the contrary. THere is some testimony by the Staff that -- it is also depending on certain measures being taken. Some of what you are saying we will consider applying in findings and in our decision as to the extent of the level of detail necessary.

But for now, we will allow the cross examiner to proceed, as I said, to assist us in judging the knowledge of the witnesses, and thereby the bases for the conclusions given.

mm9

BY MS. BUSH:

Q Mr. Lehr, if you will turn to page 10 --

JUDGE BRENNER: Do you want to ask him the question that was objected to?

MS. BUSH: I am. I am going to set more background.

BY MS. BUSH:

Q If you would turn to page 10 of the booklet which is Applicant Exhibit 166 --

A (Witness Lehr) Yes.

Q Are you familiar with the line that runs across the Schuylkill River from the East Park pumping station that connects the Delaware fed system with the area on the west side of the Schuylkill River?

A I'm not aware that there is a line from the Delaware fed side -- is that what you said?

Q Well, from the east side of the river, of the Schuylkill River.

A I know a line exists. I am not familiar with it. I haven't examined it.

Q But you know that there is a line that connects the east side f the Schuylkill with the west side of the Schuylkill distribution system?

A I'm aware that there is a line from the Belmont treatment plant to the East Park Reservoir, yes.

Q Are you aware that there is a line that connects all of the City's distribution system on the east side of

mm10

the Schuylkill with all of the distribution system on the west side of the Schuylkill?

A I'm aware that that line exists from the reservoir, which is a point of distribution to the system from the Belmont Plant.

Q The Belmont Plant is on the west side of the river?

A Yes.

Q You are saying there is a line from the Belmont Plant which is on the west side of the river over to the east side of the river?

A Yes.

Q Would you agree that for the plan to supply the west side of the river with the Delaware water, that line would have to be operational?

A That line or some other line would have to be a means of getting water across the river.

Q When you say some other line, you mean some other line would have to be built?

A A line could be built, or there may be an existing line. I do not know.

end Tll
Sim fls.

Q You do not know. Now to your knowledge, has there ever been an occasion or a test where it was tried -- a system where you had all of the water except for the caveats that we have discussed provided from the Delaware River water?

A Did you say a test of the system for the --

Q Any occasion for test purposes or other purposes, are you aware of any occasion when that has actually been done?

A Conversations with City water department people in the flow control center who we visited indicated that such a test would be desirable. The individuals we talked to who have been working for the City for only a short time, a matter of a couple of years, had not tried such a test or had been complete such a test in that time period.

Q In terms of the effectiveness of the decontamination -- let me withdraw that.

In terms of the effectiveness of the current treatment processes for decontamination, I wanted to ask you a few questions from your testimony.

Side 2. Page 5 of your testimony, answer 9, does it affect the decontamination level -- do your assumptions or your results here in terms of the amount of decontamination that can occur with current treatment processes, are those numbers affected by the point in the treatment process where a line is entered into the system?

A In question or answer 9, I don't give any numbers for removal. I don't know which ones you mean.

Q Okay, don't focus on question or answer 9 then, just in terms of the numbers that have been presented by the Staff in terms of the level of decontamination that results from the current treatment processes, are those conclusions a function of any particular assumption as to when lime was put into the treatment process?

A The system is operated in a manner in which I have described here. That information was taken from the information provided by the City.

The other information that I had indicated, removal of various radionuclides elsewhere in the testimony, when I referred to the same kinds of unit processes that are referred to here, they are similar, so I think the answer to your question is no.

Q Did you make any particular assumption as to whether lime was inserted into the water at the beginning of the treatment process or at the end of the treatment process?

A The assumptions or the comparisons were based on my understanding on how the chemicals were added in the Philadelphia plants as described in the City's brochure.

Q It was your understanding that the lime was inserted at the front end of the treatment process? Or does it make a difference in terms of the decontamination levels?

A For the coagulation sedimentation, the lime is added at what you would call I guess the head end of the system, the treatment scheme, and that is similar to studies, lab studies and operational studies, operational experience that I cited elsewhere.

Q Now in terms of rechlorination, does the process of rechlorination affect the level of decontamination?

A Not to my knowledge.

Q Is it correct that the level of decontamination that results from the treatment process is a function of the combination of radionuclides in the water?

A Well, I think I make that statement in my testimony.

Q In making your conclusions as to the level of decontamination that could occur here, have you made particular assumptions as to the combinations of radionuclides that would be in the water?

A Which assumption, or which conclusions of mine are you referring to?

Q Well, you have an actual figure of 44 percent removal for strontium, is that correct, Strontium-90?

A Pardon me?

Q You have an actual figure for Strontium-90 of 44 percent removal on the historic data, is that correct?

A Yes.

In my answer, A-11, on page 7.

Q You state on page 10, answer 16, that you don't expect to have a 90 percent degree of removal, is that correct for the Philadelphia drinking water?

A Yes. I characterized it that the combination of drinking water treatment processes currently employed by the City of Philadelphia will likely not result in a high degree, that is over 90 percent, of removal of the radionuclides of strontium and cesium from the intake water, based on my review of the laborabory municipal plant study results cited above.

Q Are you making any conclusion in here as to -- or presenting any conclusions depending on a certain level of decontamination?

A Well, I think the next question and answer speak to that. In fact, the next two. I was talking in terms of meeting the EPA maximum contaminant level of 8 pico-Curies per liter.

Q Do you have an opinion as to what level of decontamination -- what level or what range of decontamination could occur for the City of Philadelphia's water system?

A For what radionuclide?

Q For strontium, cesium and iodine?

A I did not address iodine in my testimony and I think as we have indicated earlier, that iodine was not considered in our testimony based in its relatively short half life and the attention to the long-range effects in the

Staff's testimony.

Q For Strontium-90, are you concluding that there is a 44 percent removal or are you not offering any opinion or can you tell us what your opinion is?

A I wouldn't offer 44 percent. I offer 44 percent as a -- just what it was. It was a historic number.

Philadelphia was part of a sampling program and that information was available. As you can see in the testimony, that was a blended tap water anyway, so to propose that specific number for this point in time for that particular plant would not be appropriate.

Q What do you mean, "blended tap water?"

A Well, the study indicated if I recall that it was water taken from two treated sources. I don't know how it was blended. It was indicated that way in the study and apparently it would mean it was water mixed from treated water taken from the Delaware for the Baxter plant and from the Belmont or Queen Lane plant.

Q Do you mean by that the initial levels of contamination would have varied? What is the significance of having two sources?

A I am merely indicating that that particular figure was not attributed either to the Baxter plant or to the Queen Lane plant or to the Belmont plant.

Q I see.

A There is other information that I give in my testimony with regard to strontium removal percentages using alum as a coagulant and some of the numbers are given in my answer A-11. There is other information provided in answer A-13 and also information provided in answer A-14 and A-15.

I think what the studies have indicated is that it is difficult, very difficult, to predict precisely what a removal percentage would be for a given radionuclide or mixture of radionuclides by water treatment processes and much depends on the characteristics not only of the radionuclides themselves or the mixture but also on other characteristics of the water, incoming water.

Q Is it your testimony that you do not have an opinion as to the range of decontamination we could expect for Philadelphia?

A No. I believe, as I stated here in question A-16, excuse me -- answer A-16, that the removal is not going to be high and it is not going to approach 90 percent. I think the experience has indicated for the types of treatment processes that Philadelphia has, you just don't experience that kind of removal percentage.

Q Do you think it would approach 50 percent?

A It is my feeling that it could be in that range, yes.

Again, I want to emphasize that the particular

characteristics of the water and the radionuclide under consideration would have an awful lot to do with the exact percentage of removal that you would experience.

Q Could the level of decontamination be lower than 50 percent in your opinion?

A It could be lower, it could be higher.

Q Could it be lower than 44 percent?

A It could be lower, it could be higher.

Q Could it be lower than 30 percent?

A Some of the studies that I have referenced in my testimony indicate removal ranges with lower limits, below 30 percent.

Q So that is a possibility here?

A Yes.

JUDGE BRENNER: I want to make sure I have still got the thread. I am sure it was in your earlier question, but I missed it.

These questions and answers are under the assumption of taking the additional alternative treatment methods, such as those discussed on page 13 of Mr. Lehr's testimony? Or only the methods currently available in the plants in the water treatment plants?

BY MS. BUSH:

Q What were you answering for?

A (Witness Lehr) I understand our conversation to

be based on the types of unit operations currently employed by the City.

JUDGE BRENNER: Is that what you meant?

MS. BUSH: Yes.

JUDGE BRENNER: All right.

End 12.

JUDGE BRENNER: As long as I interrupted you, on the same line on page 13, answer 21, Mr. Lehr, you say alternative treatment methods such as lime-soda softening could be employed to "improve" -- that is your word -- the removal of Strontium-90 activity from the influent water.

Can you tell us a little bit more about what you had in mind by "improve" on a more quantitative basis?

WITNESS LEHR: Yes, I can. Studies of lime-soda softening processes for the removal of Strontium-90 have indicated removal percentages as high as 96 percent on a single pass. And as we heard earlier in the Applicant's testimony, that is an often-used and well-understood treatment process and I agree with that.

JUDGE BRENNER: Is that as high as 96 percent, just based on one experimental or historical datapoint or is it typically very high in that range?

WITNESS LEHR: The studies that I was referring to cited several instances, or several different treatments, I mean all being lime-soda softening, but in numbers typically that were given -- excuse me, ranges, ranges that were given for one 67 and 73 percent, for another 89 and 91 percent, for another 79 to 86 percent and the other one, up to 96 percent removals.

End 13.

Sim 14-1

JUDGE BRENNER: I am sorry for the interruption, but you were on the subject. Go ahead.

BY MS. BUSH:

Q Are those treatment processes for strontium isolated, or is it strontium mixed with other contaminants?

A (Witness Lehr) I believe these were for strontium alone.

Q What would be the effect on the percentage removal of having other radionucides in the water, do you know?

A I don't know. I am not aware of the presence of other radionuclides that would necessarily degrade that kind of performance.

Q You mean as the result of an accident at Limerick?

A No. I am saying if other radionuclides were also present. I have seen nothing that would indicate that it would interfere or lower the removal percentage for strontium 90.

Q In your earlier testimony where you indicated the level of removal was affected by the combination of radionuclides, is that statement not applicable to strontium 90, or how are those two statements consistent?

A I believe that statement was made, or this was the observation of some of the researchers. I was what was intended there was that the level of removal, percentage removal depends on the radionuclide present. If you have

Sim 14-2

a mixture that is high in strontium or say in cesium, one particular treatment process may be more effective than others in reducing its concentration, or reducing the activity in the effluent.

Q On page 11, at the top of page 11 you talk about there is only a need for a high level of removal of strontium and not cesium.

A This is in Answer 17?

Q Yes, Answer 17.

A Yes.

Q Why do you state for cesium? Is that because of the time period of interdiction of the water?

A No. The next question and answer go on to explain that somewhat, and in there I say that the basis for my conclusion or the staff's conclusion that only strontium 90 would contribute significantly to population dose.

Q And that is for the reasons that you discussed earlier in terms of the long-term contribution of strontium results in cesium only contributing 10 percent?

A I believe that was not in my gestimony.

A (Witness Fliegel) That is correct. That was based upon results from the study at Indian Point that the contribution to dose was overwhelmingly from the stront m 90. So we did our analysis primarily on strontium 90.

A (Witness Wescott) We also looked at strontium

14-3

90 in this basin, too, and cesium and compared them and arrived at the same conclusion that cesium would only be a small percentage of the dose.

Q Is that a function of the fact that the strontium is a longer contaminant, a longer period of time contamination?

A (Witness Fliegel) The half lives are close for both the strontium and the cesium. The difference is that cesium is much more readily bound up in the soil and winds up not in solution in the river.

A (Witness Wescott) Also the dose conversion factor is much lower than cesium. So when they put the two of them together, cesium becomes a much lower total contributor to dose.

Q In Answer 18 you talk about the percentage removal to get down to certain levels of contamination. Is there any strontium already existing in the water, and did you take that into account if it was?

A (Witness Lehr) Who are you asking?

Q Well, whoever it would be appropriate. I guess it is in your testimony, but whoever is qualified to answer.

A (Witness Wescott) Are you talking about background strontium that may still be in existence in the watersheds from the atmospheric tests back in the 50's and 60's?

Q Yes.

A Okay. That was receding down to approximately

14-4

one pico curie per liter or lower when we stopped looking at it. So I would assume that you probably wouldn't even have a pico curie per liter of background strontium 90 in the drinking water prior to an accident.

Q When did you stop looking at it?

A Oh, I think in the -- let me check.

(Pause.)

In 1967 it had gone down to less than one pico curie per liter in the various rivers, the Schuylkill and the Delaware Rivers.

A (Witness Fliegel) And to clarify a point, we weren't looking at it. That is cited in the literature.

Q Have you considered in your analysis the sedimentation contamination and how that might affect the environment in terms of the sedimentation basins?

A (Witness Lehr) Which sedimentation basins are you referring to?

Q At the three treatment facilities.

A You mean the presedimentation basins?

Q Well, I am really not referring to any particular one, whichever one or both of them if the radionuclides would be coagulated out and precipitate down into either or any of the sedimentation basins.

A My testimony did not address those from that or any doses from that.

A (Witness Wescott) I made an inquiry as to that when we were at the treatment plants, and I was told that normally at Baxter that most of the sediment is flushed out of the basins into the treatment plant, the sewerage treatment plant. However, this does not have to be done. It can be taken out and trucked away. It would depend on how contaminated it is and the procedure for handling it would be dependent on that and how to keep doses to workers and such at a minimum. But it does not have to be flushed down and taken care of at the treatment plant, the sewerage treatment plant. There are alternatives that it can be taken out of the basins directly if need be.

Q Now again on the bottom of page 12 you talk about the use of the Baxter plant to provide water for the needs for the city. Would you agree that there could be other kind of industrial spills on the Delaware that could render the Delaware water unusable for periods of time?

A (Witness Lehr) I think something as you are proposing could happen. I don't have any information on it.

Q Now in terms of serving the higher areas, the Belmont and Roxborough area, I take it that you have not studied in detail the feasibility or the method of supplying that area with trucks, for example?

A As I say at the end of my testimony, we haven't gone into detail on supplying the Belmont High Service

Sim 14-6

District with water by means other than the present distribution system.

Q And if trucks were able to supply the usage for the drinking water, would I be correct that that would not take care of the needs associated with fires?

A Excuse me. I was writing something down. Would you repeat that, please?

Q Am I correct that the utilization of tank trucks to supply water for drinking needs would not address the problem of water needs associated with fires?

A The water supplied by tank truck would be for potable purposes and would not be for fighting fires.

Q Would you agree that there would be some need to address the fire question?

A I would think the city would want to make sure that it had water to fight fires within its boundaries.

Q Would you agree that another need that should be met for the high service territory would be water associated with summer cooling needs and winter heating needs, particularly for hospitals and nursing homes?

A While that seems reasonable, that is a decision to be made by the city either in consideration consolidation of facilities or other economic measures or alternatives.

Q Would you agree that for there to be reliance on other sources outside of the city sources, the Delaware

Sim 14-7

Baxter plant, that one would have to obtain a commitment from the neighboring utilities to supply that?

A If you were going to go to another supply, some means to secure that supply would have to be secured. I don't know whether you would do it by court order or what. You talk about permission and I don't know.

A (Witness Fliegel) Let me add something to that. You can certainly fight fires with water with some strontium 90 in it. So if the city deemed it important to have the ability to fight fires, they can leave contaminated water in the lines and be available at the fire hydrants and still truck in drinking water.

Q That then would result in the contamination of the Schuylkill distribution system and treatment system associated with the Schuylkill, the Belmont and Queen Lane, would that be correct, the contamination associated with the Queen Lane and Belmont?

A (Witness Wescott) I think what we are trying to say is that this is a decision that the City would make based on the level of contamination. It is conceivable that the City may not want to put water through their lines and may have a fire fighting problem, and it is conceivable that they would leave water in their lines. That would be a decision that I think would be made at the time of the accident, and I think you have got to put everything in

Sim 14-8

perspective about the things we have said before, that you are not going to get reservoirs contaminated at the same time you get a heavy contamination in the river. I think when you start looking at this, the scenario where you envision that you don't have drinking water and you don't have fire fighting water and you don't have anything, we just don't feel is a likely occurrence.

However, some parts of that like not having drinking water is possible. That is I think the bottom line that we are making from the various studies and conclusions that we have drawn.

Q When you say it would not be likely that you would not have drinking water and not have fire water, is that what you just said?

A That is correct. I am saying that it is not likely that everything would be so contaminated that you are not going to have any water to fight fires and you are not going to have any water to drink.

Now certainly you don't have to drink from the faucets. I think the point that is being made is you can truck in drinking water.

Q Under that scenario what did you have in mind that there would be fire water? Are you talking about contaminated fire water?

A We did not make any type of study as to how

Sim 14-9

contaminated the water would have to be before the city decided they didn't even want it in their fire hydrants. I think that was beyond the scope of the contention.

I think the point we are trying to make is just because the water may be too contaminated to drink does not mean that it is unsuitable for fire fighting purposes.

Q I see. You are saying there could be levels of contamination under some scenarios, that it would not be to contaminated that it could be used for fire but would not be used for drinking?

A That is correct.

Q In terms of this alternative of having water sources from neighboring utilities, aside from the question of securing that water, as we have previously discussed, would there not also be an issue of the availability of uncontaminated water from those sources?

A (Witness Lehr) My testimony was that you can normally consider various alternatives when your primary source is threatened with contamination or interruption, and one of those was I made the point of delivery of safe water. It doesn't do you much good to go to an alternative if it is contaminated also.

Q So we would have to determine if any of our utilities that are nearby would have contaminated water or not?

Sim 14-10

A I think before securing any source of water for drinking water purposes, the City would have to assure itself that what it was getting met whatever standards the City felt was appropropriate.

A (Witness Fliegel) I think it is also obvious that were there to be an accident of the magnitude that is envisioned here, that all of the aeas around the plant would be measuring radioactivity in their water so people would know what the radioactivity would be in the various water supplies was.

Q Is it likely that all the utilities from this area would be getting water from the same watersheds, the Schuylkill or the Delaware?

MR. WETTERHAHN: I think I am going to object on the basis of relevance to this contention. We have gone beyond the needs of the City of Philadelphia and I am not sure what point is being made. I don't have the cross-examination plan.

JUDGE BRENNER: Well, the point I think stems from the phrase in the last paragraph on page 13 of Mr. Lehr's testimony that was just recently alluded to again by Mr. Lehr that one of the alternatives that he says can normally be considered is construction of temporary or permanent pipelines from the points of use to safe and adequate supply, and I think the cross-examination is

Sim 14-11

stemming along those lines.

So I will overrule the objection.

I was going to interrupt, too. I am going to caution the people at the tables, and I won't single the person out that stimulated my last remark, and it has happened several times during the day, you had better reframe from nodding yes, no or maybe at the witnesses when they are considering a question. Once in a while it is natural, but it was too strong most recently. Maybe the witnesses are ignoring you anyway, but nevertheless cut it out.

Go ahead, Mr. Bush.

WITNESS LEHR: Would you repeat the question, please.

BY MS. BUSH:

Q Is it correct that the neighboring utilities that are closest to the Philadelphia Water Department would be getting water from the same watersheds, the Schuylkill and Delaware?

A (Witness Lehr) Not necessarily. It is my understanding, for instance, that the nearby municipalities in New Jersey rely on groundwater for their drinking water supply. So there may be a chance for water to be available there and it may not be contaminated at all from an accident at Limerick.

Q Is that across the Delaware River in New Jersey?

Sim 14-12

A Yes.

Q So that would involve a pipeline across the Delaware River?

A Some form of conveyance. It could be trucked across.

Q Would you agree that we would also have to detgermine the availability of underground water for these areas in the City as well as any needs of the other utility in New Jersey that you know about would have?

A I don't why the City would have to determine the availability. I think that would be the responsibility of the municipality or corporate identity or whoever that owned the sater or the rights thereto.

Q Do you know if that New Jersey utility is right across the river?

A I don't know exactly where their wells are or their service area.

Q So we would have to know how much of their water supply is underground and how much is on the Delaware to know whether they would have that available for us, or it would have to be determined.

A It would have to be determined.

Q Now you talk in Answer 21, the first paragraph, about the modifications to the treatment plants. Is that the same process that was discussed yesterday during the

Sim 14-13

hearing?

A What are you referring to specifically?

Q Throughputting the water a second time for further treatment.

A You mean repeated precipitation?

Q Yes.

A To do that I think it is likely from my brief visits to the Baxter and Belmont plants to accommodate that that on a long-term basis that would likely involve new construction either of some pipelines or installation of a pump structure or something like that. Certainly on a short-term basis those things could be accomplished with temporary measures.

Q The measure that you talk about here in Answer 21, the lime softening process, that is a different process than repeat precipitation?

A No. As it was discusse yesterday, it was using lime-soda softening and treating the water repeatedly to get as much of the strontium out at the same time as you are precipitating the calcium out.

Q So you are talking about the same kind of construction project that was discussed yesterday?

A Well, I referred to it. As I have said here, I didn't do any detailed analysis as to just what would be required and whether the City would be inclined to do it

Sim 14-14

or not.

Q Do you have any opinion as to how long it would take to set the system up even on a temporary basis?

A I think on a temporary basis it could be accomplished fairly quickly. Of course, that depends on the resources that you want to devote to it in terms of money and manpower and so on.

Q Would it be necessary to order a pump?

A Yes, I believe it would, or, excuse me, I shouldn't say necessary to order a pump. I think a pump would have to be used to bring the water around again or to the head of the basin because my understanding in talking to the -- and I am referring here specifically I guess to the Baxter plant, although I think it would be true for Belmont and Queen Lane as well, that there was not physical way to bring the water back to the head of the basins as the plants were presently plumbed.

Q So you would need to use pumping facilities to get the water back to the beginning of the process?

A Yes. The water wouldn't flow by gravity back there, that is right.

Q Are you talking about a two week, three week or one week time frame or four weeks or six weeks for a temporary system?

A My opinion is that it could be accomplished

in less than a week.

Q This would be getting distribution lines in and getting a pump there?

A Well, I don't know what you mean by distribution lines. Do you mean just pipelines?

Q Go ahead.

A Did you mean just water conveyance lines to bring the water back to the head of the basins?

Q Yes.

A Well, certainly.

Q Do you think a pump could be obtained and installed in a week?

A I think that you could certainly juryrig something that would work in that time period. It may not be just one pump but it may be several smaller ones. I think it could be done, but when you do that you are going to decrease the throughput of the plant of course.

Q Do you think that kind of equipment is available and on hand?

A I don't know. I would imagine it shouldn't be too difficult to obtain it under the circumstances of an emergency that we are talking about here.

Q On the question of cutting the throughput in half, have you ---

A Excuse me, I didn't say a half. I said you

Sim 14-16

would be cutting it.

Q Do you have an opinion as to how much you would be cutting it?

A Well, it depends on what the level of contamination is coming in and what level you are trying to achieve coming out.

Q If you put the water through one more time, in addition to the one time that it goes through, would you not necessarily cut the throughput in half?

A Well, if you treated all of the water, I would imagine that you would, but there is a possibility you may not. Depending on the level of contamination, like I say, coming in and the level you desire to have leaving the plant, you may not have to treat all of the water the same. You may be able to threat a side stream or a portion of the flow and remix and achieve a limit that you find acceptable.

Q Are you suggesting there would be some way to dilute the water?

A Essentially you would be cleaning a portion of the water to a high degree and the remainder of the water perhaps not as much or not at all, whatever you decide. Then according to the volumes that you have treated in remixing essentially the real clean water, or the clean water dilutes the contaminated water.

Q Would there be a need for any holding facility

Sim 14-17

to do that, or any additional construction?

A Possibly. Again, it depends on the volume of water you want to be able to treat. You may be able to accomplish the high degree of treatment in one portion of the plant and the lower degree of treatment in another portion of the plant and you may not have to construct additional basins.

MS. BUSH: Your Honor, I have no additional questions. I have some exibits that I would like to have identified at some point that are Applicant's Exhibits that we have been discussing.

JUDGE BRENNER: Why don't you tell us now what they are and why. Are you talking about marking them for identification?

MS. BUSH: Well, actually they are marked for identification and I would like to have them introduced.

JUDGE BRENNER: All right. Tell us which ones and why.

MS. BUSH: It is Applicant's Exhibit 166, which is how water in Philadelphia is treated and distributed, Applicant Exhibit 169, which is the Bruce Aptowicz letter, and Applicant's Exhibit 170, which is the Philadelphia Water Department Table of Pumping Treatment and Consumption Rates, and that would be all.

JUDGE BRENNER: All right. Let me get the

Sim 14-18

position of the parties.

Applicant.

MR. WETTERHAHN: I assume that the City is requesting that they be admitted for the truth of the facts contained therein in all of them?

JUDGE BRENNER: I assume. Otherwise, the purpose is already served by identification, correct, Ms. Bush?

MS. BUSH: Well, I wanted to be able to refer to them in briefing.

JUDGE BRENNER: To the extent the witnesses have relied on them as brought out in the testimony, you can do that already, but only to those parts brought out in the testimony either written or oral.

MS. BUSH: I will raise this again after the parties have done their re-cross. Could I consider your question and raise it again at the end of the examination?

JUDGE BRENNER: Yes.

JUDGE BRENNER: We are talking about three relatively concise documents, the longest of which is seven pages and I guess the other two are what, two pages each, or more pages than that I am told.

MS. BUSH: Yes, the other two are two pages each.

JUDGE BRENNER: All right. But only 166 only a portion of it has been marked for identification and you

Sim 14-19

have the list as to which portions and I will refer you back to that. Even so, my seven pages was in error. It is more than that.

While this is not precisely relevant to your last request, but in the ball-park of being relevant, let me remind you of what I said yesterday, that you have had the whole City Water Department at your disposal to put on as witnesses if there was any material fact that either applicant or staff witnesses were using in reliance on how the water system worked or in reliance on these three documents, including particularly the letter from Mr. Aptowicz and you were free to put in your own testimony origianlly or else certainly rebuttal after receiving the written testimony, and the City has chosen not to.

So if you have really got a material disagreement, the information was at your disposal to put on before us. Certainly your cross-examination has helped us, or I will speak for myself, has helped me understand a little bit about the way the water system works and these witnesses' reliance on it and that has been very helpful. But that is a lot different than if the City now has a litigative position that they have a very material disagreement with some facts put forward by these witnesses involving how the water system works. You had that opportunity and we can infer from that silence that there is no major material disagreement on that

Sim 14-20

subset of this contention.

Well, while I am on the subject, as I have been listening here, and you don't have to answer this question if you can't, or you will have to answer it eventually in findings, but maybe you can help me out now. Because the City is an interested governmental agency and they put forth an issue, it doesn't necessarily mean that there is a material disagreement as opposed to a desire to at least get at some of the facts in the issue.

I would like to understand, if you can tell me, if it is the City's present litigative position that some reasonable combination of the range of mitigative measures talked about in the testimony of the witnesses we have heard, whether it be -- well, it is a combination of decontamination measures and some alternate source measures, some of that alternate source being within the City's system itself, but with different valving changes and so on, whether it is the City's position that some reasonable combination of those, not necessarily all of them, but some reasonable combination of those measures are simply infeasible or whether it is just your position that in order to rely on them that proper advance planning is necessary.

MS. BUSH: Well, certainly the latter is our position in any event.

As to your first question, we certainly, as

Sim 14-21

Mr. Abtowicz indicated in the letter, we believe that there is almost a certainty that the Delaware River can supply the Schuylkill area, except for the two high service areas. As you said, it should be tested and various things like that.

As to the larger questions of the long-term and the probabilities associated with contamination and the ability to decontaminate to certain levels, that I can't tell you what our position is at this time, but we will be addressing that in findings.

JUDGE BRENNER: I would ask you to keep it in mind and to be very clear on those points in your findings, because it is possible that you may have findings at this stage that some reasonable combination of these factors, particularly the one you pointed out, which is in Mr. Aptowicz' letter, is feasible and reasonable at this stage, but that is not to the prejudice of some other possible contention you might have, and we will deal with that later this afternoon on emergency planning in terms of the necessary rigor in the City's view of advanced planning.

MS. BUSH: Yes.

MR. WETTERHAHN: May I suggest a related question that the Board may wish to consider, and that is since the City is an interested governmental unit, that after

Sim 14-22

completing its cross-examination whether the City is now able to state whether there is a contention now or whether it is now satisfied that if the information as contained in the testimony, if adopted by the Board, would satisfy its informational requirements and thus that nothing further need to done except put this information in a decision?

JUDGE BRENNER: I won't ask that the City give me answer to that now because it is a mouthful, as you recognize. In fact, the answer is, at least to one small subpart that I asked about, that you cannot, and there is a lot more in the testimony than just the mitigative alternative meausres.

Nevertheless, let me adapt Mr. Wetterhahn's nice try at this point to the fact that he is correct as to your posture here. In fact, the City emphasized it at the time we admited the contentions, that they were still at the information seeking stage and that has become obvious to us in terms of the good faith negotiations that have occurred in various aspects, and we will talk about that a little more with off-site emergency planning.

But you should think about what Mr. Wetterhahn just said, and if the parties think it would be helpful to talk with each other during this same stage that findings are being prepared, you might be able to come up with some stipulation that either in part or totally covers the

Sim 14-23

contention and the information needs.

You will also by then have the benefit of our action on your somewhat related, although distinguishable emergency planning issue, and that may help you also. So I will leave it at that.

MS. BUSH: We are definitely at the point of analyzing the much more extensive analytic effort by the company and the staff in both areas, the water and the airborne, and that is my agenda now is to look at the record and I think I have indicated my framework for looking at that in terms of probabilities and consequences.

We have talked on two occasions with the staff and the applicant in trying to talk about the record and what the record says and understanding what the consequences are, and that is what I will be doing now with the water as well as the air.

JUDGE BRENNER: All right, and we have talked about that before, particularly in the context of air last time.

MS. BUSH: Yes.

JUDGE BRENNER: But I think part of Mr. Wetterhahn's point is the time frame now. We already told you wht the finding schedule is going to be.

MS. BUSH: Yes.

JUDGE BRENNER: The applicant is going to have

Sim 14-24

to file findings two weeks from today, and then we will take a look at the calendar and work out the others.

I think part of the point is you may be able to limit or maybe even eliminate, but at least limit the necessary area for findings. But in order to do that you are going to have to come up with some sort of stipulation in the immediate time frame. You also have had the benefit now of not being stuck, so to speak, with the information they have given you because you have been allowed to cross-examine on the record as opposed to just informal conversations. So now you have had both avenues open, and I think I am paraphrasing what you have just said.

If you can put all that together sooner than the proposed findings date for the applicant and come up with something, it may help you all, and the best I can do is leave it at that at this time. You are not required to do any of that, but it could help your position.

MS. BUSH: I am doing it for my own purposes, to as quickly as possible now digest all the information that we have gathered here.

JUDGE BRENNER: One thing that will help you is that we won't be in your way any more.

MS. BUSH: Right.

(Laughter.)

JUDGE BRENNER: That is we won't be in session

Sim 14-25

here.

MS. BUSH: Right. No more new testimony.

JUDGE BRENNER: Right.

Applicant cross-examination.

How much time do you have, Mr. Wetterhahn, can you give us an estimate? I have got your cross-plan, but questions have been asked since the filing of your plan.

MR. WETTERHAHN: Yes. Approximately a half hour or so.

JUDGE BRENNER: Okay.

XXXXXXXXXX

MR. WETTERHAHN: I am going to pick up some of the questions as a result of the cross-examination by the City of Philadelphia first and then go back and start my cross-plan.

CROSS-EXAMINATION

BY MR. WETTERHAHN:

Q Mr. Lehr, I believe you answered a question in response to a question of the City of Philadelphia that the maximum water usage was about 700 mgd. Do you recall that response?

A (Witness Lehr) Yes.

JUDGE COLE: Excuse me. That isn't what I remembered though, sir. He said the peak use was, the peak hourly rate was 700 million gallons a day.

BY MR. WETTERHAHN:

Q Would you clarify your answer?

A (Witness Lehr) I understood it to mean what Dr. Cole just indicated. The peak rates approach 700 million gallons a day.

Q For clarification, let's turn to the letter to Mr. Robert E. Martin from Mr. Bruce Aptowicz, which is identified as Applicant's Reference 17, which is Applicant's Exhibit for identification 169. Do you have that letter?

A Yes, I do.

Q If you turn to the second paragraph of that letter, the last phrase is "instantaneous peaks reaching 700 million gallons per day." That is the basis for your response?

A Yes, it is.

Q So that is not 700 million gallons would not necessarily be used in a day, but that is an instantaneous rate, correct?

A That is correct, yes.

Q Do you know what the maximum daily usage during the fiscal year in question was?

A Well, which fiscal year is that, 1980 or '82?

Q Is that the 470 million gallons a day also referenced on that same line?

A The line indicates on peak days in the summer what usage can actually amount to. It is about 470 the

Sim 14-27

way it is characterized here, yes.

Q And even considering the maximum usage, would you believe that conservation efforts during an emergency would be sufficient to reduce it below the normal or average uses?

A I would think that conservation appeals and/or other control measures that the City could exercise could reduce that substantially, yes.

Q You answered a question about the possible usage of water in certain intermediate basins as clean water supplies inasmuch as they were covered. Do you recall that?

A In my response today or in my testimony?

Q In your response to a question particularly related to the presence of a weir between two parts of the water treatment system.

A I remember us talking about a weir.

Q If there was a weir there and it served as an obstacle to utilization, couldn't you set up pumps similar to theones you had set up in order to utilize the water if you couldn't use gravity flow because of the presence of a weir?

A You could use pumps or perhaps even hook up a siphon.

Q Let us turn to the testimony of Messrs. Wescott and Fliegel, particularly with regard to Attachment 3.

Sim 14-28

Did anyone on the panel look at uses other than direct consumption such as bathing and washing clothing as contributors to man-rem dose, or could you give us an estimate as to the relative contribution of all other uses aside from consumption to an individual dose?

A (Witness Acharya) Independent of Attachment 3, we have noticed in other analyses that unless the water body is a major source of an aquatic pool, unless that is so, the drinking water pathway exposure is the dominant one and the other types of uses, like swimming, boating or using the shoreline of the contaminated water body, the dose from there is negligible compared to the drinking water pathway dose. And I would assume, or I believe that the same would be true in this case.

Q Looking at Attachment 3 for the Schuylkill water concentration at a probability of non-exceedence of 99 percent, it is somewhat below 800 pico curies per liter; isn't that correct?

A (Witness Fliegel) 1800.

Q I am sorry, it is below 1800.

A (Witness Acharya) That is correct.

Q In your opinion,considering the relative contributions of the effects of the use of this water, could water with these concentrations be used for sanitary purposes other than consumption?

Sim 14-29

A Well, I have not analyzed that pathway in detail, but Dr. Fliegel says that he has something to say.

A (Witness Fliegel) Pennsylvania says that you can drink water at 8,000 pico curies for a month, and I would assume that you can bathe in water with 1,800 pico curies.

Q Indefinitely. Is it indefinitely?

A Yes.

Q And would you say something similar if I postulated that you could use such water at such concentrations for washing clothes?

A It would appear so.

Q As far as fighting fires, would you say that that is true also?

A I would conclude that the risk of the fire is much greater than the risk of putting water with this contamination on the building.

Q Okay. Did you have anything to add?

A (Witness Wescott) No, I didn't

Q Then you would say that even with these highest ranges that you are approaching as far as concentrations in the Schuylkill River, it is probably not necessary to stop the water intake into the treatment systems from the Schuylkill except to prohibit it from usage. Is that your conclusion based upon our discussion?

Sim 14-30

A (Witness Fliegel) Yes. The major concern is to prohibit people from drinking the water.

Q Okay. Since the fraction of water that is drunk is a very small fraction of the water actually utilized, couldn't you set up a gold-plated treatment system, if I can call it that, for the small amounts, the relatively small amounts that will be consumed to remove radionuclides and supply that separately from the remainder of the other water uses? Isn't that a possibility?

A We have not considered that, but that is indeed a possibility.

Q So that in fact would be a two-tap system, one top for one source for drinking water and one source for other water; is that a proper characterization of that?

A We have not investigated that, but it would involved two separate water supplies if you tried to do that.

Q Mr. Lehr.

A (Witness Lehr) I would just like to add that a separate system like that does exist for this downtown portion of the downtown area of Philadelphia already, a separate main and hydrant system for supplying water to fight fires, but it is not available elsewhere in the city.

Q Dr. Acharya, we had some questions about the CRAC code. Let's talk about CRAC, the original CRAC code as utilized by you. Is one of the inputs to the CRAC code

Sim 14-31

by the analyst a determination of the level which the CRAC code then considers to be raining or not raining, is that one of the inputs?

A I didn't understand the last part. Would you please repeat that?

Q Is there an input by the analyst utilizing CRAC to allow it to determine what level of rainfall constitutes raining for the purposes of wet deposition as opposed to dry deposition?

A In CRAC only the information as to whether it is raining or not raining, that is provided. The actual magnitude of the rain is not input.

Q So any rain, no matter how small, would cause CRAC to consider it wet deposition?

A That is correct.

Q Isn't that conservative in that there are some levels of rainfall which would not cause a significant deposition rate usually attributed to heavy rainfall?

A Under the circumstances as you described, yes, but there are other circumstances where it would be the opposite.

Q But utilizing CRAC in that manner provides in your estimation a realistic estimate of the deposition from rainfall and non-rainfall situations?

A I would think so, yes.

Sim 14-32

Q In the CRAC code it said it assumes the constant wind direction. Do you recall that previous testimony in answer to questions by the City, that the constant wind direction is assumed? Do you recall that?

A Yes, I recall that, but what I meant is the plume propagation in either CRAC or CRAC 2 is assumed to take place along a straight line, and that straight line later on is identified with the different sectors of the compass to similar situations of wind blowing into these different sectors in proportion to the annual average probabilities.

Q Assuming that you have a given wind direction as determined by the first sample, does the CRAC code on each time it samples meteorological data sample the stability of the air?

A Yes.

Q And it changes the stability depending on what the meteorological data has told it to do, correct?

A That is correct.

Q So it does sample stability and follow that throughout the course of an accident?

A That is correct.

Q The staff has chosen to perform for water what it calls a reasonably bounding type of analysis; isn't that correct?

Sim 14-33

A That is right.

Q That is slightly different than the analysis for the air pathways found in the final environmental statement, isn't that correct?

A That is correct.

Q Did the staff choose to do a reasonably bounding type of calculation for the water pathways because of the time constraints on it and also the fact that it was aware that the water pathways were a small contributor to risk?

A Well, we have said in the EPS that the water contamination is a smaller contributor to the risk, but that was not the reason why we chose to do it the way we did. The reason we chose to do it the way we did was because it is simpler, less time consuming and with the proper caveat relating to the results, that would not imply any distortion of what a very detailed analysis would provide otherwise.

Q So you just can't compare the numbers in your testimony with the values in the FES without understanding the caveat that one is a bounding calculation and the one for air is not?

A With the caveat one can make a judgment.

Q But you didn't mean for the numbers to be compared without that caveat; is that correct?

A That is correct.

Q You chose the sequence II-T/WW as the bounding

Sim 14-34

accident sequence, did you not?

A Yes.

Q I believe you earlier stated that you considered both the probability of the occurrence and the fraction of the core of strontium which would be released by that sequence in making that determination; isn't that correct?

end 14
Mimi fols

A Yes.

T15 MM/mm

Q And if you would look at the product of those two terms, the probability times the percentage of the core fraction release, that would be a good indication of the risk associated with that pathway for this analysis, correct? Relative?

A The relative importance of this release category in relation to the others.

Q If you were to look at the fraction of strontium released for all other release categories and multiply it -- multiply the probability of that occurrence with the release category, multiply each one and sum them up, and then divide that into the product, the probability of occurrence times the fraction of release of II-T/WW, that would give you a relative indication of the importance of II-T/WW as a percentage of the total risk caused by all core melts, wouldn't it?

A Yes.

Q Let's turn to page 13, answer 18, if you would. Dr. Acharya.

A Okay.

Q What you have done in the latter part of the typewritten response to that answer is, in effect attribute the probability of all core melts, the sum of all core melts to the result from the II-T/WW sequence. isn't that what you have done there?

A That's correct.

mm2

Q But inasmuch as there are a number of core melt sequences that have no strontium release, or smaller fractions, and some have slightly larger fractions but lower probabilities, you are overstating the expected results by doing that, aren't you?

A We have said there that this result is conservative.

If you mean overstating is the same as conservative, that is true.

Q Do you know, have you done any calculations to give you an approximation of how conservative, or to use my term, overstated you have if you have done a rigorous result?

A Yes, I have made a first-cut rough assessment as to how much conservative could be.

Q Okay. What is your first cut?

A I took the help of Mr. Wescott as to what could be the minimum fraction of the strontium in the release category that has the potential for causing a concentration level of strontium 90 in either of the two rivers equal to that of the EPA, 8 picocuries per liter.

Now he came up with an estimate that if the release category has a minimum of 5.4×10^{-4} of the core fraction of the strontium 90 in the release, it has the potential of contaminating either of the two water bodies at the EPA level.

mm3

Then with this 5.4 x 10^{-4} for the cesium release fraction, I scanned all the release categories in the Table 5.11(c), and I found that except four release categories; namely I-T/WW, I-T/WW Bar, I-T/LGT, and III-T/LGT, except these four all others have got the strontium fraction at or above this level.

Q I'm sorry, you said -- I heard you were saying cesium prior. Have you been consistently in your response speaking about strontium?

A I have been consistently speaking about strontium.

Q Thank you.

A Now, the four release categories that I just mentioned who have strontium 90 level -- a strontium level below 5.4 x 10^{-4}, they carry 5 x 10^{-5} probability per reactor year. Excuse me. 4 x 10^{-5} per reactor year.

So, if I take off this amount from the total probability of 9 x 10^{-5} which I have used before, the balance of probability is 5 x 10^{-5} per reactor. That, the various release categories could -- various release categories means 20 minus these four release categories hae the potential to contaminate the two water bodies at EPA level. However, there is still some conservativism in this statement. That is, the release categories just releasing this minimum amount of the core fraction, namely 5.4 x 10^{-4} of the strontium, though they have the potential to cause the EPA level of

mm4

contamination, they -- not all of the release categories would necessarily do so. For example, those ones which are just near about this minimum, but above this minimum, may because of the atmospheric disbursement and all other parameters that go with it, may fail to reach the EPA level. But they will provide some contamination nevertheless.

So, applying this 5×10^{-5} probability instead of 9×10^{-5} that we have done, would still have the element of conservatism in it.

On the other hand,the four release categories that I just mentioned who have less than the minimum necessary to cause the EPA level of contamination would, however -- are likely however to cause the contamination, though less than the EPA level.

Drinking the contaminated water from the contamination of this release categories would also add to the population exposures.

So, if I discard them in the first cut, these four release categories, I will be somewhat underestimating. On the other hand, if I apply the 5×10^{-5} per reactor year as the probability, which excludes the probabilities of these four ones, I may be somewhat overestimating.

So, on the balance, however, the result will be -- is likely to be -- my suspicion is the result is likely to be close to the application of 5×10^{-5} per reactor year of

mm5

probability to the consequence that is calculated using the risk category II-T/WW in the analysis.

So, instead of 13 person rem as you see here in the last part of 18, my first cut analysis marked it down to 7 for the whole body person rem and 29, I believe to the bone-dose person rem.

A (Witness Wescott) I would like to add something to that also.

That fraction that I calculated was purely for getting to EPA concentration on the Schuylkill River. If you apply it to the Delaware, then you are talking about roughly four times as much. So you are knocking out even more accidents, and your probability is coming down even further. So this is basically based on the Schuylkill.

I didn't do it for the Delaware. I didn't realize it would be asked. But, if we went into this more extensively, we would even get a much lower number.

Q So, let me try to paraphrase what my understanding is:

It is extremely likely to be less than the risk of 7 whole body person rem per reactor year. That is very unlikely to be exceeded, but it may well and it is probably well below that.

A From the hydrologic standpoint, yes.

Q Would you agree with that statement?

A (Witness Acharya) Though I tend to believe that it

mm6

could be less than 7, but I don't have very firm reason to say that it would be very much -- too different or too much lower than 7 because there are a lot of details of analysis that are absent in here.

Q But you would be willing to state it is very unlikely that it would be above 7 at this point in time?

A All right.

Q That's a yes, isn't it?

A Yes.

JUDGE BRENNER: Dr. Acharya, along the lines of your description of your so-called first-cut analysis to check the conservatism in your answer 18, you explained how you used Table 5.11(c), and looked at the fractions released for strontium.

You said, as I read the table, it combines releases for barium and strontium. Is that correct?

WITNESS ACHARYA: Yes. But barium is not regarded as a dominating radionuclide from the radiological point of view, as well as in terms of its half life. I do not know exactly the number to explain at this point in time as to what the half life is. It is in the FES table. But, radiologically it is much less significant compared to strontium.

JUDGE BRENNER: Did you actually further break out the releases for just strontium, or for the reason you

mm7

just indicated, did you use the combined release reported, and this is just another footnote we should add, that barium is included, but insignificantly so?

WITNESS FLIEGEL: Maybe I can clarify that. I think the number you are referring to basically is the percentage or the fraction of the original amount of that nuclide that winds up in the plume. And wehat that is saying, that the fraction of original barium that winds up in the plume is the same as the fraction of original strontium, because they behave similarly chemically. But, it doesn't partition.

If I started with ten bariums and a hundred strontiums, I will wind up with the same percentage of barium and the same percentage of strontium, but not the same number.

end T15

Sim fls

JUDGE BRENNER: All right, just to put it in a simpler term, so I understand, given that it is fair to say that all the doses recorded throughout the testimony both orally and in writing could Dr. Acharya, in your first cut, as you stated it, of checking the conservatism, is still limited to strontium, and the reference to the table is valid for that purpose?

WITNESS ACHARYA: That is correct.

The reason the cesium, which is one of the significant radionuclides for drinking water contamination is not carried on further in the analysis because as was determined by Messrs. Fliegel and Wescott that in the presence of the Strontium-90, I mean using the dose conversion factors of Regulatory Guide 1.109 and the run-off rate of the cesium, the strontium turns out to be much more dominant.

JUDGE BRENNER: Maybe I wasn't clear in my question. I thought I had the answer before. I was not asking about cesium at this time.

WITNESS ACHARYA: What I meant to point out here is that compared to Strontium-90 all other radionuclides in our Table of Radionuclides, in the Table 5.11 (c), they are not very significant.

JUDGE BRENNER: Mr. Wetterhahn, I had interrupted you.

How much more do you have? We can take a break

at this time and come back.

MR. WETTERHAHN: Let's take a break now, but it is not more than 10 minutes.

JUDGE BRENNER: All right.

We will come back at 3:40.

(Recess.)

xxx JUDGE BRENNER: Back on the record. Mr. Wetterhahn, you may continue.

BY MR. WETTERHAHN:

Q Dr. Acharya, you have heard in the testimony, you recognize that the Applicant used dose converstion factors that were found in the WASH-1400 and as I understand it, Staff used similar conversion factors from Regulatory Guide 1.109, is that correct?

A (Witness Acharya) That's correct.

Q If the Staff utilized the Applicant's dose conversion factors, that is the ones from WASH-1400, would that change the Staff's conclusions with regard to the low risk involved in these waterborne pathways?

A It may change the results but it is difficult to say by how much because if we would use, like Applicant did, the WASH-1400 dose conversion factors, we would not be able to do our eight specific type of analysis, including the age distribution of the Philadelphia population and the second thing that we would not be able to do is because of

Reg Guide 1.109 dose conversion factors, that Strontium-90 became the dominant one compared to all other radionuclides, particularly the Cesium-137.

On the other hand, the use of WASH-1400 dose conversion factors would make us -- would require us to carry both Strontium-90 as well as Cesium-137 along throughout the analysis. So we might get less dose from Strontium-90 if we would use the WASH-1400 dose conversion factor and would pick some additional dose from Cesium-137 if we do the same thing.

So it is very difficult to say as to by how much our estimates would change if you would use WASH-1400 dose conversion factors.

Q Considering the difference, the large difference in the strontium dose conversions, the one from 1.109 to be higher than that in WASH-1400, is it highly likely that the dose, the manrem and the health effects would go down?

A I would leave this to Messrs. Wescott and Fliegel. They have looked at what is the relative amount of cesium that will be spewed out in II-T/WW in relation to Strontium-90 because the dose also depends on how much comes out in the core.

A (Witness Fliegel) Can you repeat the question, please?

Q The question is, considering the large difference

in the dose conversion factor between 1.109 and WASH-1400 for strontium, isn't it quite likely that the dose and -- I'm sorry, the manrem calculation and the health effects would go down rather than up, if the Staff utilized the WASH-1400 dose conversions?

A Certainly, if you use the WASH-1400 dose conversion factors, the Strontium-90 dose would go down.

Q And since the Staff considered that the most significant by a large factor, isn't it therefore likely that the entire dose in calculated manrem would go down?

A I would surmise so.

Q Could you turn to page 5-93 of the FES?

Let me read the final sentence of Section 3: "This water pathway would be of small importance compared to the results presented here for fallout onto land" and they are talking about the waterborne pathway. Considering your entire testimony as presented here and your answers on cross examination, do you ratify and affirm that this is your conclusion regarding the waterborne pathways we discussed here?

A (Witness Acharya) Yes, I do.

Q Is that the same answer for the remainder of the panel?

A (Witness Fliegel) Yes.

A (Witness Wescott) Yes.

A (Witness Lehr) That was not in my area.

MR. WETTERHAHN: Thank you. I have no further questions.

JUDGE BRENNER: Does the Commonwealth have any followup?

MS. FERKIN: No, I have no followup.

xxx

EXAMINATION BY THE BOARD

BY MR. COLE:

Q Mr. Lehr, in your testimony on page 7, in the table you have in the center of that page, you list several treatments in strontium removals. Which of the list of treatments is the one most closely associated with what Philadelphia has?

A (Witness Lehr) It would be the second listing there, the alum or ferrous sulphate plus lime, indicating removal of 10 to 75 percent.

Q All right, sir.

In the last four lines on page 7 of your testimony, you refer to the results of indicated treatment of alum and lime fluctuation and it goes on further to say it indicated a removal of as much as 44 percent of the Strontium-90. Are you referring there to the City of Philadelphia treatment plants?

A Yes, I am.

Q Where did you get that information, sir? Was that

in the article identified as strontium and calcium in municipal water supplies? I believe it is Staff reference 6?

A Yes, that is correct.

Q I believe Philadelphia is listed on page 649 of that reference. Do you have that reference there?

A Yes, I have it. I will get it.

Q I was wondering if you got the 44 percent from that article and could you point out to me where in that article you got that information?

A Okay. Yes, it was on page 649 and in there two raw water strontium concentrations are indicated there for under samples 106 and 107 and a tap water blend is indicated as sample 108 and the removal or the percentage -- excuse me, the concentration of strontium for the tap water blend is given as a tenth of a part per million; whereas, the raw water for sample number 107 is given as .18.

Q And that is how you calculated the 44 percent?

A That is what I indicated, yes.

Q What is 106?

A There, as indicated, is .03, .031 and obviously for that it represented an increase. It wasn't a removal. I mean if you compare the two -- sample 108 is a blend of the treated waters taken from -- as I read this, from samples 106 and 107 or those sources.

Q But 106 has a concentration of strontium that is

less than the blend. How did you calculate the percent removal?

Is it an even -- even if it was a 50 percent mixture, 106 and 107, it seems to me you would wind up with something that would be very close to the treated blend and there would be no removal?

A Well, the blend would indicate no removal, in fact, an addition over raw water sources indicated in sample 106.

Q All right, sir. How then did you calculate 44 percent removal?

A Well, I am just saying that the amount present in the finished product, which I took to be sample 108, would be 44 percent less than that which is indicated under sample 107, that raw water.

I had indicated in here in the testimony of as much as 44 percent.

Q All right, sir. But if you were to take an exact blend, a 50 percent mixture of 106 and 107, and not remove any of the strontium contained in either of those two samples, what would be the resulting concentration of strontium?

A You would just have an average of the two, which would be very close to .1, yes.

Q And the concentration in the blend was .1, was it not, sir?

A Yes. However, since sample 108 represents the tap

water having gone through treatment, treatments A, C, and G there, of alum, line and chlorination, I took that to be finished water and the raw water, of course, was untreated, so I didn't interpret this table to mean that the sample 108 was just an average of samples 106 and 107.

Q So when you said 44 percent, you say based upon the results that you have if 107 was the only water used and 108 was the treated water that would have been in effect 44 percent that is the maximum you would get?

A From these samples, yes. That is what I get.

Q All right, sir. It makes a big difference in the removal efficiency whether -- the form of the radioisotope, does it not, sir? I believe in your testimony you indicated a big difference between particulate and soluble?

A Yes, that is correct.

Q Do we know whether we are dealing with particulate or dissolved, or what combination of the two?

A The information in the literature would indicate that the cesium is dissolved. That was the reason given for its difficulty in removal by coagulation techniques and why the lime-soda softening technique was judged -- the reason why that technique was better in its removal.

Q What about strontium?

A I meant for strontium. For cesium, since the coagulation techniques have not been shown to be particularly

effective for it either, the same reason I believe was attributed.

Q You are saying it is probably in the dissolved form, the one that is more difficult to remove?

A Yes, that is correct.

Q All right, sir. I believe at different times, both Mr. Wescott and Dr. Fliegel, you indicated -- and I think it is also in your testimony that you are not going to have heavily contaminated rivers if you wind up with heavily contaminated reservoirs. Do you recall saying that, sir?

A (Witness Wescott) Yes, I do.

Q Could you tell me a little bit about your basis for that statement?

A (Witness Wescott) And I would refer you to at least for discussion purposes to the map showing the distribution system of the City of Philadelphia. That was in Applicant's Exhibit 160, or what?

End 16.

166 -- I believe Ms. Bush referred to that and it is page 10 of that exhibit.

A Okay. As I had said before, and we will start out river by river, for the Delaware River, if you are going to get deposition on the City reservoirs, the wind will have to blow in such a way that the only deposition you will get on the Delaware River Basin appears to be below the Torresdale intake, so you are not going to get a contaminated Delaware River.

Q So this is because the plant is located in what direction from the City of Philadelphia?

A Well, that would be northwest, almost due northwest.

Q Okay, almost due northwest from the plant?

A Yes.

Q All right, sir.

A Now in regard to Schuylkill, the Limerick station, if the wind blows directly southeast it will blow over the reservoirs and it can blow over the Schuylkill River. Now the main reservoirs in the Schuylkill Basin are upstream, also the main access of the Schuylkill direction upstream of the Limerick plant, and to the north and northwest of the Limerick plant.

So if it blows southeast to get to the Schuylkill, or the Philadelphia City reservoirs, it is not going to contaminate the large reservoirs in the Schuylkill River

Basin and it is not going to contaminate along the long axis of the Basin. In other words, it is going to blow over a relatively small part of the Basin.

Therefore, under most conditions, you are not going to have a heavy deposition either on the Schuylkill watershed or in a large part of the open water which is going to lead to immediate contamination.

Q And with respect to the Delaware River, are you looking at the map, sir?

A Yes, sir.

Q The Torresdale intake is located -- do you see where that is located?

A Right. Just above Pennypack Creek.

Q So your point is if you are going to contaminate the reservoirs down in the city it would not get as far north along the Delaware River as the Torresdale intake?

A That is correct. Now you can always get -- if your plume gets very wide and you have a very dispersed condition, you can always get a little bit on the stream itself, but I think when we are talking about contamination, in this sense for dose, we are talking about heavy contamination over the watershed as a whole and to contaminate the Delaware watershed heavily, we have to have the wind blowing almost pretty much north - northeast from the plant, so that you go over the long axis of the Delaware Basin.

Q All right, sir, thank you.

xxx BY JUDGE BRENNER:

Q On page 11 of the Wescott and Fliegel testimony, answer 20, which continues over from the previous page, are you with me?

A (Witness Wescott) Could you repeat the page again?

Q Yes, page 11. It is answer 20, which starts on the previous page and continues over.

A Okay.

Q Your concluding sentence there is that it is highly probable that the Delaware River would remain a safe drinking water source after the accident. That conclusion comes after the preceeding sentence that says there is a 50 percent probability that the concentration of Strontium-90 in the Delaware following the assumed accident would be less than 15 pico-Curies per liter.

Is that 15 pico-Curies per liter your definition of the line for safe drinking water and, if so, are you characterizing 50 percent as highly probable?

A The 15 percent is a one-year average. Most of the concentration that makes up that one year average is going to be from the initial wash off.

Q You said 15 percent. Did you mean 15 pico-Curies?

A 15 pico-Curies, I'm sorry. I had better start over.

The majority of the wash off into the river that

makes up that 15 pico-Curies comes from the initial wash off. In our model, this happened to be two percent of the total deposition that comes off within, oh, probably a few weeks to a couple of months after the accident, depending on how much rainfall is taking place at the time.

That is where most of the -- that is when the concentration is going to be highest and it is going to be above 15 pico-Curies.

After that it is going to drop considerably below 15 pico-Curies, in fact I assume just looking at it, below 8 pico-Curies earlier and that is basically what I base my definition on, say if it wasn't purely 8 pico-Curies as a cutoff, but knowing that that was a drinking water standard and that it certainly was going to be around and probably a little bit less than that after the initial wash off.

Q Okay, but the probability we are talking about attaching to those values, there is a 50 percent probability?

A That is correct.

Q And you would characterize the 50 percent probability as highly probable?

A Well, okay I understand your question a little better. All right, there is certainly a 50 percent probability that the Delaware is going to be safe in regard to drinking water standards without regard to any type of treatment at all.

In regard to emergency standards, which we were looking at one-third MPC and so on, it looks like it is almost certain to be below those. I think a 98 percent chance.

Q I think it is elsewhere in your testimony.

A Okay, a 98 percent chance, that is going to be below MPC and an 85 percent chance, that is going to be below one-third MPC, so that was also why I concluded that it is probably going to be a safe drinking water source.

Q All right.

On page 9 of the same testimony, Answer 17, you discuss the comparison of Strontium-90 measurements between New York City tapwater on the one hand and the Schuylkill and Delaware Rivers on the other hand, in the '50s, in the 1950s and '60s and you say that the review of those measurements showed approximately the same concentration of Strontium-90 in the Schuylkill and Delaware Rivers as was recorded for the New York City tapwater.

We have asked the Applicant some questions about that before. What did you mean by "approximately the same concentration?"

A I meant among the same order. It was hard to compare them directly because the New York City concentrations as I understood them were average concentrations over a month.

The data that I had from the Schuylkill and Delaware Rivers were grab samples, say taken once during a

quarter.

However, where the Schuylkill -- where the New York City tapwater measurement seemed to go up, in other words, where they got to around an average of 2 pico-Curies per liter, the Delaware and Schuylkill concentrations were in the same order and a couple of them are a little higher but many of them are a little bit lower and we just -- they just seemed to be close enough that in my judgment I felt that the two rivers were behaving similarly enough to coefficients applicable to one were probably somewhat applicable to the other.

Q Do you know whether the Applicant's testimony that the correlation coefficient would be between .5 and .6 is correct in your view. Do you have a judgment on that?

A Well, first of all, I don't know which correlation he was referring to. There is two correlations there, one for the Schuylkill River and one for the Delaware.

Q I don't know either, offhand.

A I don't have any --

Q Have you made that kind of comparison?

A No, I didn't try to correlate them, one of the reasons being I thought they were sort of different measurements.

Q Okay, thank you.

xxx

BY JUDGE COLE:

Q Just one more question, gentlemen.

You were talking about the dose conversion factors, the difference between WASH-1400 and Regulatory Guide 1.109 and indicating that there is a significant difference for strontium, something of the order of a difference of a factor of 20.

Is there any difference in the dose conversion factor for cesium, do you know, between WASH-1400 and Regulatory Guide 1.109?

A (Witness Acharya) They are approximately the same.

Q All right, sir, then in response to a question concerning what difference would it make if you were to use WASH-1400 or Regulatory Guide 1.109, if the cesium is the same, and the WASH-1400 is drastically different, I guess maybe then I didn't understand your response, where you say it would depend on cesium if the factors for cesium is about the same.

A Is this to me?

Q Yes, sir.

A Messrs. Fliegel and Westcott's analysis says -- I cannot identify the page -- it was looked at several times today -- that the reason that Staff dropped the consideration of Cesium-137 any further because the cesium contribution to the dose was about 10 percent of the contribution from strontium. That judgment -- that conclusion was based on the

Reg Guide -- I mean based on that the dose conversion factor for strontium is much higher than that of cesium and they also had other considerations, namely cesium is held bound to the soil more than strontium but I believe that the relative contribution of cesium and strontium there is that of 10 percent to 90 percent.

Now consider on the other hand that we stop using Reg Guide 1.109 dose conversion factor for strontium, use the dose conversion factor of WASH-1400 of strontium, then so much difference between strontium and cesium as was noticed in Fliegel and Wescott's analysis would not be there, so we would be hesitant to drop the Cesium-137 from carrying into the analysis for that.

Now with both cesium and strontium present in the game, and if we would apply only the WASH-1400 dose conversion factors to both of them, and then looking at the release fraction for cesium that is associated with the release category II-T/WW, release fraction plus the core inventory, the core inventory for cesium is in the ratio of 5 to 4 to strontium.

So when both these radionuclides will be carried on in the analysis, as I said, I would not be able to say that the Cesium-137 would not contribute comparably.

Q All right, sir. I think I understand what you did. I guess I am confused about then the sudden importance

of Cesium-137 considering it with the Regulatory Guide 1.109. It is insignificant compared to the impact of strontium, right, sir, and so you did not have to carry the Cesium-137 forward. You could just evaluate the impact of strontium?

A That is what we did, using Regulatory Guide 1.109.

Q All right sir. So then when you use a different dose conversion factor for the strontium, it reduces it close to the level of impact of the cesium and then they both become important?

A Right. That is what I have been saying.

Q Or they could both become relatively unimportant?

A That is right.

Q So you don't know that.

A That is what I said, but Mr. Fliegel had a supplemental statement to that.

Q Could you give me your estimate of the significance of -- I don't think I am going to get the answer I want.

Let me try another question. Obviously, nothing has changed with respect to the absolute impact of Cesium-137. Is that correct, sir? If you have the same dose conversion factors for WASH-1400 and for Regulatory Guide 1.109, the absolute predicted impact of that isotope is about the same, whether you use WASH-1400 or Cesium-1.109, is that correct?

A That is correct.

Q Reg Guide 1.109 -- that is what I meant to say?

A Yes.

Q So it only then becomes important relative to what the impact of strontium is?

A That is correct.

Q A'l right, thank you.

A (Witness Lehr) Excuse me, could I add something to a response made earlier in response to Dr. Cole's question?

JUDGE BRENNER: Certainly.

WITNESS LEHR: Another bit of information. With regard to the water storage reservoirs in the City, the filtered water storage reservoirs in the city, that they amount to some -- well, 323 million gallons at the plants themselves and another 798 million gallons elsewhere in the system as indicated in Table 2 attached to my testimony.

I wanted to indicate that the standpipes, of course, and all the inplant filtered water storage basins and at least 370 million gallons worth of the open reservoirs are all covered.

I don't know if that point was made before. I am not sure about the Roxboro, the Upper Roxboro and Lower Roxboro filtered water basins amounting to 28.6 million gallons in capacity. I don't know whether they are covered or not. I was not able to determine that.

BY JUDGE COLE:

Q I assume that the comments about contamination of

reservoirs pertain to the surface reservoirs in the system?

A (Witness Lehr) Okay.

Q Filtered water surface reservoirs.

A Okay, but they are covered is what I am saying.

Q There are some of them that are not covered.

A Within the City?

Q Yes.

A Okay. The only ones I was aware of that might not be covered would be the Upper Roxboro and Lower Roxboro. The East Park filtered water reservoir, 300 million gallons of it, is in the process of being covered now. The other two basins there which account for the other 477 million gallons, are not planned to be covered at this time by the City. That is what we were told anyway.

Q All right sir. Thank you.

End 17.

JUDGE BRENNER: Staff, any redirect?

MR. VOGLER: Yes, sir.

xxx

REDIRECT EXAMINATION

BY MR. VOGLER:

Q Dr. Fliegel and Mr. Wescott, in response to an inquiry regarding the Schuylkill and the Delaware simultaneously receiving a high concentration of contamination, would you comment on that, please, in your view?

A (Witness Fliegel) Yes. There was a question earlier or a discussion about highly contaminating both the Schuylkill and the Delaware.

If you look at our Exhibit 1, which shows a probability distribution of deposition at the extreme right where we have a very low probability of seeing a high deposition, what we are seeing on the Schuylkill is pretty much all of the Strontium-90 from the accident being deposited on the Schuylkill.

What that implies is that if we have an accident of that type in which practically all or almost all of the Strontium-90 is deposited on the Schuylkill, quite obviously there is no more strontium to deposit on the Delaware.

The Delaware -- the worst situation calculated does not quite have all of the strontium deposited on it. That is, of the slightly over 160,000 curies available in this accident at the extreme, 150,000 will wind up in the

Delaware but if we have that extreme an accident in the Delaware, we could only get 10,000 more curies on the Schuylkill, so that is one reason why you can't highly contaminate both river basins. That is, you can't get more strontium coming out than you release in the accident.

Q Dr. Fliegel, you referred to Exhibit 1 -- you mean Attachment 1?

A Attachment 1, yes.

Q Fine. Would that same analysis apply to any of the other attachments?

A Well, the concentrations are dependent upon the deposition, so clearly it would apply to the concentration curves also.

Q Mr. Lehr, you were asked to assume the fact that the Schuylkill was contaminated and the City was using the Delaware and what in your view would happen if there were an accident on the Delaware River -- obviously not a nuclear but some sort of --

JUDGE BRENNER: Mr. Vogler, I can't hear you.

BY MR. VOGLER:

Q Obviously some sort of a spill -- would you comment on that, please?

A (Witness Lehr) Yes. I had agreed with the statement that it was possible that the Delaware intake for the Baxter plant would have to be shut down and I don't think

that such shutdown would be very likely to last for a long period of time.

For instance, in response to the Applicant's interrogatories, the City provided a summary going back to the past 10 years of the major spills that have forced closure of plant intakes, water treatment plant intakes due to chemical or oil spills and during that time period, there was only one listed for the Torresdale intake. There were two listed for the Belmont intake and the Torresdale intake was closed for a period of four days and that was because of an explosion at a chemical plant.

Q Thank you.

Dr. Acharya, in your testimony, A-18, Answer 13, we turn to the 0.8 personrem, whole body dose, about the fifth line down.

Is this a risk estimate?

There was confusion in the Staff's mind when this was -- when testimony was taking place.

A (Witness Acharya) This is a risk estimate only for the risk category II-T/WW.

Q Thank you.

Also, Dr. Acharya, Mr. Wetterhahn asked you about how much lower the values of 13 rem whole body per reactor year in a 5.2 rem bone per reactor year. Do you recall that could be a more realistic analysis?

The question is, are these values expected values? And would uncertainties also apply to these estimates?

A These are expected values. That is correct.

As regards to the uncertainties, certainly there are uncertainties associated with these values.

Q Thank you.

JUDGE BRENNER: I'm sorry, I did not understand the last part of that. With regard to uncertainties --

WITNESS ACHARYA: These expected values are also associated with uncertainties.

BY MR. VOGLER:

Q Mr. Wescott, in view of what -- and Dr. Fliegel -- in view of what Dr. Acharya just said applying only to II-T/WW, do your attachments in your testimony apply to only the II-T/WW sequence?

A (Witness Wescott) The concentrations, depositions and so on are derived from analysis of the II-T/WW sequence.

MR. VOGLER: That concludes the Staff's redirect, Mr. Chairman.

JUDGE BRENNER: Any followup, City?

xxx

RECROSS EXAMINATION

BY MS. BUSH:

Q One area about the uncertainty associated with the risk number on page 13, Dr. Acharya, that you just mentioned. Are there different uncertainty levels associated

with that risk number than with airborne risk, or would that be the same?

A (Witness Acharya) They won't be the same. The sources about the uncertainties in these are different than the sources of uncertainties of the airborne risk estimates.

There are certain common elements which would contribute to the uncertainties in here as well as there but there are other elements which are different, so though uncertainties would be somewhat similar, the numerical estimates, if they can be determined, are likely to be different.

A (Witness Wescott) I would like to add something from the hydrologic standpoint and the hydraulic calculations. We believe our analysis is conservative.

We took care of some things that we were uncertain about by making a conservative choice of parameters and so on.

Q So does that indicate that you do not feel there is any uncertainty associated -- any additional uncertainty asscciated with the hydraulic?

A That is correct. We feel if we took care of the uncertainty by overestimating factors that would tend to increase the consequences.

A (Witness Fliegel) Or put another way, by making conservative assumptions while you still have uncertainty,

most of -- more of your uncertainty is below the estimate than above it.

Q On the uncertainty associated with the probability values here, would that same factor that you discussed in the airborne cross examination, the factor of 30, I believe it was, would that still be associated with these probabilities?

A (Witness Acharya) Not with all the probabilities. If I can recall what I stated there, the uncertainty factor for 30 in the worst accident, not necessarily in all accidents, so that factor would be the same here for the worst accident but not for all accidents.

Q So the uncertainty factor would not go with the 9×10^{-5} but would go with the probabilities associated with the II-T/WW?

A I cannot identify which of the accident sequence of the risk category will be associated with that uncertainty.

Q What is the range of uncertainty that would be associated with any of the probability figures?

A I cannot speak to that because I am not an expert in the accident probability quantification.

MS. BUSH: I have no further questions.

xxx

EXAMINATION BY THE BOARD

BY JUDGE MORRIS:

Q Just so we are clear, Dr. Acharya, what does the factor of 30 apply to again?

Side 2 BU

A (Witness Acharya) It referred to the fact that I had stated in one of my earlier testimony in the previous week as to -- I recall I guess I said that a factor of 30 could be the uncertainty -- not that way.

The probability of the worst accident could be higher by a factor of 30 or could be lower by a factor of 30.

Q So by "worst accident," what do you mean? An accident sequence or are you talking about a core melt or what?

A Accident sequence leading to very large release of radionuclide.

JUDGE MORRIS: Okay, thank you.

MR. WETTERHAHN: I have one further question.

JUDGE BRENNER: Let me see if the Commonwealth has any followup?

MS. FERKIN: No.

JUDGE BRENNER: Go ahead.

FURTHER RECROSS EXAMINATION

xxx BY MR. WETTERHAHN:

Q Looking at the same page as the questions you were just asked, since you have stated that 13 whole body personrem per reactor year is a bounding value, is it proper to apply the same uncertainties as you would to a realistic version as you would in air pathways?

A (Witness Acharya) Well, I had already said that

I would not apply the same uncertainty factors to these numbers as applied, or I might have been attempting to apply to the air pathways.

MR. WETTERHAHN: Okay, thank you.

JUDGE BRENNER: Incidentally, on that last point, Dr. Acharya, it is Mr. Wetterhahn that has called it a bounding value.

Didn't you describe it as a reasonably bounding value in your earlier testimony? We are talking about the answer 18 -- 13 whole body personrem per reactor year value.

WITNESS ACHARYA: I am looking for exactly what exactly did I use.

JUDGE BRENNER: I was referring to something you said orally. I don't recall it is in your written testimony.

Well, is that a bounding value, an absolute bounding value?

WITNESS ACHARYA: That is what I meant, because I used one of the very severe accidents and then treated all other release categories on similar footing as this one.

So that is why I call -- I could label it as bounding.

JUDGE BRENNER: All right. Staff, anything further?

MR. VOGLER: Nothing further.

JUDGE BRENNER: All right. Everybody is nodding

"no" so we have nothing further for these witnesses.

We thank you very much for your time. I want to comment, since I have made adverse comments by other testimony by other witnesses in the past, just to be even-handed.

Without commenting on the merits of the testimony, I found it well laid out in terms of describing the bases for the conclusions in all the pieces of testimony filed by the Staff on this contention and we appreciate that.

I think that helps the efficiency of the cross examination as well as we have seen somewhat, so thank you very much for that and thank you also for your appearances here today.

You are all excused.

We have some other business here, though, but you can pack up and go while we keep talking. Thank you.

(Witnesses excused.)

End 18.

JUDGE BRENNER: We will give it a try. I don't know if we will finish or not.

We have some matters related to this. Let me give the findings schedule.

Merely plugging in the dates to the findings schedule that we have previously ordered, this schedule applies to all the NEPA severe accident contentions. The Applicant's proposed findings will be -- these are all receive dates, will be due on July 5th. The City's and the Commonwealth's, if it decides to file any proposed findings, will be due on July 16, the Staff's on July 26 and any reply by the Applicant on July 31st.

Page limits -- I guess I will solicit any recommendations that you might have. Otherwise, we have our own idea.

This would be a page limit for the proposed findings, solely on City-15. We have already established page limits for the others.

Ms. Bush, what do you have in mind?

MS. BUSH: I think 30 pages should be more than adequate.

End 19.

JUDGE BRENNER: More than more than adequate.

Sim 20-1

MS. BUSH: Thirty pages should be more than adequate.

JUDGE BRENNER: More than more than adequate. That sounds a little long.

Applicant?

MR. WETTERHAHN: Thirty pages is sufficient.

JUDGE BRENNER: A hundred pages is sufficient. Do you need 30?

MR. WETTERHAHN: Well, from our experience with our first drafts of the other findings, it would probably run 20 pages. So in order to give us a little leeway, I asked for 30 and I think it is reasonable.

JUDGE BRENNER: Okay.

MR. VOGLER: The staff will go along with the 30 pages.

JUDGE BRENNER: All right. We had 25 in mind, but we will give you 30.

(Laughter.)

JUDGE BRENNER: Thirty will be it then and 15 for the reply. You don't have to use the maximum as we have said before.

MR. WETTERHAHN: I notice that July 5th is the day after Independence Day, and it may be impossible to get a delivery service.

JUDGE BRENNER: Well, I can make it July 3rd

Sim 20-2

then because the due date would have been July 4th.

MR. WETTERHAHN: Well, then we would have gotten the 5th anyhow. We will take the July 5th. If there is a problem on delivery, we will let the Board know.

JUDGE BRENNER: Okay. Do you want the 6th?

MR. WETTERHAHN: The 6th would be helpful.

JUDGE BRENNER: We will make it the 6th for the applicant, and all the other dates stay the same anyway because the reason it is the 16th for the intervenors, for the City, is because that was a Monday. So they get some extra days anyway. But give it your best efforts to get it to them on the 5th if you can, but we will make the 6th the due date so you don't have to come back to us for a request.

We have two miscellaneous matters, one of which relates to emergency planning, although not the main subject of emergency planning and then we will get into the main subject.

The first miscellaneous matter is we want to receive on or about the 1st of each month, starting with July 1st, an affidavit from a cognizant high official of the applicant giving us the estimated date for fuel load, not completion of construction, but fuel load, they are sometimes different, and just a brief explanation of the bases. If there is a change in the estimate, we don't want

Sim 20-3

to wait until the 1st of the following month, but we want to receive the change right away, and I say on or about the 1st. It not an absolute due date, but give or take a few days, depending on weekends and so on, that is the date.

On that score, we had seen some correspondence going back several months that the staff's panel, and I forget the exact title, forecast review panel, or something like that, that does these estimates was going to be out there doing an estimate by this time, and if they have made a report we haven't seen it.

Does staff counsel know what the status of that is?

MR. VOGLER: That is the caseload forecast panel. I hate to predict, but they have had meetings this past week, and to my knowledge there was nothing out when we left.

JUDGE BRENNER: All right. As soon as there is something issued ---

MR. VOGLER: We will advise the Board.

JUDGE BRENNER: And make sure the parties of course get copies. Now I realize we would be getting the routine correspondence anyway, but I don't want that treated as routine correspondence. I want it highlighted and for us to get it on a rapid basis.

MR. VOGLER: Okay.

JUDGE BRENNER: There is a nine-month difference,

Sim 20-4

seven-month difference in the estimates between the staff and the applicant. That is why we are interested in it.

On the subject of emergency planning, we have heard nothing about the status of the Greaterford Plan. parties know how we left that. Is the status still the same, uncertain status?

MS. FERKIN: The status is still the same and it is still uncertain. We are waiting on Department of Defense input on the plan. I have spoken to counsel for the prisoners and he is aware of the delay.

JUDGE BRENNER: Okay. Our previous orders still apply and you know what they are.

MS. FERKIN: Yes, I understand.

JUDGE BRENNER: The present subject is the proposed issues of the City of Philadelphia for off-site emergency planning and let me comment very briefly that we certainly appreciate the efforts of all of the parties. The predictions that if we gave the parties more time for good faith negotiations it would be time well spent have proven to be correct. The issues have been substantially narrowed and it is obvious that there was a lot of effort on the part of the City and the Commonwealth, particularly, and to some extent apparently by the other parties and we appreciate that very much.

What we have before us now, based on the City's

Sim 20-5

reply to the answers of the other parties, which is dated June 12th, are relatively narrow issues being proposed.

However, Mr. Small in the City's reply did not neatly say this is still pending, and by elimination we can make some inferences, but I don't want to rely on just our inferences, and that is the main reason for having to have an oral session.

In addition, we perceived redundancies in what we think is still remaining, and the parties did, too, in thier answers, and your reply did not address that.

As we informed other counsel for the City yesterday, we are hoping you can start out by giving us the precise wording of what your issue is now, or what your proposed issue is.

MR. SMOLEN: Basically we are down to two issues, one dealing with an alternate water supply and one dealing with a decontamination plan.

Insofar as the alternate water supply is concerned, we think that the issue can properly be stated by saying that there is no adequate implementable plan for providing an alternate source of water for the City of Philadelphia which is appropriate to the locale of Philadelphia and which gives consideration to the PAG guidelines, namely, substitution of other drinkign water sources, importation of water, rationing ---

Sim 20-5

JUDGE BRENNER: Okay. Wait a minute. We are doing this orally, if we can, and maybe I am not taking notes as far as other people. I have got you as far as which gives consideration for PAG guidelines. Could you go on from there.

MR. SMOLEN: Including substitution of other drinking water sources, importation of water, rationing, substitution of other beverages and, finally, designation of critical users.

JUDGE BRENNER: Okay.

MR. SMOLEN: I do want to emphasize the word "implementable" plan, which as I have stated, includes consideration of ability to implement and in which is included resources available.

With respect to the second issue of concern, I think it can be phrased that there is no adequate implementable plan or implementable alternatives and methods for decontamination of the City's water supply and water supply system.

Now I will repeat it. There is no adequate implementable plan or implementable alternatives and methods for decontamination of the City's water supply and water supply system, again with an emphasis on implementability and consideration of alternative methods.

JUDGE BRENNER: Okay. Did that complete your

Sim 20-6

statement of the issues?

MR. SMOLEN: Yes, it does, Your Honor.

JUDGE BRENNER: That helps. We can see certainly where that is derived from, and let me get the numbers right. It is derived from City 3, Part 7 and 8, and also from City 7, and you have taken care of the redundancies now.

MR. SMOLEN: Exactly, Your Honor.

JUDGE BRENNER: All right. Let me ask you this if you can answer it. In putting forth these issues which you would like us to admit as issues for litigation at this time, is it the City's hard and fast position that these issues are true, that is they would be much the same as contentions and certainly you have stated them in contention language, or are you seeking further efforts and work and examination by all parties on it?

MR. SMOLEN: The latter is always a proper consideration I believe, further work on it by the parties. However, they are genuine concerns of the City of Philadelphia. There has been a lot of testimony, not necessarily in emergency planning, but I have heard today about Belmont High Service and the need for an alternate water source under certain circumstances. Decontamination has been all afternoon. There simply are no plans. Without restating the issues, there are genuine concerns of the City.

JUDGE BRENNER: Okay. I think you have gotten

Sim 20-7

to the next point I was going to ask you about, and one reason for asking you to restate the issues was now we could get the carefully studied language, and you have had time to prepare that language of the concise issues. Your language appears to me to be very careful that there is no adequate implementable plan. That is not the same as saying no adequate implementable measures could never be feasible if proper planning is undertaken. Am I hitting on a possible distinction correctly?

MR. SMOLEN: Well, I used implementable plan or alternatives and methods in City 7 under decontamination. I am not sure that it is necessary to use that when we discuss an alternative source of water since I have listed the PAG alternatives within the framework of the contention. So the alternatives are there really in both. One is fully spelled out and the other is not spelled, but just subsumed under the term alternatives or methods.

JUDGE BRENNER: Okay. We had essentially the positions of the parties in the the written filings before us and we have been through them quite carefully. But given the further focusing of the language just now and the fact that we received the last City written reply after written filings, I will give each party an opportunity just to very briefly give us their position and why, but don't repeat all of your other arguments because we have them.

Sim 20-8

Let me ask the Commonwealth first. We are talking about the position on admissibility of these two issues and we will give them numbers at some point if we need to.

MS. FERKIN: Just a procedural point. Are you certain you would like our position first being that the applicant is the party with the burden of proof?

JUDGE BRENNER: Yes.

MS. FERKIN: Okay.

JUDGE BRENNER: Unless you don't want to give it to us.

MS. FERKIN: No, I am ready to give it to you. I would also like to ask a clarifying question of the City, or I would like the Board to ask a clarifying question of the City.

JUDGE BRENNER: We will let you ask it directly.

MS. FERKIN: Thank you.

With regard to what was City 7, the decontamination issue, the original statement of the issue was in the context of actions for recovery and re-entry. Is that still the City's intent?

MR. SMOLEN: I am not sure that that was our original position. Demineralization is listed in the PAG's as a protective action, page 1.30 of the PAG's. It is also listed in the PAG's as a restorative action under processing at pages 1.48 through 1.50 of the PAG's. So that it is really

Sim 20-9

not limited to either. It is both a protective action, which is required under 10 CFR 50.47 as well as NUREG 0654, and a restorative action which is required under both of those citations.

JUDGE BRENNER: Okay.

Ms. Ferkins, let me give you our view and maybe this will moot the point. We say a possible distinction, and that is the one you just raised in your question. We saw it as a distinction without a difference for purposes of deciding on the admissibility of getting to the essence of the contention and that is what led to my comment the other day and presumably some of the comments by the parties in the written answer that these appear to be redundant as raised by the City, and the City has cured any possible problem in that regard.

MS. FERKIN: So then I am to understand the City is arguing that planning for decontamination should be undertaken as both a protective action and as part of a recovery action?

JUDGE BRENNER: That is what he said.

MS. FERKIN: Okay.

JUDGE BRENNER: Right, Ms. Smolen?

MR. SMOLEN: That is what I said. It can be an and/or, but we are looking for the and.

JUDGE BRENNER: We wanted to get to the essence

Sim 20-10

of what the technical issue was, and the City has now done that for us.

MR. SMOLEN: But I might say, Your Honor, that the regulations requires the development of general plans for recovery and re-entry as well. So that we are certainly not limited to a protective action under the guidelines.

JUDGE BRENNER: I don't know if the substance of any proof, depending on our action on admissibility of this would matter either way, and we can wait for another day, if there is going to be another day, which we will determine shortly.

Applicant, why don't you give your position on the contentions as restated.

MS. FERKIN: Excuse me, Mr. Chairman, I thought you wanted the Commonwealth's position.

JUDGE BRENNER: Yes, I do.

MS. FERKIN: The Commonwealth would stick with its position on admissibility as set forth in its response. We don't believe either issue of concern is admissible in this proceeding, and I would like to add a couple of points.

JUDGE BRENNER: Because it seeks more detail than that required by the planning process.

MS. FERKIN: Than is required in emergency planning, and I would like to make a couple of extra points.

The first point I would like to make is a point

Sim 20-11

that I believe the applicant has raised, that the PAG's per se are not an emergency plan. They are, as we stated earlier today, philosophical guidance. They are guidelines and dose estimates to be used in implementing emergency plans.

The protective actions outlined in the EPA's manual are not planning requirements. They are suggested protective actions to be taken once a dose is reached per se.

The second point I would like to make is that overall it is the Commonwealth's position that its emergency plan is aimed at protecting the City as well as the rest of the State's water supply in terms of protective actions by recommeding curtailment of intake should there be any question of contamination of permissible limits, and we believe that satisfies the thrust of both the NRC's regulations and NUREG 0654.

I would also like to make two subsidiary points.

The Commonwealth's plan is not an untested plan. It has been reviewed with regard to other nuclear plants in the State, specifically Susquehanna and Three Mile Island. It has been tested in emergency exercises. This aspect of planning has never been questioned, and I might add that with regard to Limerick FEMA recently issued at least its first crack at the evaluation of the state and local plans and came up with quite a few detailed deficiencies, but did not cite either area that the City

Sim 20-12

cites as a possible deficiency.

JUDGE BRENNER: We are not limited to what FEMA might find as deficiencies though, are we, particularly at a first crack, as you say?

MS. FERKIN: I would not argue that. I am simply stating it as a point.

JUDGE BRENNER: Okay. The Commonwealth hasn't always agreed with the FEMA findings on other subjects, has it?

MS. FERKIN: That is very true.

JUDGE BRENNER: Applicant.

MR. RADER: Since there has been considerable testimony today regarding these matters in general, it is important to recognize of course at the outset the obvious that the issues as regards the NEPA review for the purposes here in the hearing today and the emergency planning are certainly not congruent, and the fact that certain items like this may have been discussed in the hearing certainly does not indicate that they are appropriate for discussion or consideration in emergency planning.

I agree with Ms. Ferkins in that this goes beyond really a level of detail type issue for emergency planning. I think it goes to the scope of the issues which are necessary for emergency planning.

The City has pointed to basically two provisions

Sim 20-13

of the NUREG 0654 which it relies upon to say that this is required. It cites Criterion J.9, which in the first place purports to deal only with areas within the plume exposure EPZ and not the ingestion pathway. Protective pathways for the ingestion pathway, on the other hand, are covered exclusively under J.11.

Although it has underlined certain words under J.11 which deal with decontamination as an option for food and water supplies and so forth, there is certainly nothing in that criterion nor anything else in the regulations under 50.47 or any other regulatory requirement which the City has pointed to which requires the planners to consider in advance the availability of alernative water supplies or the decontamination of existing reservoirs.

The only other point I would mention in that context is that in terms of the PAG's that the City has cited, they cite decontamination as an option. I would point out that with regard to decontamination, the PAG's at page 1.48 discuss decontamination in terms of the natural functions of the filtration plant, and it says at that point that many reservoirs supply water to municipal systems through a filtration plant, and such a plant would tend to decontaminate the water supply.

So I see it in that context. I dn't see anything in the PAG's and certainly nothing in the regulatory guidance

Sim 20-14

furnished by the Commission or FEMA which requires planners to make advance plans for decontamination of existing water supplies. Certainly that is a long-range option, but it is not required for emergency planning at this stage.

The only point I would make is that these options which the City has discussed certainly would be available to them. As Ms. Ferkin has said, the State plan is intended to cover all affected areas within the State and if the City believes that actions should be taken in advance to plan to truck water from one area to another, say in the Belmont High Service area, if that is required, there is no reason why you can't do so, but that is not a deficiency in the State plan.

That is all for the applicant.

JUDGE BRENNER: On your last point, Mr. Rader, if we admitted the issues as phrased, that wouldn't necessarily preclude the testimony and a finding by us that the City can readily take care of itself if it wished to, and that would be our findings on the merits, correct.

MR. RADER: That is correct, but it would also be a basis for finding that the contention itself lacks basis.

JUDGE BRENNER: If we knew that was the basis now.

MR. RADER: Well, whether nor not it is the case might depend upon the City's efforts, but my point is simply

Sim 20-15

that is beyond the scope of emergency planning. If the City believes it is necessary, the City obviously will put whatever resources or considerations are necessary to achieve that result, but simply for the City to throw up its hands and say this is a problem and to attempt to make a contention out of it doesn't justify in terms of the regulatory content which the Board must consider.

JUDGE BRENNER: All right. I have the references for J.9 and J.11 from the written testimony, but I have misplaced them momentarily. I know J.11 is on page 64 of NUREG 0654.

MR. RAGER: That is correct.

JUDGE BRENNER: Where is J.9?

MR. WETTERHAHN: 61.

JUDGE BRENNER: 61.

(Pause.)

All right. Thank you.

MR. RADER: If I may just briefly add in that context, for example, pointing to J.11, the only reference there to reservoirs and watersheds deals with the requirement that maps for recording services and monitoring data be maintained.

MR. SMOLEN: For what purpose?

JUDGE BRENNER: Well, let's not have a dialogue. We can read the whole thing when we have the written papers.

MR. SMOLEN: I would like to refer the panel to page 59 where it discusses protective actions for the ingestion exposure pathway EPZ appropriate to the locale having been developed. So that the J, the subsection J, protective response is not limited to the plume area. It encompasses both, and particularly J.9 talks about that each state and local organization establishing a capability for implementing protective measures based upon protective action guides and other criteria. And it goes on and talks about contamination of human food. That is certainly within the ingestion pathway.

JUDGE BRENNER: All right. You made that point in our written filings.

MR. SMOLEN: J.11 of course really speaks for itself. May I make some response at this point?

JUDGE BRENNER: I think I have got the arguments really. I want to get the staff's postiion.

MR. SMOLEN: Oh, I am sorry.

MR. VOGLER: I would like to state at the outset that there is nothing here that has caused the staff to change its position from its previous filing. With regard to City 3 ---

JUDGE BRENNER: Well, let me say we didn't find the staff's position fully consistent because you had a different position on City 3 as compared to City 7 and we have already

Sim 20-17

discussed that.

MR. VOGLER: I was attempting to address that, I think. What was your complaint?

JUDGE BRENNER: We thought your position was inconsistent and you started out by saying that you weren't going to change it. So I wanted you to have the benefit of that view.

MR. VOGLER: With regard to City issue 3 the staff was of the opinion that A, B and C were admissible. I think A and B ---

JUDGE BRENNER: You are going to have to be accurate, Mr. Vogler, because the designations were changed.

MR. VOGLER: All right. Well, I will talk about alternative sources of water.

JUDGE BENNER: Okay.

MR. VOGLER: For the reasons just stated by Mr. Smolen, the staff feels that that should be explored and, therefore, we haven't changed our position.

With regard to Issue 7, decontamination, we believe that there is no basis for that issue.

JUDGE BRENNER: Why not?

MR. VOGLER: That is basically ---

JUDGE BRENNER: You said that you don't think there is a basis, and my question is why not?

MR. VOGLER: Because we are unable to find any

Sim 20-18

in our review of NUREG 0654.

JUDGE BRENNER: What about J.11, unless you don't consider water as a food stuff for ingestion.

MR. VOGLER: We are talking about maps and plans to identify for detecting contamination, but they are not saying anything there about decontaminating it.

JUDGE BRENNER: All right. What is your basis in NUREG 0645 for alternative sources of water?

MR VOGLER: The ones that Mr. Smolen cited, the beginning of planning standard on page 59 of NUREG 0654. We think that is basically where the staff comes out and we feel that there is an issue there. We don't know the bottom line. We feel that there is enough basis there to admit that issue to see what the City of Philadelphia has to say.

JUDGE BRENNER: Well, we will see what you have to say, too, if we admit it.

MR. VOGLER: And we will.

JUDGE BRENNER: All right.

JUDGE MORRIS: Mr. Smolen, you may not be able to answer this question, but it is a question that bothers me not only in this context, but in the phraseology of many contentions which allege that there is inadequate planning or inadequate action, and I never quite know what inadequate means and I wonder if you would be able to tell me what kind of actions or facts or whatever would lead to an adequate

Sim 20- 19

response to your contention?

MR. SMOLEN: If Your Honor please, in this particular case there is no plan. Therefore, there is no adquate plan and therefore there is no adequate implementable plan. There simply is no plan within the context of the state emergency plans relating to an alternate water supply and relating to a decontamination. We used the terminology "adequate" because we haven't see any plan yet.

So what we would like to have is a plan and an adequate plan, and I might add in response to counsel for applicant, the NUREG does say that it is a state responsibility to plan in the ingestion exposure pathway. It is not merely a city function. The NUREG itself is clear on that.

I might also add to another argument proposed or submitted here, the FEMA submission regarding emergency planning when I read it didn't deal with the ingestion exposure pathway. It dealt only with the plume, and it may be that is the reason that no objection was raised in the FEMA report to a lack of an alternate water supply or a lack of a decontamination plan.

It appeared that it only dealt with the plume area. Moreover, the fact that the state plan has never been questioned in other proceedings is not definitive that it is lacking in an alternate water supply or decontamination plan that that may be a requirement. That no one else ever

Sim 20-20

raised it, that is not definitive in this case and that is not an issue. I hope I have answered your question on adequacy and a lot of other things in response to what the other counsel has argued.

JUDGE MORRIS: Well, let me follow up briefly on adequacy. Do you believe it possible to develop a paper plan which could be judged adquate or would you believe that it would be necessary to go beyond simply a paper plan to some kind of test or execution to determine adequacy?

MR. SMOLEN: Well, I think the key word is implementability, and that is a question which is in, or is covered by 10 CFR that there has to be reasonable assurance that the emergency plans are implementable in order to protect the public. So implementability of a plan is an issue, a major concern of the city and we think it is covered by the regulations and the code of federal regulations, as well as the NUREG.

JUDGE MORRIS: I won't ask you what reasonable assurance is because that is our word, or our term.

Thank you.

MR. SMOLEN: Thank you.

JUDGE BRENNER: All right. We are going to take a recess of 15 minutes and then see if we can come back and rule on these issues. So we will be back at 5:20.

(Recess.)

T21 MM/mm1

JUDGE BRENNER: All right, back on the record.

We are going to admit both issues of the City of Philadelphia as issues for litigation, as they have now been phrased by the City. We will ask the City to check the transcript and to make sure the transcript accurately reflects what the City said. Don't change them. Just that they accurately reflect what you said. And, file a memo with us stating exactly what they say in the transcript, if it is accurate, with the transcript reference or some notification that there is a minor inaccuracy if that is not the case, just as soon as you can.

We will wait for that before issuing a confirmatory order.

In essence, we find that the general planning Standard J which has been referred to on page 59, which, of course more importantly, is almost an exact statement of the regulation -- namely 10CFR50.47(b)(10), almost verbatim. It may be verbatim. I haven't compared them again. It does provide a regulatory basis for consideration of both issues, particularly whether or not protective actions for the ingestion exposure pathway EPZ appropriate to the locale, which the City emphasized, and we emphasize, too, have been developed.

In terms of a factual basis, we have enough of a basis in part with the litigation of the severe accident

mm2

contentions, but I think even without them, that in the event of a severe accident, you have a large city which is largely, if not exclusively dependent on surface water drinking water sources, that protective, mitigative and alternative type measures for supplying of drinking water to the city residents could be necessary.

And that supplies the factual basis for the issues at this time. Of course that is just the admissibility stage. As all the Parties know on the merits we could conclude that A, no planning is necessary because everything can be done ad hoc; or B, some further planning that the Parties want to put into evidence has been done, and that is sufficient. Or, more planning and measures are necessary and so on. But that would be for the merits.

That is the general basis for our ruling. I can give you a few particulars now.

The Applicant and the Commonwealth and the Staff with respect to the decontamination contention are arguing in effect that far-reaching detailed planning -- I think that phrase comes out of one of the Applicants' filings, but it seemed to have summarized the views of the other two parties also -- that that type of far-reaching detailed planning for the ingestion exposure EPZ is not required, and thatmore generalized planning utilizing ad hoc responses during an emergency might be appropriate.

mm3

And in part the Applicant cited the Southern California Edison Case of San Onofre, which is ALAB 717, appearing at 17 NRC 346. Particularly cited was page 373.

However, as we read that decision, it talks about certain things before it in that case on the merits and has not overruled the guidance in 50.47(b)(10) and the general guidance of Part J that we alluded to. And we also looked more particularly at J-11. And in applying J-11 we believe that consumption of contaminated foodstuffs includes water. If it doesn't expressly in the NUREG, the City has provided us sufficient factual basis as to why you should worry about water consumption as well as foodstuffs. And to say that the only thing applicable to water is mapping and surveying is just not a very common sense reading of the potential harm to which the General Planning Standard A, and more particularly J-11 is directed.

To some extent J-9 would also support the City. We don't necessarily agree with the Applicant that J-9 clearly only applies to the plume exposure pathway EPZ simply because it refers to plume exposure. It also refers to contaminated foodstuffs from exposure to the plume. But we don't have to worry about that, because General Planning Standard J and J-11 provides enough of a basis as we had stated. And San Onofre does not overrule that type of guidance.

In addition, we will evaluate on the merits what

mm4

kind of planning is necessary to admit the contention doesn't necessarily mean a finding that some far-reaching detailed planning, or whatever that label might mean, is necessary. And all the Parties will be free to argue during litigation of the issue that whatever planning is available will provide reasonable assurance.,

All right. There is an argument made that even if we apply J-11, the alternative -- idea of alternative sources of water supply is beyond anything in J-11.

Again, for purposes of admitting the contention, we think there is enough of a factual basis that for the locale involved, that should be explored. And that really the two contentions are part and parcel of the totality of what we have to look at to the extent; A, whether or not anything is needed; B, if something is needed, you might need more planning for alternative sources if you don't have decontamination capabilities.

And on the other hand, if you have decontamination capabilities, you might not need more planning for alternative sources.

If we were going to make a distinction as to regulatory basis in 0654 between the two issues in contrast with the Staff's views, there is more of a basis for the decontamination contention than there is for the alternative sources contention. But, nevertheless we don't make that

mm5

distinction because of the General Planning Standard and 50.47(b)(10).

More particularly, as the Parties should know, adherence to the guidance in NUREG 0654 is not expressly required, it is not a regulation. And, of course, I am addressing these comments now to J-11 and not 50.47(b)(10) which is the same as the General Planning Standard.

It is open to any Parties to show that adherence to the guidance in NUREG 0654 is either necessary or not sufficient. And Three Mile Island has addressed that at ALAB 698, and this is the Appeal Board Decision, of course, 16NRC1290 at 1298 to 1299. There is a little more on it in the Licensing Board Decision which the Appeal Board cite I just gave you was affirming. And the pertinent portion of the 1981 Licensing Board Decision on that can be found at 14NRC at page 1460.

All right. Again we would emphasize that there is enough flexibility in the important words appropriate to the locale to admit the contention.

One of the Commonwealth's reasons for opposing the contention differs somewhat from the Applicants', more precisely is in addition to the Applicants' ojections, and the Commonwealth reemphasized that objection today, namely that it is not legally obligated to supply the City with analternative supply of water.

mm6

However, in admitting these issues we are not precisely -- we are of course not even close to finding that the Commonwealth should supply an alternative source of water. As we understand the issues, it is that the total umbrella, if you will, of emergency planning coverage, should contain provisions which reasonably assure that the City would have an adequate water supply if the normal water sources in some part or in whole would become unusable in a radiological emergency.

In fact, the Commonwealth has noted in one of the written answers by the Commonwealth, that it is willing to work with the City and the Applicant regarding development of a City-specific alternate water supply plan. The Commonwealth is mainly saying, however, it is not the Commonwealth's responsibility to do it either by money or resources, I gather.

So, in admitting thecontention and relying on, in part, Planning Standard J-11 as a basis, we want to emphasize that we are not adopting the marginal note in J-11, which assigns an X, if you will, in the columns, only to state for J-11. Part of our reliance was on the General Standard of J. And we are not determining who should do the planning. In fact, it would be open on proof if we were to find, hypothetically, that measures can be taken by the City.

We may find that and thenconclude that since this

mm7 is within the City' own area of responsibility, authority and capability, it is now up to the City as to whether or not it actually wants to take those planning measures.

That's one possible result.

I think that sufficiently discloses our reasons. I want to emphasize that although we took only a brief recess now to consider the further clarification of the arguments, we have indeed spent quite a bit of time considering the written filings of the Parties, and they were very helpful to us. I did not want to take the time now, nor is it necessary in disclosing the basis for a decision, to discuss each and every subsidiary argument of the Parties. But I think we have hit the main arguments, and we did appreciate the assistance of the Parties in those filings.

I think that concludes our business here today.

Our written order on this would simply be a confirmation referring back to these transcript pages. But we will await prior confirmation from the City that the issue is worded correctly in the transcript when we see it.

If there is any particular question or clarification, given the fact that we are doing this orally, I will entertain them now. But not reconsideration, just a question if somebody is confused as to what we have done here.

MR. RADER: One point I would raise In the event

mm8

the Applicant were to seek reconsideration of the ruling, would it be five days from today or five days from your confirmatory order?

JUDGE BRENNER: From today. You had better come up with some mighty good new reasons, because I emphasized that we did give the Parties a lot of opportunity which the Parties properly took, to give us the arguments.

We did find the arguments helpful. We did not find the arguments outrageous. It is just, to the extent we have indicated, we disagreed with some of the arguments.

MR. RADER: I wasn't personally offended. I just wanted to know in case the client wanted to take that action.

JUDGE BRENNER: Well, once in a while if perhaps we made faces, if not verbally, in person at some of the arguments -- and the arguments on these issues did not fall in that category, I wanted to emphasize that.

MR. SMOLEN: Having a last-word syndrome --

JUDGE BRENNER: That is our syndrome. Go ahead.

MR. SMOLEN: -- how many days would there be for a reply to a reconsideration?

JUDGE BRENNER: You are not required -- there is no provision for reply to reconsideration unless we ask for a reply.

MR. SMOLEN: May we request same, should a reconsideration --

mm9 1 JUDGE BRENNER: Before we would grant reconsideration, we would give any parties who might be adversely affected, a chance for reply. So, if reconsideration is filed by the Applicant, and you hear nothing from us, unless and until you do, you are still in good shape.

That is, we can summarily deny request for reconsideration without seeking answers.

MR. SMOLEN: Thank you very much, your Honor.

JUDGE BRENNER: And we followed both courses as the Parties in this case know. When we wanted more information we did ask for replies to reconsideration motions in the past.

MR. SMOLEN: Thank you.

JUDGE BRENNER: Well, we thank the Parties for their good efforts all this week. In fact, I should take this opportunity to say throughout this hearing. We will be in recess for some uncertain period of time and we have already set the mechanisms in motion for further advice from the Parties who have to get back to us on different points that would lead towards the litigation of offsite emergency planning matters.

But for now, the record is closed on all the other issues which we have litigated, including the issues this week.

MS. FERKIN: Just one matter. I was hesitantto bring this up, but I have to for personal reasons. I have to

mm10 do it.

Do you have a ballpark estimate as to when you would like to start Emergency Planning?

JUDGE BRENNER: No. And there is a lot that has to happen before we get there, and we don't know when those things will happen.

MS. FERKIN: Okay. Thank you. You said what I wanted to hear.

JUDGE BRENNER: We are adjourned at this time.

(Whereupon, at 5:30 p.m., the hearing in the above-entitled matter was adjourned.)

CERTIFICATE OF PROCEEDING

This is to certify that the attached proceedings before the NRC COMMISSION

In the Matter of: Philadelphia Electric Co.

Date of Proceeding: 20 June 1984

Place of Proceeding: Philadelphia, Pa.

were held as herein appears, and that this is the original transcript for the file of the commission.

Mary C. Simons
Official Reporter - Typed

Mary C. Simons
Official Reporter - Signature

CERTIFICATE OF PROCEEDINGS

This is to certify that the attached proceedings before the NRC COMMISSION

In the matter of: Philadelphia Electric Co.

Date of Proceeding: 20 June 1984

Place of Proceeding: Philadelphia, Pa.

were held as herein appears, and that this is the original transcript for the file of the Commission.

Mimie Meltzer
Official Reporter - Typed

Mimie Meltzer
Official Reporter - Signature