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CORRECTED TRANSCRIPT

Agency:	Nuclear Regulatory Commission Atomic Safety and Licensing Board
Title:	Kerr-McGee Chemical Corporation (West Chicago Rare Earths Facility)
Docket No.	40-2061-ML ASLBP No. 83-495-01-ML
LOCATION:	Chicago, Illinois
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ANN RILEY & ASSOCIATES, LTD.
1612 K St. N.W., Suite 300
Washington, D.C. 20006
(202) 293-3950

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
KERR-McGEE	)	Docket No. 40-2061-ML
(West Chicago Rare Earths Facility)	)	ASLBP No. 83-495-01-ML
	)	

Thursday

December 14, 1989

Everett-Dirksen Building

219 South Dearborn

Court Room 1719

Chicago, Illinois

The above-entitled matter came on for hearing, pursuant to notice, before:

Judge John H. Frye, Chairman

Judge James H. Carpenter

Judge Jerry Kline

APPEARANCES

Douglas J. Rathe
Christine Bucko
Jerome Sisul
ASSISTANT ATTORNEYS GENERAL
100 West Randolph
12th Floor
Chicago, Illinois 60601

ON BEHALF OF THE CITY OF WEST CHICAGO:

Robert P. Greenwalt

ON BEHALF OF THE ILLINOIS DEPARTMENT OF NUCLEAR SAFETY:

Stephen J. England

ON BEHALF OF KFRR-McGEE CHEMICAL CORPORATION:

Richard A. Meserve, Esq.
COVINGTON & BURLING
Peter Nickles, Esq.
COVINGTON & BURLING

ON BEHALF OF THE NUCLEAR REGULATORY COMMISSION:

Ann P. Hodgdon, Esq.
OFFICE OF THE GENERAL COUNSEL
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

C O N T E N T S

PROCEEDINGS 9:20 a.m.

JUDGE FRYE: Good morning ladies and gentlemen. This is hearing on an application by Kerr-McGee Chemical Corporation for a license amendment which would permit it to dispose of certain thorium mill tailings on site, at its site located in West Chicago, Illinois.

The hearing comes about as a result of orders which we issued on November 14 which denied Kerr-McGee's and the State of Illinois' motion for summary disposition on Contention 4A which has to do with the suitability of that site under the Nuclear Regulatory Commission's criteria set forth in 10CFR40 Appendix A.

We set down certain limited issues for hearing with regard to that contention. We also denied Kerr-McGee's motion for summary disposition on Contention 3G2 having to do with the formula used in calculating movement through the unsaturated zone and that matter will also be heard in this session.

We are an Atomic Safety and Licensing Board of the Nuclear Regulatory Commission. I am Judge John H. Frye, a lawyer and full-time member of that panel. On my left is Judge James Carpenter, a full-time member and environmental chemist and on my right is Judge Jerry Kline a full-time member and environmental scientist.

We have certain motions which are pending which we want to take up first before we get into the evidentiary session.

But before I get to that let me ask if there are any members of the public here and if so do they have a statement?

Is the West Chicago Chamber of Commerce present? No. Fine.

Let's go on with the motions then. I understand from Mr. Rathe from the State of Illinois that there are four motions which you have filed. We have three of them.

MR. RATHE: If I, at this time, I have sent a number, I sent some of the motions by express, by FAX, which I understand weren't received. And I sent a complete package again with some additional matters by U.S. overnight mail and apparently you didn't get that.

JUDGE FRYE: It was not there when we left yesterday.

MR. RATHE: I have previously tendered these motions to Mr. Meserve, Ms. Hodgdon and respective parties and what I'd like to do if I can is present copies to each board member.

JUDGE FRYE: Fine.

MR. RATHE: If I may approach.

JUDGE FRYE: Yes, please.

MR. RATHE: I'm presenting the motion to strike which you already received, I believe, but did not have the exhibits on it. We have previously sent you a motion for on-site view which I believe you have received. We have a motion in limine which I don't think you have received. We have a motion for me to submit Contention No. 10, which I believe you received and a

simple, a letter to the Administrative Judge simply advising the judges that enviro care has a part -- I apologize for any inconvenience.

I believe the only one you probably haven't seen at all would be the motion in limine --

JUDGE FRYE: I believe that's correct. Why don't we take these up first and Kerr-McGee has a motion pending to strike the testimony or a portion of the testimony of Dr. Warner on behalf of the State.

Are there any other motions from Kerr-McGee?

MR. MESERVE: No, your Honor, there is only that one pending.

JUDGE FRYE: I see. And nothing from staff?

MS. HODGDON: Nothing from the staff.

JUDGE FRYE: Good

Let's take up the State's motions first then and perhaps the easiest one is the motion for on-site viewing.

We have, let me say, Mr. Rathe, seen the site. Judge Carpenter and I have been out there twice. We were out there in the summer of '84 at which time we took a tour of the site and as well as the Kress Creek and its environs, a tour that was arranged by Kerr-McGee and the other parties participated in.

And then when we held the Kress Creek hearing we informally drove past the site, so we feel that we are familiar

with it and we are familiar with the environs.

MR. RATHE: Fine, your Honor. We had been led to believe that perhaps you had not been out there and we thought it was important in light of the proximity of the residences to the site, but if you've been out there, that's all that's important.

JUDGE FRYE: I agree with you, that is important and we have been there.

MR. RATHE: Thank you.

JUDGE FRYE: So we will deny that motion largely as being moot.

Why don't we then move to the motion to submit Contention No. 10 and the motion to strike the testimony which I think to some extent are related.

Am I correct, Mr. Rathe? I read them as being somewhat related, but perhaps --

MR. RATHE: I don't know if they're --

JUDGE FRYE: I'm sorry, I'm sorry.

MR. RATHE: I do not think they're related.

JUDGE FRYE: All right. Let's go --

MR. RATHE: I will say they are separate motions that are -- there might be some relationship to other motions pending, but I don't believe they're related.

JUDGE FRYE: Okay. Fair enough. Let's take the motion to strike then and hear from Kerr-McGee.

Let me ask first, Ms. Hodgdon, do you have any, do you support or oppose the State's motion to strike Kerr-McGee's testimony?

MS. HODGDON: The staff opposes the motion.

JUDGE FRYE: Okay. Let's hear from Kerr-McGee first.

MR. MESERVE: We want -- motion summary could have been filed well before. The motion to strike has components to it.

The first component is a motion to strike Dr. John Stauter from the panel which Kerr-McGee has tendered the board to provide his testimony in this proceeding.

Dr. Stauter is the only Kerr-McGee employee who is a member of that panel. He is an expert in chemistry. He is an expert in sampling the water and he is fully familiar with the site history, having been involved with the site for a considerable period of time.

His role in the preparation of the testimony was testimony that was drafted in a large part by the other two witnesses that we will be submitting to the panel of the doctors -- but his role was one of reviewing that testimony and providing -- thrust of the State's motion is that because he would not take pen in hand in the initial drafting, that somehow he cannot -- testimony. I don't believe that he is, that's in fact the case of the situation with witnesses.

He has reviewed the testimony carefully, he testified that he is being here in support of testimony. We believe that

he would be a helpful member of the panel. He has offered testimony of his own, he has familiarity in certain issues that the board has indicated that it has interest in and we would -- that has to do with the leachate analyses, having to with questions with the -- of materials.

He is a chemist. The others are hydrologists. He has expertise that might serve to eliminate the variations the board has indicated in response to your testimony.

I don't believe -- prejudice to the State. He is a person who participates in panels. They've had an opportunity to depose him. It's certainly not a hydraulic issue but -- but his role here is one that we believe to be helpful to the board if he were to participate and we therefore urge that the, before the motion to strike Dr. Stauter from the panel be denied.

There is a second component to the motion to strike and that is that the state moves to strike a paragraph on Page 16 of the testimony that has to do with retardation.

As the board may be aware that Kerr-McGee -- did not include taking analysis of retardation of the staff -- the State urges this testimony should be stricken and they claim there is no support to this testimony because the Kerr-McGee mold fails to analyze vertical movement of the chemical for radiological positions.

It is in fact proof, Kerr-McGee model does not provide that support, but it is shown by the paragrapn that they like to

strike there is specific reference to where this information comes from. The reference is from any spot that Kerr-McGee -- which sets off the entire calculation as to how Kerr-McGee made its assessment of retardation. -- right -- sets off the very same information.

So, your Honor, I don't understand the foundation for this, I think the foundation of this particular component the State's motion is just fundamental misunderstanding of the Kerr-McGee testimony and perhaps failure to examine any -- to that testimony who sets up various information --

For those reasons, your Honor, we urge that both components of the State's motion be denied.

JUDGE FRYE: Thank you. Any data from staff, Ms. Hodgdon?

MS. HODGDON: The staff supports Kerr-McGee, the staff supports Kerr-McGee's position and would add only that Illinois has not offered any basis for striking Dr. Stauter's testimony -- under the Commission's regulations regarding evidence. They have not said that his testimony is not relevant -- nor have they attacked his expert qualifications. All that Illinois contended is that he contributed no original work -- to the panel -- the Commission -- regulations in -- are Section 2743 regarding evidence has no requirement that the witness may an original contribution.

And some of the other basis that Illinois offers --

work of Dr. Grant and Dr. Fetter and they -- comments. Again -- we can improve -- strike --

With regards to the second item the paragraph, the staff agrees that that paragraph merely represents, presents his testimony -- set forth at length -- and Illinois has offered no reason for striking that. In fact --

JUDGE FRYE: Thank you. Do you want to respond, Mr. Rathe?

MR. RATHE: I apologize to the board that in terms of the not having the exhibits attached, as you can see they were relatively late and with the very short time I felt that it was only practical to send it out by U.S. Express Mail.

JUDGE FRYE: Surely.

MR. RATHE: Unfortunately that did not get to you.

I would respond to the two parties, Kerr-McGee and the NRC Staff in terms of Dr. Stauter, by saying that first it is clear that based on the entire deposition, of course you don't have a copy of that, that Dr. Stauter never did anything in this proceeding other than make editorial comments and changes and --

JUDGE FRYE: But how are you hurt, that's what puzzles me. He is the only representative of the applicant here, Kerr-McGee who is a witness, the others are consultants and, you know, to the extent that he hasn't contributed, don't see how that hurts your case.

MR. RATHE: I would agree that in terms of Ms. Hodgdon's representation to the board that the requirement under the regs is that there be relevant evidence submitted. I submit that nowhere in the deposition does he in any way participate and therefore he is contributing no relative evidence.

I certainly agree he is not in the hurting position of the State of Illinois, but I don't believe it satisfies, in terms of moving to strike he simply is providing no relevance and then I can say --

JUDGE FRYE: Okay. Then as to the point with regard to the paragraph.

MR. RATHE: My main concern is that the paragraph itself as set out was misleading because the way it indicated is that the fact that Kerr-McGee actually did some modeling that would show the passage of the uranium rate and through the strata and depth -- would be 6,000 to 1, 3,000 for another.

It's the misleading nature that is of more concern and I don't want that, for the board or anybody to be misled that Kerr-McGee did anything to model what was going downward. And that's our position.

JUDGE FRYE: Well, understood, I think that really goes to the weight of the testimony and that certainly, you know, I think we will deny the motion to strike.

Let's move to the motion to submit. Well, let's take up if I may the motion in limine first. Can you briefly

summarize, Mr. Rathe, what the problem is here.

I've had a chance just to briefly scan it and not really understand it.

MR. RATHE: Very briefly we received the day, on Monday, December 4th I believe, a telefax or U.S. Express mail some sampling results of some cyanide tests.

The next day, Tuesday, December 5th, we were presented with an updated and finalized version of these cyanide results. This was done by Kerr-McGee after the board indicated some concern in its November 20th letter.

We feel that to have such testing one, at a relatively waste of time, the board wasn't asking for a new round of samplings and two, without letting the State of Illinois be aware that the testing was done so we could get a split sample, puts us in the unfair position that we cannot affectively evaluate the results.

So Kerr-McGee eventually said, not eventually but during the course of the deposition, after phone calls before it, that we would be entitled to take some samples, we made -- with the IEPA lab, the State of Illinois Lab and the representations made to us is that there was a holding time on cyanide and therefore we wouldn't be able to get accurate results.

All we're saying is that in light of the lateness of the testing; in light of the lack of notice; in light of the

scientific problems with any reference to do cyanide testing simply be not allowed --

JUDGE FRYE: Do you have any ability to obtain samples now? And have them tested now?

MR. RATHE: Well we, we could run, we could go out there and conduct our own sampling, that's certainly a possibility. But in terms of using the samples that Kerr-McGee --

JUDGE FRYE: That wouldn't work, I understand.

MR. RATHE: Yes, there is always the possibility to go out there and obtain -- but, of course, our concern is that the board is about here some and we may not be able to turn it over quite as quickly as Kerr-McGee did. We may not have results for a period of time.

JUDGE FRYE: Okay, thank you.

Mr. Meserve, yes.

MR. MESERVE: Well, Mr. Rathe is quite correct that the board's order of November 20th, I believe, for the first time raised the issue of cyanide. None of the State's contentions have anything to do with cyanide.

And in light of the board's orders and concerns about the cyanide issue, Kerr-McGee easily did have the samplings conducted by independent agencies, Weston Laboratories, went out and performed this. Collected the samples, maintained in their custody, did their own analysis and the sheet was all showing --

We believe that these samples are correctly responses to an issue -- don't have anything to do with any issues that are raised by the State.

I think that in light of that fact that the dubious standing it seems to me for the State to be filing a motion in limine with regard to testimony that doesn't have anything to do with any --

Now we have conducted the sampling as a service for, to help the board, -- independently had come across in his analysis of the supplement and I say, it was not encompassed by any of the State's contention.

When the State says it has difficulty in conducting the samples, the records show that the sampling that Kerr-McGee conducted was done on the 27th and 28th of November and the final results, from Monday and Tuesday, we had final results or the final results and letters are dated Friday, December 1st.

I received a preliminary, a copy of the preliminary results myself on Saturday and as Mr. Rathe indicated, immediately FAXed them to the State so that they would have an opportunity to be able to cross examine our witnesses with regard to the sampling which they did bring forth in depositions.

We were able to get the entire draw done between Monday and Tuesday of one week through the analysis by Friday. They had notice the following Monday, last week ago Monday.

They would have had an opportunity if they wanted to, to conduct the -- and go out that day, they would have results by the following Friday, if they had just used the same type of independent contractor which we had used.

If the State has any doubts about this, they had full capability to be able to collect their own samples. Now, if the board will recall, we had a conversation about this, I believe it was on Wednesday, December 6th, and I offered and made arrangements on that very day for the State to obtain the same samples that Kerr-McGee had -- it is my understanding that the EPA allows the sampling for cyanide to be conducted within 14 days from the date of collection.

They had an opportunity to have those samples analyzed any time before the following Monday or Tuesday, in other words they had another five or six days minimum of time to reach that analysis.

My understanding is the analysis of cyanide is fairly simple. It's a triculation and a core analysis -- laboratory can turn that around if it wants to inside a half a day. They ask for two days, but it certainly doesn't require that to do that kind of test.

They had an opportunity to take their own samples if they'd wanted to. They had an opportunity to do a further analysis of the Kerr-McGee samples. This is not any question that Kerr-McGee had somehow had an involvement in this, other

than requesting to work. Get an independent contractor, it was our understanding that the contractor is widely used by the State in other cases for conducting analysis in exactly the same way.

So we believe that this testimony bears directly on matters the board has raised and is totally the part of these proceedings and we fail to understand how, is there any foundation whatsoever to this motion.

JUDGE FRYE: Thank you. Ms. Hodgdon?

MS. HODGDON: I will speak to this subject very briefly. I -- believe that Illinois put in any deposition -- recollection -- asked for the split samples and Mr. Meserve said that they might be stale and wasn't sure that they'd be preserved -- correctly in the laboratory and that she -- Mr. Meserve said they might be stale or they might, he didn't know that they were --

In any event, Mr. Meserve came back later and said that the samples were good for 14 days and that they had, in fact, been taken on the 27th and 28th and therefore on that date, December 5th, they were still in good samples and could be tested for cyanide.

Whereupon Mr. -- said that the State was no longer interested. The State had said that they were probably stale anyway. So, I offer this to you and say that there's a great deal of confusion going on with regards to this and we certainly

do not support the motion in limine or any objections that the State might have to the introduction of evidence about the samples --

JUDGE FRYE: And staff, I don't recall specifically, but we asked staff to testify on this issue and I will assume that you have testimony which addresses it.

MS. HODGDON: Well, we have testimony that addresses why the staff used the number of the cyanide the staff used, where the number comes from and how the staff treated that final and actually it was based on the terms you sent --

JUDGE FRYE: Well now is it based on the samples that Kerr-McGee took at the end of November?

MS. HODGDON: No.

JUDGE FRYE: It's based on some earlier samples?

MS. HODGDON: -- testimony was given before that --

JUDGE FRYE: Yes, that's right.

MS. HODGDON: It was based on old samples, I don't recall the exact date.

JUDGE FRYE: Okay.

MS. HODGDON: But it was based on existing samples. It's based -- the number of cyanide -- samples --

JUDGE FRYE: Thank you. Do you want to respond at all, Mr. Rathe?

MR. RATHE: Just very briefly. Again it's not so much did we have, were we granted the opportunity to actually do the

samplings, it was the late notice of it, it was the fact there was some question of validity as to the results, as to our ability to actually analyze the particular samples we were given. It's the untimeliness that is the most unfair -- if Kerr-McGee had said okay, we're going out and sampling, do you want to split samples, that would be fine. Then we'd have no basis -- basically to be told the day before depositions begin, a week before our hearing is scheduled, that they now have results, that I believe is unfair.

JUDGE CARPENTER: The board understands your complaint about the time, but coming back to the truth of the matter, it's my impression that the State did take samples at the West Chicago site in 1986 and did analyze it for cyanide and you have data, accurate data, and this shows cyanide concentration was essentially unmeasurable. As I recall something like a microgram per liter or a few micrograms per liter.

So you're not coming at this with an empty hand. You have previously sampled and you have, as far as I know, a valid observations in your hand which are not in disagreement with Kerr-McGee's results.

So I have sympathy for the lack of split samples and so on, might have been arranged for, but coming to the bottom line, is there a real question in the State's mind about the amount of cyanide in this factory site where as far as I can determine cyanide was never used.

I'm curious as to whether or not the samples which the State took in 1987 are a sufficient basis for you to have a feeling for whether or not the -- results are valid.

MR. RATHE: Judge, my only response to that is that obviously Kerr-McGee must have had some concerns of things to take samplings prior to that so, if they didn't have similar concerns they wouldn't have taken the 1989 samples.

JUDGE FRYE: We asked them to. I think that's what our order prompted us to do that, because we asked that the staff and Kerr-McGee address the difference between the Kerr-McGee forecast and staff forecast on cyanide contamination of groundwater.

MR. RATHE: I took that to explaining the different -- run a sample, but I don't want to belabor this, Judge, so whatever your ruling is we'll go on from there.

JUDGE FRYE: Why don't we just hold that one until we get to that particular point in the testimony and then we'll rule at that point. I don't think it becomes critical before then, does it?

That brings us to the motion to submit Contention No. 10 and I suspect I know where Kerr-McGee stands on that one.

Does staff have a view?

MS. HODGDON: Staff opposes the motion.

JUDGE FRYE: Opposes it. Let me, Mr. Rathe, let me ask you, the thing that hits us immediately about this is that Dr.

Warner is basing his testimony on data that was in the SFES and that's been available, you know, for quite some time.

It does seem to me as you recognize that it's a new matter and I trouble with your justification for a good cause.

MR. RATHE: Well, again, it's a balancing test. I don't think the way the rate is set out that I have to meet, necessarily, every single one of the five elements.

JUDGE FRYE: No, but this is probably the most important one and if you don't get past this one then you're in trouble on the others.

MR. RATHE: As I say, it's our belief that this becomes an issue because I would say that, not that the material as you point out, the material may or may not have been available in the SFES, procedure -- was sufficiently available for Dr. Warner's review.

Essentially Dr. Warner commented, the comments arose in response essentially -- Kerr-McGee staff and I believe that it was that response that, of course, have only been done after with testimony received, therefore that testimony was not served on us until the end of November, beginning of December and I believe that under those circumstances the board should consider this a timely submission.

After all it was, not only did it involve the testimony with respect to part of this, but it became additional commented on by the -- deposition. So I would believe that this is the

kind of information that we would not have necessarily have had until very recently.

So in terms of the time element, we did it as fast as appeared to us that it was indeed a contention.

JUDGE FRYE: But Dr. Warner in his first line, first sentence of the second paragraph says that if one examines the input to the model and the resulting output, it immediately raises the question of what is happening in the modeling process that leads to the results that are presented in the SFES and how realistic are those results.

MR. RATHE: Well, and as I submitted before, I believe that there were certainly some information available, perhaps the information was such that the board may have viewed or may view that we could have put this contention together before we did.

It's our position that the information could not be completely developed until we had an opportunity to examine the components, the components were examined last week on 5, 6 and 7 of December and it was at that point after discussion, after reviewing this deposition testimony, after getting Dr. Warner's further input, that we were then decided that this indeed was the service concerned.

JUDGE FRYE: I think when I said that earlier that this motion appeared to be related to the motion to strike, I was thinking of the Kerr-McGee motion to strike and it seems to me

that it may be related to that, is that?

MR. MESERVE: Yes, your Honor. I think it is related because --

JUDGE FRYE: Why don't we take up the argument on that motion then and give you a chance to respond to it, decide them together.

MR. MESERVE: Do you want to recount, -- before the State filed their Contention No. 10, they submitted a motion to strike at that point -- Dr. Warner. The contention having been drafted and -- has to do with the way the staff had analyzed movement of -- saturated and allegations to the model which they used had not been validated.

And criticism was that the alternative analysis conducted by the staff was therefore -- was the actual word contention. Dr. Warner in his testimony has basically conceded all those issues. He states and I'm quoting from his Contention 52 states that perhaps the averaging -- used in the NRC -- are satisfactory -- as an alternative site. -- that is not the issue I am addressing.

The specific issue which is in contention, which had to do with the analysis alternatives, the testimony -- that the --

The contention drafted is limited to the NRC's modification of its -- had to do with -- and/or in asking that this issue -- noted that either Kerr-McGee or the staff had

derived the equation -- quality from --

While Kerr-McGee did that in its testimony and Dr. Warner in his testimony stated that -- used by the NRC can be derived for the first principle, instead of the issue in which the board said it wanted testimony connected with this issue, is one that Dr. Warner has addressed and has confirmed that the viewpoint expressed by the staff, by Kerr-McGee.

The main thrust of the Warner testimony is the challenge -- that was conducted by the NRC and Kerr-McGee and it raises an entirely new issue. The argument we hear now for the first time is that the modeling was inaccurate because Kerr-McGee, we said Kerr-McGee because Kerr-McGee model was a two-dimensional model and it -- three dimensions.

Well, this is an entirely new issue. It doesn't have anything to do with low, with the unsaturated -- the first we heard of it was when we received Dr. Warner's testimony, received -- and Mr. Rathe suggested that this issue only became, they only became aware of this issue during the course of the deposition of the Kerr-McGee's witnesses.

Well, the Kerr-McGee witness depositions started on December 5. We were given this testimony on December 5. So this was an issue -- Dr. Warner's -- before any deposition --

We don't think there is any good cause to delay the State in presenting Contention 10 which is, I think we ought to see that Contention 10, we interpret Contention 10, and

basically -- Dr. Warner's testimony is that Contention -- doesn't matter what the Contention is, they want to get the testimony in --

We don't think there is any good cause for that. NRC groundwater -- fully explored in the SFES and as you noted Dr. Warner has stated that it was apparent in the SFES -- if you don't take the risk, but that's -- testimony. -- it's something you should have been aware of at the time or SFES -- and we also draft of the SFES, it's available to the State some time in 1987. As for the Kerr-McGee modeling they've been fully aware of the Kerr-McGee modeling since 1986. The modeling is fully described in the engineering report. They've had an opportunity to divulge the Kerr-McGee witnesses as to the modeling, in fact, did depose those witnesses back in 1986 --

All the information that they needed presents this contention, in fact it's a serious contention was available to them long ago.

Here we are at the eve, the very eve of the hearing and all of a sudden we have a brand new issue that's confronted, we're confronted with. Do you think that's improper, do you think the new contention should be, a motion to submit a new contention should be denied, we urge that Dr. Warner's testimony as to Contention 332 be stricken in its entirety.

JUDGE FRYE: Ms. Hodgdon, do you wish to add anything?

MS. HODGDON: Let's see, the facts support Kerr-McGee

mentioned -- Dr. Warner's testimony and opposes the admission of the proposed Contention 10.

The staff agrees that these things are very closely related. It seems that Dr. Warner's testimony is, does -- issue, and the new issue that -- very closely related to proposed Contention 10.

It does seem that proposed Contention 10 is Illinois' answer to Kerr-McGee's motion to strike Dr. Warner's testimony. -- apparently without due cause, the Contention as stated is -- very hard to understand without Dr. Warner's testimony. I'm supporting it, because with their obligations -- in the contention are lacking in basis in the regulations -- and contentions, I don't -- the whole paragraph because most of it goes off that way.

By the same token Dr. Warner's testimony also addresses something -- and so the staff supports Kerr-McGee's motion to strike Dr. Warner and opposing --

JUDGE FRYE: Thank you. Mr. Rathe?

MR. RATHE: First I want to respond to what Ms. Hodgdon refers to, she makes two criticisms, one lack of specificity, I believe this is extremely specific and it certainly says what the two parties, Kerr-McGee and the staff did in terms of their modeling and why a three dimension model would be a more appropriate one. So specificity I don't believe is a problem here.

In terms of Ms. Hodgdon's criticism that in fact Illinois thinks somehow this issue or this case is all about modeling and when the fact there's no requirement the model in the -- or model anywhere else, I think she's missing the underlying point of what's going on here and that is this whole case is about modeling.

Because what we have right now, we have a situation where the entire analysis that Kerr-McGee is making to this board is based on its models and certainly the model of the NRC is relevant to this. In fact we don't have any -- data that you really can rely upon. You have to assume that the validity of their models are right because if there models are wrong, then there has got to be serious questions in the way you -- the appropriate site.

So if Ms. Hodgdon suggests that modeling is somehow irrelevant or a non-issue or Illinois thinks that we should get off on a tangent here, I think she's wrong.

Now in terms of Mr. Meserve's suggestions that Dr. Warner's testimony should be stricken, one, Dr. Warner's comments are a logical extension of the contention itself and he is point out the reasons that the NRC models flaw. He is going on comment on the Kerr-McGee end of it, because Kerr-McGee in fact in its testimony submitted justifications for the model.

So all he's doing is responding to the model. Now, one of the things that the board can do, if it says well it doesn't

quite fall within the context of the 3G2, then I would ask the board to take it out of the context of 3G2 because the board in its November 14th order specifically invited Illinois to submit any testimony to the board.

And so if you don't say that it falls within the narrow parameters what 3G2 is all about, then I'd ask you to take it out of that and say that this is a critical issue. This issue must come before the board, and since Dr. Warner is the sole expert the State of Illinois is providing, to strike any of his testimony would certainly be prejudicial to the State of Illinois.

We still and in terms of the lateness of Contention 10, this board is not going to be able to resolve everything they hear in the next two days, because Contention 2 remains outstanding. I don't know how we're going to resolve that, whether it be an additional hearing, motion for summary disposition, but the point is if Kerr-McGee or the staff says this is unfair, because it's late and it's old -- that's not true, it can't answer that in terms of testimony. So they have some time to respond to it.

It's a clear revelation. I submit to the Court that this whole case is about adequacy of their models. If their modeling is good modeling, then perhaps Illinois is parking up the wrong tree, but if there is questions in the board's mind about the adequacy of this modeling, this West Chicago site is

inappropriate for -- disposal.

So I would ask that the 10 be allowed.

JUDGE FRYE: Thank you. Mr. Meserve you indicated that, Mr. Rathe reminds me you indicated that Kerr-McGee was going to file a motion for summary disposition with regard to the -- and

MR. MESERVE: That's right. We did have a conversation about that. We will be filing a motion for summary disposition with regard to all of the remaining portions -- that are issued.

We had indicated that we would try to get that motion filed by this morning. In light of the problems -- weather difficulties at this time of year and collecting affidavits, we have not been able to do that.

It is out contention to file a motion for summary disposition fully supported by affidavits and the like by December 22nd, a week from tomorrow, Friday. Which is the same deadline, incidentally you had given the State to file their motion for reconsideration.

We would suggest that their response to that all be on the same schedule, January 5th. Our view that the motion for summary disposition will adequately resolve the remaining issues of this case --

JUDGE FRYE: Thank you.

MR. RATHE: Could I add one thing?

JUDGE FRYE: Sure.

MR. RATHE: On the schedule comment. We have not decided what we're doing it in terms of the board's suggestion on filing the motion for reconsideration --

JUDGE FRYE: Well, that's up to you. I mean --

MR. RATHE: I understand that, all I'm saying is that when the board, and you don't have to get into this at this second, but when the board proposes a schedule, a response to motion for summary disposition, -- have 10 days under the regs, because it's the Christmas holidays.

JUDGE FRYE: I want to get into all of scheduling matters when we get to the close of the hearing. We don't have any preconceived ideas about what the schedule ought to be at this point.

Are there any other motions that we've overlooked?

MR. MESERVE: Your Honor, may I just go on just briefly to something that Mr. Rathe said, it has to do with his contention on 10.

JUDGE FRYE: All right.

MR. MESERVE: He has indicated and he indicated forcefully that this is an important issue. The obvious question now, if it's so important how come it wasn't raised months ago. The board had asked, issued orders when the contention was filed, I believe it was by June 15th, April 15th I believe allowed amendments to the contentions by the State that were filed I believe in mid-June.

We've had months and months of dealing with this issue and if he believes it's so important, I wondered why he comes in at the end.

Ms. Hodgdon has made reference to the lack of specificity that's in this contention and we share that concern. There's a critical sentence here that I'd like to attract the board's attention to and this is in the proposed contention.

It says in order to accurately model the vertical movement of chemicals and/or radio washable constituents through the disposal cell, the party should have used a three-dimensional site --

So I think from Dr. Warner's testimony the State is probably trying deal with some issue about three-dimensional wall being necessary in the -- and not having to deal with the disposal cell, but the least -- contention is the -- what exactly are we talking about. We lack the understanding to be able to respond to this for that reason alone.

MR. RATHE: It is a -- that we are clearly talking about the aquifer --

JUDGE FRYE: You're talking about the aquifer?

MR. RATHE: Yes.

JUDGE FRYE: Okay.

MR. RATHE: I apologize to the board, to Mr. Meserve, Ms. Hodgdon if it is misleading.

JUDGE FRYE: Any other motions that we've overlooked.

MR. MESERVE: I believe not, your Honor.

JUDGE FRYE: Fine. Let's take our break at this point then and we will confer and then rule after the break and then we'll have the first witness panel as soon as we've done that.

So why don't we be back here in 15 minutes.

(Whereupon a 15 minute recess was held.)

JUDGE FRYE: With regard to the motion to strike Dr. Warner's testimony on Contention 3G2 and the motion for leave to submit Contention No. 10.

We think that perhaps the motion for leave to submit Contention No. 10 may reflect a little bit of a misperception of the state in which we are. If Illinois can show us that the models that have been done, as you point out Mr. -- are inadequate, then that should be the end of this. You don't need Contention No. 10.

If they are adequate, then I'm not sure Contention No. 10 would do you much good.

So we will deny the motion for leave to submit Contention No. 10. It's -- it's awfully late; it would -- clearly could have been advanced much earlier, and it would I think substantially delay the proceeding while everybody scurried around trying to address that particular issue.

Similarly, we will grant Kerr-McGee's motion to strike the testimony of Dr. Warner on 3G2. I think Dr. Warner himself recognizes that the con -- testimony goes well beyond

the issue which we had set down for -- for hearing.

And for that reason, we will grant that motion.

With regard to the motion in limine, we will deny that. But, if Illinois wishes to conduct some sampling, do some sampling and so some analyses and let us know at a time which we'll set at the end of the hearing, we will consider whether the record ought to be re-opened because of some evidence that there is a problem from cyanide.

The state of the record at this point appears to be that there is one number that indicates a -- a problem with cyanide, and all the other testing that has been done over the years indicates no problem. And as Judge Carpenter points out, we are not aware that cyanide was ever used in this process. So we suspect that that one number may not be a reliable number.

But, if Illinois wishes to do some more testing and let us know, we will listen to that in the future.

So. Mr. Meserve, are you ready to present your first panel, or your witness panel?

MR. MESERVE: Yes, Your Honor.

MR. RATHE: Judge, can we address the floor here in terms of just the procedure? It's not to go ahead.

Can you explain briefly, it's to be presented as a panel testimony? Is that what's going to happen? And --

JUDGE FRYE: That's correct.

MR. RATHE: -- where are the witnesses physically to

sit?

JUDGE FRYE: That table there.

MR. RATHE: Over there?

JUDGE FRYE: Um-hum.

MR. RATHE: Okay. The first thing I'd like to know is: Mr. Greenwalt represents the City of West Chicago.

JUDGE FRYE: Um-hum.

MR. RATHE: Does he have the right to participate during the cross examination?

MR. NICKLES: Your Honor, let me speak to that for a moment. I have high regard for Mr. Greenwalt, but I think when Mr. Greenwalt filed his request he said they did not intend to participate but to monitor the proceedings.

JUDGE FRYE: That was my recollection. What's your intention, Mr. Greenwalt? Do you want to --

MR. GREENWALT: I believe that is not a quite accurate statement of what our application says.

As if we would not advocate a position, which we have not; throughout the proceedings did not enter into the motions. Or that -- or anything of that nature.

However, I do think that it's reasonable that we nominally have the right to cross examination, to cross examine the witnesses.

JUDGE FRYE: Well, you have that in your capacity as a -- as an interested City. You traditionally --

MR. GREENWALT: That's all I --

JUDGE FRYE: -- have that right to do so. But, I think it would be helpful --

MR. GREENWALT: Uh-huh.

JUDGE FRYE: -- for all of us if we knew whether you intended to -- to cross examine or not.

You've got the testimony?

MR. GREENWALT: Yes.

JUDGE FRYE: So you know what they're going to --

MR. GREENWALT: I only expect my cross examination would be minimal.

JUDGE FRYE: I see.

MR. NICKLES: Your Honor, I have no objection to that, as long as the ground rule remains that, stated by the City, that they would take no position. I -- I think it would expedite the matter rather than to argue, to have Mr. Greenwalt to ask his questions.

I want him to be --

JUDGE FRYE: Sure.

MR. NICKLES: -- as bound as all of us to these matters.

MR. RATHE: The next thing, Your Honor. Is it appropriate to call you Your Honor? I'm used to that. Is that --

JUDGE FRYE: That's fine.

MR. RATHE: That's an appropriate designation.

We, being the State of Illinois, has -- have divided up the issues. So I'm going to question the panel as to some of the issues and Mr. Sisul as to the others. Is that --

JUDGE FRYE: That's --

MR. RATHE: -- any problem?

JUDGE FRYE: That's fine. So long as we are not duplicating, we don't have a problem with that.

MR. RATHE: We'll try not to.

The final issue is the order of witnesses. We would prefer Dr. Warner, at this point, to go second--

JUDGE FRYE: Traditionally, the way it would -- would occur would be that the Applicant, with the burden of proof, would go first. Then the Intervenor, in this case the State of Illinois, would follow. And the Staff would go last.

So it sounds like that's what you want to see.

MR. RATHE: The only other thing is: Can I -- am I in a position where I can ask the questions to individual members of the panel?

JUDGE FRYE: Surely. Um-hum.

MR. RATHE: Thank you.

JUDGE FRYE: Mr. Meserve?

MR. MESERVE: Your Honor, at this time I'd like to call Charles W. Fetter, Jr., James L. Grant, and John C. Stauter as witnesses to the --

JUDGE FRYE: Fine.

(Whereupon, the witnesses were duly sworn.)

JUDGE FRYE: Thank you. Please be seated.

MR. MESERVE: Gentlemen, could you briefly state your names for the record?

DR. GRANT: My name is James L. Grant; I'm a consulting engineer and hydrologist.

DR. FETTER: My names is Charles W. Fetter, Jr.; I'm a professor of hydrogeology and chairman of the Department of Geology at the University of Wisconsin at Oshkosh.

DR. STAUTER: I'm John C. Stauter, Director, Environmental Affairs for Kerr-McGee Corporation.

MR. MESERVE: Do you have before you a document entitled "Testimony of Charles W. Fetter, Jr., James L. Grant and John C. Stauter in response to the Board's order of November 14, 1989 and November 20, 1989"?

DR. FETTER: Yes, we do.

MR. MESERVE: Did you prepare that document?

DR. FETTER: Yes, we did.

MR. MESERVE: Do you have any corrections to that testimony?

DR. FETTER: Yes. There are five corrections, which I will go through.

On Page 15, at the bottom we would like to delete Footnote 9. This footnote is redundant of material that appears

in a table. And is, in fact, out of place.

On Page 18, the last line of the text which says, "Table 2," should read Table 6.

On Page 26, the fifth line from the bottom, the first word, which is conductivity, should read transmissivity.

On Page 33, the sixth line from the bottom, where it begins a quote. It currently says, "a small percentage of the water". The word "very" should be inserted between a and small, so that it reads, "a very small percentage of the water".

On Page 40, the thirteenth line from the bottom. There is a blank after the word Appendix. It should be Appendix 5.

MR. MESERVE: Are those all the corrections, Dr. Fetter?

DR. FETTER: Yes, they are.

MR. MESERVE: With those corrections, does the testimony that you submitted on November 28th, 1989 accurately reflect your views?

DR. FETTER: Yes.

MR. MESERVE: Do you adopt it as your testimony in this proceeding?

DR. FETTER: Yes.

DR. GRANT: Yes.

MR. MESERVE: Your Honor, we move to admit the previously filed document that I described as the testimony of

Doctors Fetter, Grant and Stauter into the proceeding.

MR. RATHE: We have no objection, Your Honor.

JUDGE FRYE: Fine. So -- so ordered.

MR. MESERVE: Dr. Fetter, could you -- in very brief terms, could you briefly summarize that testimony?

DR. FETTER: Yes.

In your two orders, you have indicated that you wish us to explore apparent differences in the models used and the results obtained in the engineering report prepared by Kerr-McGee, and the supplemental final environmental statement prepared by the NRC Staff. As groundwater modelling provides the basis for our conclusions about the impacts of the waste disposal cell on groundwater resources, we being our testimony with detailed descriptions of the Kerr-McGee model and the NRC model.

We used two different models: One to calculate the amount of infiltration through the cell cover; and one to simulate the effects of leachate generation on the most vulnerable aquifer, the E-strata.

The groundwater transport model which we used was developed by the U.S. Geological Survey and has been widely adopted by hydrogeologists. It is a sophisticated numerical model which was calibrated against site-specific hydrogeologic conditions.

In developing our source terms for leachate, we used a

standard test, the EP toxicity test. Actual waste was mixed with water to extract compounds, and the resulting solution was then chemically analyzed.

The results of the Kerr-McGee analysis show that under our best estimate of infiltration and leachate concentration, water quality in the E-stratum, at the property boundary, will be well below -- State of Illinois standards.

The NRC Staff employed an analytical model, which used average hydrogeologic parameters from the site. It appears that this model was selected largely so that comparisons could be made between the West Chicago site and alternative sites. The leachate quality used in the NRC model is based on a theoretical consideration of leaching. The infiltration rate used by the NRC Staff was conservative, in that it was about ten times greater than the best estimate value predicted by the Kerr-McGee infiltration model. The conclusions reached on the basis of the NRC Staff study were basically the same as those of Kerr-McGee. That is, the Illinois Water Quality Standard will be met in the E-stratum after the waste disposal cell is built.

Your November 14th order raised six questions about Contention 4(a). The first issue deals with the difference between the infiltration value used by Kerr-McGee and that used by the NRC Staff. We believe that our value of one-tenth of an inch per year is a best estimate of infiltration. It is based on a model simulation of an intact cover, but one that has

increased permeability due to weathering of the upper soil layer.

The second issue has two parts: One dealing with uncertainties in hydrogeologic properties, and the second with potential impacts of climatic change. The uncertainty in hydrogeologic parameters is limited for two reasons: First, there was extensive field testing of the hydrogeologic properties at the site; and secondly, the Kerr-McGee model was calibrated against site-specific conditions.

We have made a detailed analysis of the impact of climatic variation on infiltration through the cell cover. There are three means by which precipitation falling on the cell is diverted: One, run-off down the slope; two, evapotranspiration; and three, internal lateral drainage through a granular drainage layer. Because of the cell design, the rate of infiltration is insensitive to the amount of annual precipitation. Based on a 100 year climatic record, the annual infiltration ranges from three-hundredths to fourteen-hundredths of an inch and averages about one-tenth of an inch, which was the value we used in our model.

The third issue raised by the November 14th order addresses a perceived difference between the SFES and the engineering report in the description of changes in the fluoride concentration. The fluoride concentrations in most, but not all, individual wells are showing a statistically significant

decrease with time. These changes were masked when the results of all the wells were averaged together, since two other wells had no change and one well was actually increasing.

The Board has asked if the rate of change in solute concentration with time can be used to help characterize the groundwater flow. We do not believe that it is appropriate to utilize an inverse approach here. That is, to determine basic properties from water quality changes with time. The reason for this is because we don't have sufficient knowledge about the strength in leaching rate of the source term.

The Board noted an apparent discrepancy between the Staff's estimate that 38 percent of recharge water enters the silurian dolomite aquifer and the engineering reports' description of this as quote, "a very small percentage," unquote. However, elsewhere in the engineering report the dolomite recharge rate is given as 1.33 inches per year, which is 36 percent of the estimated annual recharge to the glacial aquifer.

The sixth area that you asked us to address is the potential that additional pumpage of groundwater would affect the groundwater flow in the glacial aquifer. There is very limited usage in this area of groundwater from the glacial aquifer itself, and all known wells are too far from the site to have any impact. Pumpage from the silurian dolomite has affected the potentiometric surface of that aquifer beneath the

site. In fact, the water levels in that aquifer are -- are already so low that any additional lowering of the potentiometric surface will not induce any additional downward leakage from the glacial aquifer.

With respect to Contention 3(g)(2), Kerr-McGee has demonstrated that the modification for vertical flow in the unsaturated zone, which was appended to the AT123D model, can be derived from first principles. Since this is an analytical model, further benchmarking is thus not necessary.

In the Board's November 20th order, you have asked us why leachate values used by NRC Staff were in general from ten to one hundred times greater than those used by Kerr-McGee. The NRC model was based on a theoretical approach which used literature values; Kerr-McGee used values derived from actual tests of the waste itself.

The final issue is the possibility of cyanide being present in the leachate. The NRC cyanide value is based on a single positive sample from one of many samples which were tested for cyanide. This value is an anomaly. Groundwater tests by both the State and Kerr-McGee have shown that cyanide is basically not present. If it were present in the waste, it would obviously show up in the groundwater. Hence, it isn't present in the waste and will not be present in the leachate.

MR. RATHE: Your Honor?

DR. FETTER: In summary, although Kerr-McGee and the

NRC Staff used different types of models which employed different assumptions --

JUDGE FRYE: You wish to make a motion?

MR. RATHE: I'm sorry, Your Honor. We do have a -- a standing objection to anything about cyanide. At least any results.

JUDGE FRYE: Sure.

DR. FETTER: In summary --

JUDGE FRYE: Continue.

DR. FETTER: -- although Kerr-McGee and the NRC Staff used different types of models which employed different assumptions, we both reached the same conclusion. The proposed tailings disposal cell can be built at West Chicago with no likelihood of groundwater contamination. Thank you.

MR. MESERVE: Dr. Stauter, was groundwater sampling conducted at the West Chicago site after the Board's order of November 20?

DR. STAUTER: Yes, it was.

MR. MESERVE: And why was that done?

DR. STAUTER: That sampling was done in response to Judge Frye's comments in his November 20th order, noting the potential discrepancies in cyanide data, recognizing the SFES.

We took this opportunity to do some sampling to see if we could resolve this question regarding both the negative results that the State had had and then Kerr-McGee's results

that -- that essentially had a high level of detection number. And it was our purpose to do that sampling to resolve the cyanide issue.

MR. MESERVE: Who actually conducted the sampling?

DR. STAUTER: We had Weston Engineers of Faniford, Illinois do the sampling.

MR. MESERVE: Can you describe Weston Engineers for us?

DR. STAUTER: Weston Engineers is a consulting -- worldwide consulting group, that has done -- with expertise in engineering and sampling. They've done work for us before, and we requested their expert services.

MR. MESERVE: Who actually went out to the site and collected the sampling?

DR. STAUTER: Weston personnel went out to the site, collected the samples, maintained chain of custody and sent the samples to their laboratories for analysis.

MR. MESERVE: What protocols were used by Weston --

MR. RATHE: Your Honor?

MR. MESERVE: -- in conducting that work?

DR. STAUTER: We required Weston --

MR. RATHE: Your Honor.

JUDGE FRYE: One moment.

MR. RATHE: Are you going to allow this testimony at this point?

JUDGE FRYE: Yes. We denied the motion in limine.

MR. RATHE: All right.

DR. STAUTER: We requested Weston to do the work in accordance with the EPA sampling and testing protocols in SW 846.

MR. MESERVE: Did that include EPA protocols having to do with the extraction of samples from the wells?

DR. STAUTER: Yes, it did.

MR. MESERVE: And did that include EPA protocols having to do with the actual chemical analyses?

DR. STAUTER: Yes, it did.

MR. MESERVE: And to your knowledge, were those protocols actually followed?

DR. STAUTER: Yes, they were.

MR. MESERVE: Dr. Fetter, do groundwater hydrologists customarily rely on chemical analyses of groundwater performed by independent laboratories in assessing concentrations of constituents in groundwater?

DR. FETTER: Yes, we do.

MR. MESERVE: Your Honor, I'm going to hand the witnesses a document which has been previously marked by the reporter as Exhibit No. 1. This is a document which the State has had before and I have additional copies for the Board.

JUDGE FRYE: Thank you.

MR. MESERVE: And for the reporter.

MR. RATHE: Your Honor, for the record I'm going to object to the introduction of this.

JUDGE FRYE: Sure.

You have, as you say, a continuing objection.

MR. RATHE: Yes, we will not make it every time that it has arisen. But it's a continuing objection to anything relating to --

MR. MESERVE: Your Honor, the record should reflect that I have handed the panel the document which is marked as Exhibit No. 1.

Have you -- without getting into the contents, have you examined Exhibit No. 1?

DR. STAUTER: Yes, I have.

MR. MESERVE: Can you tell me what that exhibit is?

DR. STAUTER: The exhibit is Weston's record of the analyses done on the groundwater samples that they ran for cyanide.

MR. MESERVE: Without referring to the exhibit, do you happen to know what wells were sampled at the site?

DR. STAUTER: Approximately -- seventeen wells across the disposal site, the B wells were sampled.

MR. MESERVE: It's the wells that are designated B?

DR. STAUTER: Yes, with a B --

MR. MESERVE: With a number by --

DR. STAUTER: It's the shallow wells, yes.

MR. MESERVE: Your Honor, I'd like to move Exhibit No. 1 into evidence.

MR. RATHE: Again, we object.

JUDGE FRYE: Yes.

We will accept it, subject to the continuing objection.

(Whereupon, said document was received into evidence as Exhibit No. 1.)

MR. MESERVE: Can you briefly describe the results that were obtained by Weston in the course of its sampling and analysis of the B wells in the -- site?

DR. STAUTER: All of the analyses are reported as non-detectable on the analysis sheets. Each one -- each well is identified; it has a result; and there's a lowercase U that represents in a data qualifier, that lowercase U says, "indicates an inorganic compound was analyzed for but not detected". So you have the results, the lowercase U, units, milligrams per liter, and then the reporting limit.

MR. MESERVE: And is Page 5 of the exhibit the page that describes the data qualifier you just mentioned?

DR. STAUTER: That's right; Page 5.

MR. MESERVE: Dr. Fetter, what conclusions, if any, can you draw -- draw with regard to the presence of cyanide in the waste from the Weston results, as to cyanide in the groundwater?

DR. FETTER: Well, if the cyanide were indeed present in significant quantities in the waste, one would expect that the site, because there is leaching taking place through at least some of the materials, that there would be cyanide in the groundwater. And with no cyanide present in the groundwater, the conclusion we draw is that there's no cyanide present in the waste.

MR. MESERVE: Dr. Stauter, why didn't Kerr-McGee direct the waste be sampled directly, rather than the groundwater?

DR. STAUTER: Well, in addition to the reason that Dr. Fetter gave, we had a very short time. And in -- and in sampling the -- the waste that we have there, we would be running a statistical-type analysis to determine how many samples we would need to get a representative and meaningful result for all of the waste. Therefore, we did not pursue the waste -- sampling of the solid waste.

MR. MESERVE: It would have been a much more major effort --

DR. STAUTER: Yes, it would.

MR. MESERVE: -- to --. So in the limited time available, you did the most direct measurement you could make, which was to sample water, groundwater?

DR. STAUTER: Yes.

MR. MESERVE: Your Honor, I have no further questions of the panel.

JUDGE FRYE: Mr. Rathe?

(Pause.)

MR. RATHE: May I proceed, Judges?

JUDGE FRYE: Please.

MR. RATHE: My first question is directed to Dr. Grant.

Dr. Grant, is the West Chicago site a good site for the disposal of radioactive waste?

DR. GRANT: I believe it's a good site for the disposal of the materials that are -- that we're talking about in this

hearing, yes.

MR. RATHE: Well, there is radioactive waste in that hearing -- in that site, is that correct?

DR. GRANT: There are -- there is a type of radioactive material on the site, yes.

MR. RATHE: And -- but I -- we're not going to argue over words right now. It's radioactive; is that correct?

DR. GRANT: That's correct.

MR. RATHE: Dr. Grant, can you explain to this Board why West Chicago is a good site for the disposal of radioactive waste?

MR. NICKLES: Your Honor, I'd like to have some indication from the Board whether we're going to stick to the issues that have been set down for this hearing or will there be some focus on the testimony that was geared to the issues of whatever -- I think we're opening up. This case can go on a long time.

As the result of the motion for summary disposition, quite a number of issues have been resolved.

I don't think this is an appropriate question to testimony.

I think the questioning ought to be more specifically directed to the issues that the Board has set down after consideration of the motion.

MR. RATHE: Your Honor, may --

JUDGE FRYE: Yes, yes.

MR. RATHE: -- may I respond before the Judges rule?

JUDGE FRYE; Yes.

MR. RATHE: It is clear that in your November 14th letter, a concern of this Board was the suitability of this site. And I believe there has to be a certain amount of latitude that the Board is going to give in cross examination.

For one, cross examination, by its definition, implies a certain amount of latitude. And while I can understand there may come a point where I'm so far afield to what the Board's concerns are, that Mr. Nickles' objections might be well sustained.

But in terms of the ultimate issue that this Board has to decide, is this the right place to dispose the waste that are going to be there from 200 years, at a minimum, that's pursuant to design, to possibly a max, a thousand years, in terms of maximum length of time, with the understanding that thorium has a 14 billion year half-life. So we're not really -- we're not even talking about a thousand years. This is going to be there in perpetuity.

So I would ask a certain amount of latitude.

JUDGE FRYE: Well, I think the --

MR. NICKLES: Your Honor, I think the --

JUDGE FRYE: Mr. Nickles, one moment.

I think we need -- we're willing to let you have a

certain amount of latitude, but we are also very anxious for you to stick to the issues which we have identified. Now, I --if you -- if you pursue this for a short period and we're not getting any -- we're not getting to those issues, then I think we're going to have to cut it off.

MR. RATHE: That's fine. I represented before that I would be asking just a few general questions before I then proceed to what I believe are the Board's concerns.

JUDGE FRYE: As they testified.

MR. NICKLES: The concerns I have, Your Honor, I don't think cross -- will limit cross examination.

The Board has resolved a number of issues --

JUDGE FRYE: I know.

MR. NICKLES: -- that are encompassed by this general question: Is this a suitable site?

I don't think it appropriate, after the Board has spent all this time resolving those issues, to have a general question which encompasses those very issues that have been resolved. I think there has to be some -- while there is latitude, there has to be some focus on the issues.

JUDGE FRYE: There -- there certainly does, but we'll give him a few more than just two questions before we cut it off.

MR. RATHE: I don't want to embarrass the court reporter; I assume -- are you taking this down, or just tape

recording it? Can you read my last question back, please, to the doctor?

Dr. Grant, let me -- let me start off again by saying: Can you explain to the Board why the West Chicago site, which sits in the middle of a -- of an urbanized city, is a good place to dispose of radioactive waste?

MR. NICKLES: I object to the question, Your Honor. It's a speech in a question.

I think the question has to be read in terms of the issues set down by the Board.

I have no objection to the witness talking about the suitability of the site in the standpoint of the issues set down for hearing in this case.

There are so many issues going to suitability. I strongly object to the question being phrased under the general terms.

I object, and I'd like the Court to instruct the Counsel not to be making speeches; it's inappropriate. The purpose of examination is to elicit facts, not to make speeches.

JUDGE FRYE: Mr. Rathe, your original question was: Was this a good site for radioactive waste? And your second question was why.

MR. RATHE: Fine.

JUDGE FRYE: Now, let's address those questions in the context of your testimony and these issues which we have asked

you to address.

DR. GRANT: Thank you, sir.

First of all, let me clarify that I said that this is a good site for the waste that are on the site, that are on the -- on the facility and are being contemplated to be -- to be disposed there. All waste -- all materials are radioactive. Radioactive waste encompasses a very wide category of materials. And my -- my statement that this is a proper site is limited, if for no other reason that I haven't examined the suitability of this site for the disposal of all kinds of waste, but rather to the waste that we're talking about.

And the reason that I make this statement, the basis for my making this statement, are the studies and the analyses that have been conducted and are reported in the engineering report, and indicate that this waste can be sequestered at this site without any significant risk to the environment, or to the public health and safety.

MR. RATHE: Dr. Grant, is this site, the West Chicago site, a suitable waste for chemical waste, chemically hazardous waste as well?

MR. NICKLES: Same objection, Your Honor. I think the question has to be read by the witness in light of the issues presented by the Court, in light of the testimony.

JUDGE FRYE: Obviously, we don't expect the witness to testify outside the issues to which he was called to testify in

his direct.

I think, when you ask this question you have to assume that their answer must come in the context of their direct testimony.

MR. RATHE: That's fine; no problems.

MR. NICKLES: I also object to the question because at no point has there been an allegation that there is hazardous waste at this site. There's a premise of the question that is un -- unsupported by the record.

(Pause.)

JUDGE FRYE: Mr. Nickles, we understand, I think, your objection in terms of -- that there are not -- you're essentially saying that there are not concentrations which reach hazardous level.

MR. NICKLES: Yes, Your Honor.

JUDGE FRYE: Okay.

I think we'll permit the question.

DR. GRANT: Can you repeat the question?

JUDGE FRYE: The question essentially is: Is this a suitable site to store hazardous waste, chemically hazardous waste?

DR. GRANT: We conducted an evaluation, we -- of a sampling program and an analyses of the waste that are on-site. And as a result of that examination determined that the waste on this site do not meet the RCRA requirements for -- RCRA

definition of a hazardous waste.

JUDGE FRYE: So we all know what you're talking about, would you define RCRA for us?

DR. GRANT: RCRA is -- is the acronym for resour -- I believe, Resource Conservation and Recovery Act. And it is the EPA program that regulates a portion of hazardous waste in -- in the -- in this country.

We evaluated the site for the waste that we proposed to dispose on it and, again I state that in my opinion, the site is suitable for disposal of those wastes.

MR. NICKLES: Your Honor, could I just make sure the witness is understanding the focus of your ruling? He's not a lawyer, and I think what the Judge is --

MR. RATHE: Judge, I object to Mr. Nickles instructing the witness.

JUDGE FRYE: Yes. I think -- Mr. Nickles, let's -- let's --

MR. NICKLES: Your Honor, the answer --

JUDGE FRYE: Do you want to approach the bench?

MR. NICKLES: I object, because I think this is going -

-

MR. RATHE: Judge, if this --

JUDGE FRYE: Let him approach the bench.

MR. RATHE: -- I'd ask the witness to step out of the room.

JUDGE FRYE: Let's approach -- let's have him --

MR. RATHE: You can't instruct the witnesses on the record, Mr. Nickles.

JUDGE FRYE: Mr. Rathe, we're going to have a bench conference. Now.

(Whereupon, a bench conference was held outside of the hearing of the witnesses.)

JUDGE FRYE: As a result of the bench conference, we wanted to make clear to -- to you all on the witness panel that when you get these general questions, you are to answer them in the context of your direct testimony. We're not trying to get back to the very beginning of this proceeding.

We want to deal with the issues that we have set down for hearing.

So your questions -- your answers should be directed or phrased in terms of the direct testimony which you have filed in this proceeding.

DR. GRANT: Thank you.

MR. RATHE: Your Honor, there's one other issue that I'd like to address briefly --

JUDGE FRYE: All right.

(Pause.)

JUDGE FRYE: Gentlemen, I'm going to so overburden you with instructions you won't know what's going on, I'm afraid.

But as a result of our latest conference, Mr. Rathe is

going to address his questions to one of the three of you. Okay? And that particular individual should respond.

If one of the other two, after hearing that response, wants to comment, then comment. We would prefer it if you did not confer with each other, but rather proceeded in that way. All right?

MR. RATHE: Thank you, Judge.

I believe the last question pending before the objection was: Is this site a suitable site for disposal of chemically hazardous waste?

DR. GRANT: Sir, I don't understand how that relates to our direct testimony.

MR. RATHE: Did that answer get formulated as you and Dr. Fetter and Dr. Stauter conferred?

DR. GRANT: We -- we discussed and speculated what I had done wrong with my previous answer.

MR. RATHE: So you did something wrong with your previous answer.

(Laughter.)

JUDGE FRYE: We have your previous answer and your present answer. All right.

MR. RATHE: So you're kind of standing on the Fifth now?

(Laughter.)

DR. GRANT: Sir, I'm trying to -- to respond to your

questions as I -- as best I can given the instructions that I have.

JUDGE FRYE: Surely.

DR. GRANT: I'm not trying to --

MR. RATHE: I understand, and I'm not -- not trying to be flippant either; I guess I am a little bit.

But Dr. Grant, clearly we spent a lot of time together in your depositions and if -- you made it clear, as Dr. Fetter and Dr. Stauter, that this was a joint project, you all contributed in terms of one might have done a first draft, but eventually all had some input on every aspect of that. Is that a fair statement?

DR. GRANT: That's a fair statement.

MR. RATHE: Okay.

So this whole testimony is your product, as well as Dr. Fetter's and Dr. Stauter's; is that correct?

DR. GRANT: It's a joint product, yes, sir.

MR. RATHE: So the question again is: Do you believe that the West Chicago site is an appropriate site for the disposal of chemically hazardous waste?

DR. GRANT: We have evaluated the site for the waste that we intended and proposed to dispose of. Chemical and hazardous waste again is a very broad category, and I -- I would not like to comment on that as a -- as a general statement.

MR. RATHE: Dr. Fetter, do you feel any more

comfortable commenting on that?

DR. FETTER: We did not evaluate the site for the disposal of chemical or hazardous waste; we evaluated the site for disposal of the waste which is there.

MR. RATHE: Is there chemical waste there? If we don't get into the semantics of whether it's hazardous or not, is there chemical waste there?

DR. FETTER: Well, again --

MR. NICKLES: I'm going to object, Your Honor. The same -- same objection.

DR. FETTER: Well, I would -- I would point out --

JUDGE FRYE: One moment, one moment.

I thought it was well-established that there is chemical waste there. Am I in error?

MR. NICKLES: The objection goes to the fact that it has no bearing on the issues that the Board has set down.

JUDGE FRYE: Okay, okay.

MR. NICKLES: I think we're getting back into something that we had the very first time.

JUDGE FRYE: Well, you've got -- you wanted to do one or two questions, general questions.

MR. RATHE: Beyond what we're doing right this second. I want to get -- get the answer to the chemical waste. I have two questions. I'm going to move on to the issues that the Board has identified.

JUDGE FRYE: Okay. All right. On that basis, let's go ahead with it.

DR. FETTER: In the sense that everything is a chemical, there's chemical waste there. But you are a chemical, sir, and --as I am. And so, in the sense that it's waste material because it is no longer a usable product and it's made of chemical, it's a chemical waste.

But the term chemical waste is a very specific definition by the Environmental Protection Agency, and it does not meet those -- we've tested the waste; it does not meet those definitions.

MR. RATHE: Okay.

Let me rephrase it so perhaps we could get to the bottom of this question and can go on to my last two questions in this general area.

Let's not call it chemical waste; let's call it non-radioactive waste. Would that give you a better sense of what I'm talking about?

DR. FETTER: Well, again, an old brick is a non-radioactive waste and I'm -- they're are old -- I believe some of those buildings were brick buildings; there are going to be old bricks there.

MR. RATHE: The question is really: Is this a good site, are you telling the Board this is a good site for the disposal of those wastes at West Chicago that are non-

radioactive in nature?

DR. FETTER: For the -- yes. For the waste that are there that are non-radioactive.

MR. RATHE: Okay. Two more questions and then I will get on as I promised.

Dr. Grant, if those wastes were not presently at West Chicago, based on your expertise, would you have recommended that those wastes be moved to West Chicago?

MR. NICKLES: Objection, your Honor. That has nothing to do with --

JUDGE FRYE: Yes. Sustained.

MR. NICKLES: Thank you.

MR. RATHE: Dr. Fetter, is -- and I'm going to try to get to the issues now that the Board has identified.

Dr. Fetter, is the cover the single most important factor in limiting infiltration into the disposal cell?

DR. FETTER: Yes.

MR. RATHE: So the -- the -- and when you say the cover, it's more than just the topsoil; is that correct?

DR. FETTER: It is a engineered cover with a number of layers of natural earth materials in it.

MR. RATHE: And among those layers are clay; is that correct? Those are some of the layers in the cover?

DR. FETTER: Some of the layers would contain clay, yes.

MR. RATHE: In fact, there are three clay layers; is that correct?

DR. FETTER: There are three low-permeability layers. And --

MR. RATHE: Are those -- are those clay layers?

DR. FETTER: A major portion of them would be clay. They would not be pure clay.

MR. RATHE: If you're going to limit the infiltration of that disposal cell, or through the disposal cell, it's necessary that that cover re -- maintain its integrity; is that correct?

DR. FETTER: Yes, that is correct.

MR. RATHE: And if the cover starts having problems with its integrity, will that affect the rate of infiltration?

DR. FETTER: Could you be more specific as to what kind of problems that you are referring to?

MR. RATHE: Well, if there are breaks in the cover, for whatever reason, will that affect the rate of infiltration?

DR. FETTER: It depends what part of the cover is affected as to what the impact might be.

MR. RATHE: Well, does the model that you developed -- not that you developed, but you employed in this case anticipate or expect that the cover maintain its integrity?

DR. FETTER: As a matter of fact, in the model we used, we did several analyses. One of them was the cover as designed,

and another analyses was the cover with the topsoil being somewhat more permeable due to weathering processes. So that we did, in fact, look at the behavior of the cover under conditions which were not as ideal as the original design.

MR. RATHE: Well, you've already told the Board that the cover really is a multi-layered design; is that correct?

DR. FETTER: That is correct.

MR. RATHE: And in fact, the only thing you really are now referring to is the topsoil, in terms of taking that into consideration in terms of weather.

DR. FETTER: Well, the first layer of the cover goes deeper than the topsoil.

MR. RATHE: But you only took into account the topsoil; is that correct?

DR. FETTER: The first layer of the cover, which includes the topsoil.

MR. RATHE: What else does it include?

Again, Your Honor, this is what I don't want to have happen. Is that, as a witness is asked -- being asked a question, another witness now provides some help.

JUDGE FRYE: Mr. Grant, do you have a comment?

DR. GRANT: Yes, sir.

In -- in the drawing that we included in our -- in our -- in our diagram of the disposal cell cover, Figure 1, we identified the entire root zone, the two-foot root zone, as a

two-foot topsoil zone. And I thought that Dr. Fetter was answering that question, describing a normal, thinner topsoil zone and considering the rest of the two-foot zone as a -- as a root zone.

I was -- I was trying to help him clarify.

JUDGE FRYE: All right, fine. But, just, let -- the point: Tell us all.

DR. GRANT: Okay. I'm sorry.

DR. FETTER: I stand corrected in terms of terminology and the testimony that root zone and the topsoil zone are all described as two-footed topsoil. And that was the layer that was --

MR. RATHE: Well, how many total layers are there to this cover?

DR. FETTER: There are five layers.

MR. RATHE: So you only took into account affects upon that top layer; is that correct?

DR. FETTER: That is correct.

MR. RATHE: What factors would affect the integrity of the cover, Dr. Fetter?

DR. FETTER: Maintaining the permeability and compaction of the various layers. The most critical layer is the two-foot clay cap, which occurs below the one-foot sand and gravel capillary break.

MR. RATHE: And how many layers down is that? Again,

we don't have this dia -- or we don't -- I don't particularly -- if you could describe, as best you can, how many layers are there between the topsoil and this two-foot clay barrier you just described?

DR. FETTER: The cell cover design includes two feet of topsoil at the very top followed by a two-foot thick intrusion barrier which is a graded layer of clay to cobbles, followed by a geotextile which is put there for construction purposes but is not considered in the overall long-term integrity of the cap. And I'm not considering that as one of the layers.

Followed by a one-foot low-permeability soil, then another geotextile, then a one-foot sand and gravel capillary break or drainage layer, followed by a geotextile, and then a two-foot clay cap.

MR. RATHE: Okay. So what is the most important barrier? You just said the two-foot barrier; where does that come? Somewhere in the middle?

DR. FETTER: The bottom two-foot clay cap.

MR. RATHE: At the bottom?

DR. FETTER: At the bottom of the cap, yes.

MR. RATHE: And that's the most important layer?

DR. FETTER: That is correct.

MR. RATHE: In fact, that layer is less permeable -- I mean, is more permeable than the top of the -- of the cover; isn't that true?

DR. FETTER: No, that's not true.

MR. RATHE: The very bottom layer isn't the most permeable of the layers and compared to the -- oh, strike that question.

Is that bottom clay layer more permeable than the other clay layers?

DR. FETTER: No.

MR. RATHE: It's not designed to do that?

DR. FETTER: No.

MR. RATHE: Wasn't the very design of this disposal cell to allow leachate in fact to move through it?

DR. FETTER: That is correct.

MR. RATHE: And wasn't in deciding that disposal wasn't the bottom clay caps, this is the very bottom of the cover?

DR. FETTER: Okay.

MR. RATHE: Wasn't that designed specifically to be more permeable so it would allow that movement of the leachate to avoid the bathtub effect, isn't that true?

DR. FETTER: No, I think you're confused, sir.

MR. RATHE: I'll get back to that later, doctor.

Dr. Fetter, did the HELP model take into account --

DR. FETTER: The HELP model assumed that the permeability of the clays were as given in figure 1.

MR. RATHE: That's not my question. The question to you, Dr. Fetter, is did the HELP model specifically take into

account the possibility of cracks in that clay layer in determining the infiltration rate?

DR. FETTER: If the cracks in the clay layer were such that the permeabilities still adhere to the values given in the table, then it took it into account.

MR. RATHE: I'm asking you again, doctor, could you answer the question. Did the HELP model specifically take into account cracks in the clay layer as a possible consequence and, therefore, would effect the infiltration rate?

DR. FETTER: Well, I'm trying to answer you that the clay layer was assumed to have a certain permeability which may or may not have any cracks in it. If the cracks, if there were to be cracks which would affect the permeability, then the behavior of the cover would be different than that which was predicted by the model.

MR. RATHE: If the Board could bear with me for one second.

Okay. Dr. Fetter, do you remember testifying in deposition the 5th day of December of 1989?

DR. FETTER: Yes.

MR. RATHE: And do you remember being asked, a Court Reporter being present?

DR. FETTER: Yes.

MR. RATHE: Do you remember, I'm referring to page 217 now of December 5 -- do you remember being asked this question

and giving this answer: "If there were cracks in C1 which we had identified at that point as being one of the clay layers, is there anything in your document you are presenting to the Board that would suggest that has been taken into account?" "Answer; I don't believe so, no."

Do you remember being asked that question and giving that answer?

DR. FETTER: I don't specifically remember that, no.

MR. RATHE: If there are cracks in the clay layer, Dr. Fetter, would that affect the integrity of the cell?

DR. FETTER: Only if the cracks were to increase the hydraulic conductivity of the clay.

MR. RATHE: Cracks, and I'm using this in layman's terms, you may have a different version -- you might have a different understanding of what I'm asking. Layman's version, a crack is something that's a break in the clay layer, something that was unanticipated, something that may be caused by freezing, may be caused by wetting and drying, that's what I mean by a crack.

Do you and I understand each other now?

DR. FETTER: I understand that, yes.

MR. RATHE: Now, if there were cracks in these clay layers, would that increase the rate of infiltration through the disposal cell?

DR. FETTER: Only if the crack were to act in such a

way that it would increase the hydraulic conductivity. A crack can be closed or open.

MR. RATHE: Okay. So, there is a possibility a crack could increase the rate of infiltration through that disposal cell?

DR. FETTER: If there were a crack, there's a possibility it could increase the rate of infiltration through the disposal cell, yes.

MR. RATHE: Do cracks occur in clay?

DR. FETTER: Cracks can occur in clay.

MR. RATHE: And do cracks occur because of freezing and thawing?

DR. FETTER: Cracks can occur because of freezing and thawing.

MR. RATHE: Do they occur because of wetting and drying?

DR. FETTER: The cycle of wetting and drying usually is to open up a crack when it drys and close it again when it wets.

MR. RATHE: But there is -- but during the cycle there is an opening, you just said that, is that correct?

DR. FETTER: That is correct.

MR. RATHE: Okay. Let me ask the question I asked earlier. Did the HELP model take into account the fact that cracks might occur in the clay layer?

DR. FETTER: Well, the clay layer we're referring to is

specificaily designed to prevent cracks from occurring, so it wasn't necessary to take that into account in the HELP model.

MR. RATHE: That's a theoretical design, I might add, is that correct?

DR. FETTER: Well, it's a design, I don't know what a theoretical design is. It hasn't been built yet.

MR. RATHE: Well, is this thing operating out there now?

DR. FETTER: No.

MR. RATHE: So this is what you hope will happen?

DR. FETTER: That is correct.

MR. RATHE: Dr. Grant, what is subsidence?

MR. NICKLES: Your Honor, this is completely outside of the scope of this hearing. We've had Dr. Thiers raise issues as to subsidence --

MR. RATHE: That's not correct.

MR. NICKLES: -- that is doesn't --

MR. RATHER: Subsidence and erosion aren't the same thing.

MR. NICKLES: That's quite correct. Dr. Thiers did deal with erosion but he also dealt with subsidence and earthquake problems and a large number of hypothetical events all of which we dealt with in motions for summary disposition in this case and has been resolved.

MR. RATHE: There's been nothing that's been presented

to the Board about subsidence.

JUDGE FRYE: Okay. Overruled.

MR. RATHE: Dr. Grant, what is subsidence?

DR. GRANT: I understand subsidence to mean a loss of ground or a loss of elevation of a soil material caused by consolidation of the underlying materials.

MR. RATHE: And does that happen to landfills?

DR. GRANT: It can.

MR. RATHE: And what happens to ground when there is subsidence?

DR. GRANT: It goes to a lower elevation.

MR. RATHE: Does it cause cracks?

DR. GRANT: It can.

MR. RATHE: And if there are cracks because of subsidence, will more water or snow melt or rain fall or snow melt infiltrate through the disposal covers?

DR. GRANT: If the cracks are sufficient to cause that, that certainly could result.

MR. RATHE: When you did the HELP model, Dr. Grant, did you factor in that landfill normally has some subsidence to it?

DR. GRANT: I wasn't designing a generic landfill when I did the -- or wasn't evaluating the performance of a cover on a generic landfill. So I don't think that was relevant to what I was doing.

MR. RATHE: The question is simple, doctor. Did you

when you ran the HELP model, include as a factor that landfill had to subside?

DR. GRANT: No.

MR. RATHE: Dr. Grant, has an actual physical model, I mean a working model of this thing been constructed? This thing, I'm sorry I'm using that term. The cover, is there something in existence that we know this thing works?

DR. GRANT: Pardon me a moment. At our deposition, you asked me a question was there a model and I understood that model to be describing something smaller than a real installation. And I answered that there was a model, but that model was demonstrative only, it had no working parts.

MR. RATHE: Right, it was just to show --

DR. GRANT: -- it was to illustrate the relationship of the various components of the disposal cell. That model was built.

MR. RATHE: But that's not the question. Is there a working model that shows you what happens in reality when a disposal, when your disposal cover is out in the fields?

DR. GRANT: There is a site very similar or a disposal cell very similar to this that has been constructed.

MR. RATHE: What would that be?

DR. GRANT: That would be the disposal cell at Cannonsburg, I believe Cannonsburg, Pennsylvania.

MR. RATHE: Okay. And did you build that?

DR. GRANT: I did not. That was built, I think, under the auspices of the Department of Energy.

MR. RATHE: The question to you, Dr. Grant, is, this is your design, is that right?

DR. GRANT: That's correct.

MR. RATHE: Did you make a scale model, a working model of this thing so you could demonstrate to this Board that the cover actually works as performed?

DR. GRANT: I think I've already answered that, I did not construct such a model.

JUDGE FRYE: You did not?

DR. GRANT: I did not.

MR. RATHE: Dr. Grant, is it your experience that landfills, when they're in actual operation versus a design or theoretical model, do they work as precisely as predicted by computer models?

DR. GRANT: Not as precisely as predicted as a rule, although the predicted capabilities that are available are suitable for assessing the probable performance of a landfill.

MR. RATHE: Dr. Grant, I had something --

JUDGE FRYE: One moment, Dr. Fetter.

DR. FETTER: The term landfill that you're using brings to mind, at least to me, the typical kind of municipal garbage landfill where you're putting a lot of waste and it tends to decompose over time and where, in fact, there might be

considerable subsidence. We need to keep in mind here that what we're burying are old bricks and dirt which are not going to decompose over time and which have physical properties which can be tested and which -- they're basically geotechnical materials that -- geotechnical engineers know the properties of and can design a cell which is much more stable than a typical landfill would be.

MR. RATHE: The question is, and I'll ask you, Dr. Fetter, is it your experience that in fact, and I'm using landfills generically here, but we'll use the word disposal cell, is it your experience that these disposal cells as modeled by computer, in fact, work out precisely in actual operation? Or are there differences between predictions and reality?

DR. FETTER: Obviously, there's going to be differences between predictions and reality in this kind of construction process and that's one of the reasons why the idea here is to allow for some settlement to take place over time and, in fact, it's built into the design that the final cover won't be completely finished until some years after the waste is put in place. To allow for that settlement.

MR. RATHE: How long does Kerr-McGee or Webber, at least from the private point of view, is actually going to be responsible for this monitoring what happens?

DR. FETTER: I don't know the answer to that, perhaps Mr. Stauter does.

MR. RATHE: Do you know, Dr. Stauter?

DR. STAUTER: The term of monitoring would be done on Kerr-McGee's part to be something that is negotiated through the NRC and will be part of licensing conditions.

MR. RATHE: Is it my understanding though that you're talking, that your preference would be ten years?

DR. STAUTER: I believe that's our starting point, yes.

MR. RATHE: Does that mean you would work down from ten years? That would be the most you'd want to monitor, you'd like to monitor less if possible?

DR. STAUTER: I believe that ten years would provide the term necessary to demonstrate the engineering itself.

MR. RATHE: Dr. Stauter, you are aware that this has a design minimum life of 200 years?

DR. STAUTER: That's correct.

MR. RATHE: And to the extent practical, the idea is that this disposal cover actually works as designed for up to 1,000 years?

DR. STAUTER: Yes, sir.

MR. RATHE: So what happens if there are problems between year 11 and year 1,000?

DR. STAUTER: I believe your question is addressed as to what would happen -- determining subsidence or those effects. --those would be identified during the first ten years as we've indicated --

MR. RATHE: Well, while the question subsidence falls within that concept, there are other problems that can happen to the landfills. What happens if between year 11 and year 1,000 there are other problems? Who's supposed to take care of those?

MR. NICKLES: Your Honor, I would object. This is way beyond --

JUDGE FRYE: Sustained.

MR. NICKLES: Thank you.

MR. RATHE: Dr. Grant, are you aware of any disposal cell that's been in existence for as long as 50 years?

DR. GRANT: I'm not aware of any disposal cell such as the one that we're, an engineered cell such as the one that we're talking about.

MR. RATHE: Is there any one that's been in existence for 25 years?

DR. GRANT: Not of the kind that I'm aware of, of the kind that we're talking about here.

MR. RATHE: How about 10 years?

DR. GRANT: I don't recall one.

MR. RATHE: Would it be accurate to say, Dr. Grant, that it's your testimony that the best you could say to the Board is that you simply hope the disposal cell works as designed?

DR. GRANT: No, that's not accurate.

MR. RATHE: Would you have any empirical data that you

could provide to this Board, anywhere, that suggests a reason this Board should have confidence based on other operating landfills, other operating disposal covers that would suggest, in fact, these things do work?

MR. NICKLES: I'm going to object, Your Honor. We've been through the landfill issue, now we're talking once again generically, philosophically about hoping that will work. We have specific issues that we ought to get to.

JUDGE FRYE: We'll permit it in the context of the issue of cell infiltration, which I think is where you were going.

DR. GRANT: Would you repeat that question, please?

MR RATHE: Is it your testimony to the Board, -- I mean, what I had asked you, you have said no, -- I had asked you, would you simply hope it would work, you said no. The follow up question was, can you provide any empirical evidence, proved evidence, that this Board can say, yeah, there's a series of disposal cover cells that are out in the United States or anywhere in the world for that matter, that have worked for a significant period of time and, therefore, we should have reliability and confidence that what you've designed is going to do the job?

MR. NICKLES: Object for the same reason it's a moot question, there are numerable questions in that question, beyond the scope of the issues.

MR. RATHE: Your Honor, the question is, will this cover limit infiltration? That's the issue before the Board. I'm trying to get at that.

JUDGE FRYE: We'll permit it in the context are you aware of other cells out there which have demonstrated that this cover design will limit infiltration as you predicted it will.

DR. GRANT: As I understand the question, it is framed to deal specifically with cells exactly or essentially exactly the same as we're talking about. And as I testified earlier, to my knowledge, there's only one, at least there's only one such disposal cell that I'm familiar with and that's one that was constructed at Cannonsburg. As far as I know, that cell is functioning properly as of now.

MR. RATHE: And how old is that cell?

DR. GRANT: That cell is a few years old, I can't tell you exactly.

MR. RATHE: More than one?

DR. GRANT: More than one.

MR. RATHE: Less than five?

DR. GRANT: Possible more than five, approximately five, maybe not more than five.

MR. RATHE: You think it goes back to '84 that Cannonsburg was --

DR. GRANT: '84, '85 or '86 or something in that range.

MR. RATHE: Dr. Fetter, is it accurate to say that

besides the cover that the movement of waste through the cell depends upon solubility of materials that are in the waste cell?

DR. FETTER: Well, the solubility of materials in the waste cell is one of the factors which goes into the strength of the leachate which is being created.

MR. RATHE: So the more soluble, the more soluble the material, what happens?

DR. FETTER: The greater the leachate which strength it forms.

MR. RATHE: And the less soluble?

DR. FETTER: Less soluble materials have lower leachate strength.

MR. RATHE: And when you came to the conclusions as to what would go through the clay barriers at the bottom of the disposal cell, did you conclude that the materials there were more soluble or less soluble?

DR. FETTER: Sir, which materials are we speaking of now?

MR. RATHE: Well, the materials that are going to be forming the leachate that will move through the clay barrier.

DR. FETTER: We did not, in fact, take into account solubility of, in terms of moving through a particular layer. We took into account solubility in terms of determining the strength of the leachate that would form.

MR. RATHE: Well, Dr. Grant, do you remember testifying

in your deposition that the solubility of the materials through the waste cell was an important consideration in determining what goes through the clay barrier?

DR. GRANT: I don't dispute testifying to that.

MR. RATHE: Okay. Can you tell me then what's the significance of that?

DR. GRANT: I don't understand that question.

MR. RATHE: Did you take into account -- let me rephrase it.

Did you take into account in the design of the cell the solubility of the materials as it moves through the clay barrier?

DR. GRANT: No, sir, we assumed that anything that became soluble within the cell would move through the clay barrier unimpeded.

MR. RATHE: Okay. Even though that was a factor, you did not take that into account?

DR. GRANT: We thought that was a conservative position to take in that our assumption would cause us to calculate larger concentrations than if we took it into account.

MR. RATHE: Okay. Dr. Grant, is it accurate to state that the movement of the waste through the disposal cell depends upon the interaction that may occur between the bottom and the top, the bottom of the disposal cell and the top of the E-stratum? Is that a fair statement?

DR. GRANT: I suspect it could.

MR. RATHE: Well, is that an accurate statement?

DR. GRANT: I don't think so, I mean, it's a very broad statement, and I don't understand exactly what it means.

MR. RATHE: Excuse me Board, Judges, just one second.

I'm referring to the deposition with a date of December 6th, page 109. Give counsels a chance to find the page, toward the top of the page. In fact, I'm going to start on the last question on page 108.

Okay. Dr. Grant, do you remember being asked this question and giving this answer: "What other factors besides the cover will determine, and that's all I ask." And the answer was, "it depends upon the solubility of the materials that are in the waste cell, it depends on the interactions that may occur between the bottom of the cell and the top of the E-stratum, the top of the -- you were being asked that question and giving that answer.

DR. GRANT: I don't specifically remember that, no, sir.

MR. RATHE: Can I refer the Board and everybody else who has a copy to table, I guess it's tab one, it's the case study table, I guess it's table four under tab one.

JUDGE FRYE: In what document?

MR. RATHE: I'm sorry, the testimony that was submitted by Kerr-McGee to the Board.

JUDGE FRYE: Table four?

MR. RATHE: Yeah, it's under T-1, under the tab 1, it's the fourth table.

JUDGE FRYE: That's certainly legitimate.

MR. RATHE: Do you have that, Dr. Fetter, in front of you?

DR. FETTER: Yes, I do.

MR. RATHE: Dr. Fetter, it is accurate to state that, and I'm referring to the top of the table, not any of the cases, is it accurate to state that the leachate concentration for many of the metals, and I'm sure all these are metals, I maybe wrong about that, but I'm describing these materials on top as all metals, if they're something else I apologize. But just for the purpose so you know what I'm talking about. Is it accurate to state that you believe, is it accurate to state that the leachate concentration from many of the metals that are reported are in excess of the IEPA general use standards at the moment they leave the clay barrier, under the disposal cell?

DR. FETTER: Well, that's not what is described in this table.

MR. RATHE: Well, let me ask you, if we could refer to the table and is the first one on the left-hand column, is that silver?

DR. FETTER: That is correct.

MR. RATHE: If I look on the one, two, three, four,

line that is entitled "Percent of IEPA Standard," am I incorrect in reading that silver is 1,600 percent to the IEPA standard? Is that wrong there? Am I misreading that? Misunderstanding that?

DR. FETTER: Okay. That line is for the maximum of leachate concentration in any one point in the, in any one point in the waste material. We actually used the composite maximum number which was based on the mixing of the waste throughout the cell.

MR. RATHE: I know, but at the moment, as that stuff sits in the cell, -- I apologize that I use phrases that probably sound kind of silly -- but as the material is about to leave the cell, is it accurate to state that whether you use the composite maximum or the maximum that invariably they are above the IEPA general use standard?

DR. FETTER: The value of the leachate in the cell for some of the materials such as silver is in excess of the Illinois EPA general use standards, yes.

MR. RATHE: And without doing this to tedium, if I went from, is the next one barium, or what is the next one?

DR. FETTER: Ba is barium, yes.

MR. RATHE: Okay. Is barium -- okay, barium is below that, is that --

DR. FETTER: That's correct.

MR. RATHE: Okay. If I went to, again, if I moved over

to 8-G, is that mercury?

DR. FETTER: That is mercury.

MR. RATHE: And is that 263 percent to the IEPA standard?

DR. FETTER: Yes.

MR. RATHE: Is Pb lead?

DR. FETTER: Yes.

MR. RATHE: Is that 205 percent to the IEPA general use standard?

DR. FETTER: That is correct.

MR. RATHE: Is Cu copper?

DR. FETTER: Yes.

MR. RATHE: And that's 145 percent to the IEPA general use standard?

DR. FETTER: That is correct.

MR. RATHE: And the next one is iron?

DR. FETTER: Yes.

MR. RATHE: 155 percent of the general use standard?

DR. FETTER: Yes.

MR. RATHE: Dr. Fetter, is it accurate to state that it is your submission to this Board that the, that you are in compliance, when I say you, of course, I'm meaning Kerr-McGee, that you are in compliance with the IEPA general use standards because of the fact that dilution occurs in the E-stratum?

DR. FETTER: Yes. The model that we used relied solely

upon dilution, which is of course, not the real case scenario because there will be absorption of many of these materials on both the lower clay liner and in the unsaturated zone and then in the aquifer itself. So that we used a very conservative approach by relying only upon dilution.

MR. RATHE: Is it true then that but for this dilution that the leachate leaving the disposal cell would be, at least to the metals that I have described, above the IEPA general use standards?

DR. FETTER: Yes.

MR. RATHE: Is it accurate to state that you are relying upon dilution of the water bearing E-stratum or sand in order to dilute the leachate that is coming through the clay barrier at the bottom of the disposal cell?

DR. FETTER: That is correct.

MR. RATHE: I would ask you to explain then to this Board how you are not polluting the waters of the State of Illinois by disposing of leachate that you, yourself, admit is above the IEPA general use standards?

MR. MESERVE: Your Honor, I believe that that's calling these witnesses to respond to some sort of a legal question, this is --

JUDGE FRYE: It does seem to ask for a legal conclusion to me. Go on to the next one.

MR. RATHE: Your Honor, that's basically the questions

that I have as to infiltration through the cell. I'd like to move on to the hydrology question.

JUDGE FRYE: Fine. Let's take a five minute break since we're at a point.

(Whereupon, a five minute break in the proceedings was taken.)

JUDGE FRYE: Shall we go back on the record.

MR. RATHE: Judge, I had indicated to you, or Judges I had indicated to you I was done with the infiltration. I just have a follow up question I'd like to ask. May I proceed?

JUDGE FRYE: Yes.

MR. RATHE: Dr. Fetter, when that leachate literally leaves the disposal cell and is now in the top one inch of the E-stratum, what is its concentration at that point?

DR. FETTER: Well, the rate -- first of all, we didn't compute the concentration of the leachate to the top one inch of the aquifer. But you have to bear in mind that the volume of water moving through the top one inch of the aquifer is significantly greater than the rate at which the infiltration is going to put leachate into that top one inch. So that there will be some dilution taking place.

MR. RATHE: Does your model make an assumption that when that leachate crosses the barrier into the E-stratum, there's immediate mixing?

MR. MESERVE: Your Honor, I'd like to object to this

whole line of questioning. We're getting into, obviously getting into the area of three dimensional modeling which the Board has already ruled that that contention is in this proceeding and that the testimony that Dr. Warner had offered on this issue is not to be held -- this doesn't have anything to do with their testimony. This has to do with three dimensional modeling issue which isn't part of this hearing.

MR. RATHE: Judge, this is critical in terms of what modeling -- we may not be able to bring a contention there, but I can certainly ask them questions about the modeling --

JUDGE FRYE: You did and his answer was that he, the model didn't predict what happened in the top one inch.

MR. RATHE: But I assume I'm going to have some latitude to ask questions about modeling at this point.

JUDGE FRYE: What was your question again?

MR. RATHE: My question was whether or not their model made an assumption that there was immediate mixing of the leachate as it entered the E-stratum.

JUDGE FRYE: All right. We'll permit that.

DR. FETTER: The model makes the assumption that the leachate will mix with the water in the E-stratum at the point where the model is predicting concentration.

MR. RATHE: Does your model assume immediate dilution of the leachate as soon as it enters the E-stratum?

DR. FETTER: Well, the practical effect of that would

be immediate dilution, yes. The model is actually predicting leachate concentrations at a certain point. So the mixing would take place before it gets to that point.

MR. RATHE: Did your model predict leachate concentrations immediately just below the disposal cell?

MR. FETTER: I'll direct that to Dr. Grant --

JUDGE FRYE: Do you know?

MR. RATHE: I don't mind Dr. Grant also answering that question, but I do object to Dr. Fetter directing that to Dr. Grant, and I'd like Dr. Fetter to answer it. If Dr. Grant has something to say, Your Honor, I have no problem with that.

JUDGE FRYE: Sure. Do you know, Dr. Fetter?

DR. FETTER: What was the question again then?

MR. RATHE: Did your model predict what happens to the leachate concentration immediately below the disposal cell?

MR. FETTER: I don't believe we ran the model to make that prediction.

MR. RATHE: Can you tell us why not?

MR. FETTER: Well, I -- my understanding would be that our requirement is to achieve a certain water quality at the edge of the site and, therefore, that's where the model was analyzed. Now, perhaps Dr. Grant would have some illumination on that.

MR. NICKLES: Your Honor, I think that counsel should be instructed that if you ask a question -- impossible the way

MR. RATHE: I apologize, Your Honor, I just try not to create a -- to be able to consult with my --

JUDGE FRYE: Let's get this answer and then continue.

MR. RATHE: I apologize to Mr. Nickles for being discourteous, I apologize to Drs. Grant, Fetter and Stauter for my discourtesy.

DR. GRANT: To attempt to clarify this a little bit. The model that we used is two dimensional, it does not calculate at any point any vertical differences in concentration within the stratum that we modeled. It calculates, in fact, a vertical average concentration. We did calculate concentrations over the entire modeled area, simply because that's the way the model works. We did not consider those important and we didn't examine those results closely, nor did we report them because as Dr. Fetter said, we were interested in our impacts at the site boundary.

MR. RATHE: May I have a minute to confer with my expert?

JUDGE FRYE: Yes.

(Pause.)

MR. RATHE: Dr. Grant, your model then predicts immediate dilution of the leachate as it crosses the barrier, is that correct?

DR. GRANT: It incorporates the assumption of the immediate mixing vertically as it enters the aquifer.

MR. RATHE: And how does that affect your modeling as the leachate moves through the E-stratum to the end of the site?

DR. GRANT: It is an assumption that is incorporated into our modeling, I'm not sure I understand your question in terms of how does it effect our modeling.

MR. RATHE: Well, if you're modeling assumes immediate dilution the moment the leachate hits the E-stratum, is there further dilution as the leachate travels through the E-stratum?

DR. GRANT: Let me state again, the model assumes immediate mixing, vertical mixing, of the leachate and the water flowing in the aquifer at the point that the leachate enters the aquifer. It then routes or transports that leachate and the other leachate coming from other parts of the cell, that is directed with the groundwater and dispersed as a result of hydrodynamic dispersion and mixed with, perhaps with other parts of the, water from other parts of the aquifer. The assumption of vertical mixing in this particular instance is not a bad assumption because the stratum that we were modeling is so thin.

MR. RATHE: When you say it was so thin, do you recall that the E-stratum at one point is 43 feet thick? Is that very thin, Dr. Fetter, Dr. Grant?

DR. GRANT: That's -- again, that's a qualitative statement. Let me say that the thickness of the E-stratum where we modeled it was not 43 feet thick.

MR. RATHE: Is it true that the E-stratum is, in fact,

43 feet thick at some point?

DR. GRANT: We measure thicknesses like that away from the disposal site, yes.

MR. RATHE: And, in fact, the E-stratum has variable thicknesses, is that correct?

DR. GRANT: That's correct.

MR. RATHE: Some points it might be as little as five feet, would you consider that thin?

DR. GRANT: Yes.

MR. RATHE: Would you consider 43 feet thin?

DR. GRANT: Perhaps not in this context, no.

MR. RATHE: Okay. Dr. Fetter, you had indicated earlier that it would be several years before the final cover was to be installed. Do you know years is anticipated?

DR. FETTER: No, that's in the engineering reports somewhere.

MR. RATHE: Does Dr. Stauter have an answer to that?

DR. STAUTER: I don't recall the time frame for the construction.

MR. RATHE: And has the fact that the cover's going to take several years, are we talking more than one year, five years, ten years, what are we talking about? Dr. Fetter?

DR. FETTER: I simply don't recall the exact time.

MR. RATHE: Doctor, I'm sorry, I don't mean to jump over your words, I apologize. Dr. Grant?

DR. GRANT: I don't recall the time frame for that. It is set forth in one of the volumes of the engineering report.

MR. RATHE: And the fact that the final cover won't be there, has that been calculated into your models of infiltration, Dr. Grant?

DR. GRANT: The modeling that we did of infiltration was modeling after the cover was constructed. The moisture conditions that we assumed to exist in the cell at the time we modeled the infiltration were at, I believe, field capacity which presumes that there has been -- either that the waste is placed with a substantial moisture content or that the moisture content of the fill has been brought up by infiltration during construction. So the long answer to that is, yes, it was considered.

DR. FETTER: May I add something?

MR. RATHE: Yes, sir.

DR. FETTER: There are also leachate collection pipes which are going to be put beneath the waste for purposes of collecting the leachate which will form in the early years of construction, and also for purposes of collecting leachate which will form as the cell consolidates. So that if the implication was there that there would be a period of time where there might be excess leachate forming because there wasn't a cover there, that's been accounted for in the engineering design of the

leachate collection system.

MR. RATHE: Okay. But this model, in order to work right, has to have a final cover to limit the infiltration to 0.1 inches per year according to Kerr-McGee's analysis?

DR. FETTER: Is that question directed to me?

MR. RATHE: Yes, sir.

DR. FETTER: Well, our analysis with 0.1 inches per year, 0.1 inches per year of infiltration, were well below the general use standards. The values of, which were used which were higher for infiltration, for example we used five inches and there with our composite maximum, we still were meeting the Illinois General Use Standards. So it's not designed -- the success of the cell cover is not predicated upon achieving the infiltration rate of one-tenth of an inch per year.

MR. RATHE: But in order to assure the Board that this is going to work right, and one of the reasons why you're suggesting to the Board that it should license, or approve the license amendment, is because you're submitting that in fact it will be one-tenth of an inch of infiltration, is that correct?

DR. FETTER: That's our best estimate, yes.

MR. RATHE: The leachate collection system pipes then become very important during the first few years of the operation of this disposal cell?

DR. FETTER: That is correct.

MR. RATHE: And can you point to the Board any other

place in the United States where a leachate collection system in fact has successfully worked under similar conditions and would give the Board confidence that this leachate collection system in fact will limit infiltration?

MR. FETTER: Well, there are about --

MR. MESERVE: Your Honor, Your Honor, I would like to object to this question. The leachate issue was an issue that was -- contention, it's been resolved by the Board. The purpose of this hearing had to do with groundwater modeling. It didn't raise the whole -- of construction issues and construction time and the whole series of these other issues that the State would like to inquire about but which simply are not part of this proceeding.

MR. RATHE: Excuse me, if I could respond first.

JUDGE FRYE: Surely.

MR. RATHE: I didn't bring this up, Dr. Fetter did. I'm just responding to the point he's made. I wasn't the one who raised this issue. I think I should be allowed to cross if a witness brings up the topic. Otherwise then it stands on the record that I haven't said anything about it.

MR. NICKLES: Let me add something, Your Honor.

MR. RATHE: I would object to this back and forth here. Can't one of these guys do this?

JUDGE FRYE: No. Mr. Rathe, --

MR. NICKLES: The point is, Your Honor, we're trying

not to object to most of these questions, we really have not dealt much with the issues the Board set down for hearing. The fact that in response to an inappropriate question, which we have let pass rather than take the Board's time and object to it, -- said something that clearly was resolved by summary disposition --

JUDGE FRYE: But by the same token I think when the witness brings up something like that, he's entitled to follow up on it, at least briefly. And I think that's what he's doing. So your question is sustained, or the objection is overruled.

MR. RATHE: Dr. Fetter, you started to say there were how many systems in the United States?

DR. FETTER: Well, I don't know, but --

MR. RATHE: That are similar to this West Chicago disposal site -- you were about to say 50 of them exist out there?

DR. FETTER: Well, I would say there are several dozen sites in Wisconsin which are municipal landfills which have leachate collection systems which are designed in a very similar manner to the way this leachate collection system is going to be designed. They're working everyday in collecting leachate. This is a standard engineering practice, there's nothing esoteric here.

MR. RATHE: But one of you, and I don't remember if it was Dr. Grant or yourself, suggested that, and perhaps it was

you, Dr. Fetter, suggested that this is not a municipal wastefill and when I made comparisons to that or illusion to that, I'm misleading the Board in some way. Now, you're coming back and suggesting that, in fact, a municipal landfill leachate collection system is very analogous, isn't that correct?

DR. FETTER: Well, may I respond to that?

MR. RATHE: Yes, sir.

DR. FETTER: You're alluding to a landfill in terms of sites, and I submit that this is not similar to a landfill in terms of some sites. But it is similar in terms of leachate collection, where it simply, well if you want to look at it another way, it's an underdrain system that they could put beneath a stadium to, you know, have a dry playing field. These are not extraordinary heroic engineering measures here to collect a little leachate that forms at the base of a pile of sand.

MR. RATHE: But this little leachate is enough that you need a system of pipes to collect them?

DR. FETTER: Yes.

MR. RATHE: Dr. Fetter, let me go on to the hydraulic concerns the Board has raised.

Is this site geologically homogenous?

DR. FETTER: It depends on the scale you're looking at.

MR. RATHE: Well, could you explain that to the Board, please?

DR. FETTER: Well, for example, everywhere in this site is covered with glacial deposits, to that extent it's homogenous. Everywhere the site is underlying by the Silurian dolomite, so it's to that extent homogenous. If you look at it on a smaller scale, the glacial aquifer has different layers in it, which makes it heterogenous, and within the layers there are different characteristics from one spot to another which would add to the heterogeneity.

MR. RATHE: Okay. If I said that to you, that no site is homogeneous, would that be an accurate statement?

DR. FETTER: Well, depending on the scale, that is true.

MR. RATHE: Is the site hydrologically homogeneous?

DR. FETTER: No, it would not be.

MR. RATHE: Can you explain why the site is not hydrologically homogeneous?

DR. FETTER: Because there are several different acquifers a person can find a layer present and they vary in terms of their thickness and in terms of hydraulic conductivity from place to place.

MR. RATHE: And when a site is not -- and so would you characterize that as a site that's hydrologically heterogenous?

DR. FETTER: Yes.

MR. RATHE: Did the NRC staff make an assumption for purposes of modeling that the site was homogeneous?

DR. FETTER: They made an assumption for purposes of modeling that the E-stratum was homogeneous.

MR. RATHE: Did you ever testify in a deposition?

UNIDENTIFIED SPEAKER: I'm referring to a deposition date of December 6, 1989.

MR. RATHE: Did you ever testify in a deposition where I asked you certain questions and you gave certain answers?

DR. FETTER: I remember the day, yes.

MR. RATHE: And do you remember this question -- I'm sorry, did you say Page 43, I'm sorry, --

Question: When the NRC did its modeling, did it make assumptions the site was more homogeneous than the Kerr-McGee model?

Answer: The type of model that the NRC used requires assumptions to be made and one of the assumptions they made was that the site was homogeneous, yes.

Was that question asked to you and did you give that answer?

DR. FETTER: Yes, the question was asked and I gave that answer.

MR. RATHE: So in fact the NRC made an assumption for the purposes of modeling that the site was homogeneous?

DR. FETTER: Yes, in the specific part of the site they assumed was homogeneous was the E-stratum.

MR. RATHE: Let me ask you -- when I asked you that --

when you gave that answer, did you qualify your answer by suggesting that in fact they were only referring to the E-stratum?

DR. FETTER: I'm sorry. You are --

Which --

I believe he is just arguing with the witness. The witness is answering --

JUDGE FRYE: Let's just read the answer into the record.

MR. RATHE: Fine. The answer has been read.

JUDGE FRYE: All right.

MR. RATHE: Dr. Grant, do you need more data to model a stratum that is more variable than one that is more homogeneous?

DR. GRANT: Yes.

MR. RATHE: Why?

DR. GRANT: Because it requires more data to describe a less homogeneous site.

MR. RATHE: Why is that?

DR. GRANT: Because the site is less homogeneous. The property --

MR. RATHE: Why do you need more data? What is it -- what is the more data do for you?

DR. GRANT: The more data describes the randomness or the changes of the less homogeneous site.

MR. RATHE: So if a site is heterogenous, you need more

data to more accurately model, is that correct?

DR. GRANT: You need more data to model a heterogenous site to the same degree of accuracy as you would model a more homogeneous site.

MR. RATHE: And there are certain sites that are so uncorrelatable. If I could use that word that you can't model them, is that correct?

DR. GRANT: That's essentially correct, yes.

MR. RATHE: Is the set -- I'll direct these questions to Dr. Grant.

If Dr. Fetter or Dr. Stauter wish to answer before I go on to the next question, just say so.

MR. RATHE: Dr. Grant, is the saturated thickness variable at the West Chicago site?

DR. GRANT: I presume you're asking about the saturated thickness of the E-stratum?

MR. RATHE: I'm sorry, yes, the saturated thickness of the E-stratum.

DR. GRANT: The answer to that question is yes it is, it varies. Okay.

MR. RATHE: And does that affect modeling in any way?

DR. GRANT: It needs to be taken into account to do an accurate model of the site.

MR. RATHE: When you say taken into account, what do you have to do because of the variability of the saturated

thickness in terms of modeling of the E-stratum that you wouldn't have to do if the E-stratum was homogeneous?

DR. GRANT: You take into account the variability of the saturated thickness. Either by varying the parameters with that saturated thickness the fact the hydraulic parameters of that saturated thickness affects over the area that you're modeling, or you chose a value of the parameter that you're interested in that represents all of the variation.

MR. RATHE: It's fair to say that when you have to use more data and data point you have to end up extrapolating between points, is that correct?

DR. GRANT: Interpolating between points.

MR. RATHE: Interpolating between points.

And interpolating involves judgment, is that correct?

DR. GRANT: That's correct.

MR. RATHE: So the more a site -- the more that the saturated thickness is variable in the E-stratum, the more interpolating you have to do as the model.

DR. GRANT: The more interpolation you have to do and the more interpretation you have to do.

MR. RATHE: What is the difference between the two words?

DR. GRANT: Interpretation is a -- well, interpolation is a mathematical calculation that estimates the value between two known points or between more than two known points.

Interpretation is -- as I was using it is a more subjective judgment of perhaps the same thing, determining how to interpolate, determining how to apply the mathematical formula.

MR. RATHE: So if I were to put it that the interpolation's the quantitative view and the interpretation is the qualitative view, is that accurate?

DR. GRANT: I don't know. I wouldn't say it that way.

MR. RATHE: Well, you're -- does interpretation take more judgment than interpolation?

DR. GRANT: Yes.

MR. RATHE: Did you in fact model -- well, let me ask you -- there are other stratum in the E-stratum, is that correct? In this site?

DR. GRANT: Yes, there are other glacial stratum.

MR. RATHE: In fact, we've identified -- you've identified D, C, B and A, is that correct?

DR. GRANT: Yes, sir.

MR. RATHE: And then the Silurian dolomite's under that?

DR. GRANT: The dolomite underlies the A-stratum.

MR. RATHE: Are any of the other stratum saturated?

DR. GRANT: Yes.

MR. RATHE: Which?

DR. GRANT: The -- all of the stratum beneath the E-

stratum are saturated.

MR. RATHE: Did you model the D-stratum for saturated thickness?

DR. GRANT: No, sir.

MR. RATHE: Did you model the C-stratum for saturated thickness?

DR. GRANT: No, sir.

MR. RATHE: Did you model the B-stratum for saturated thickness?

DR. GRANT: Let me, let me --

MR. RATHE: Sir, the question is yes or no.

DR. GRANT: No, it's not yes or no. Let me explain to you what we did and let me make sure that I'm answering your question.

MR. RATHE: Sir, I will be happy to -- I will -- your counsel will --

JUDGE FRYE: Dr. Grant --

DR. GRANT: Yes, sir.

JUDGE FRYE: -- if you'd answer the question and then -- whatever explanation --

DR. GRANT: Okay. I'm sorry.

We --

MR. RATHE: No sir, the question still remains; you could provide your explanation in a second.

Did you model the B-stratum --

JUDGE FRYE: That's what the Judge has ruled.

MR. NICKLES: I thought it was understood that he could accompany his answer with an explanation.

JUDGE FRYE: That's right, yes or no and then explain it.

DR. GRANT: We did not do a computer model of any stratum except the E-stratum. We evaluated data of -- regarding the thickness of all the stratum at the site and to the extent that that evaluation is modeling, my answer -- my previous answer when I said we did not is not correct.

MR. RATHE: Did you computer model any of the other stratum?

DR. GRANT: No, nothing other than the E-stratum.

MR. RATHE: Is the hydraulic conductivity variable at the West Chicago -- well, maybe it's clear to the Board, but I'd like to make it clear for the record.

What exactly is saturated thickness in terms that I could understand, I'm not a scientist.

DR. GRANT: As we're talking about it, I believe we were talking about the saturated thickness of the E-stratum and that is the portion, the thickness of that portion of the E-stratum that is saturated with water. And it is measured from the bottom of the E-stratum to the -- either to the top of the E-stratum if the entire stratum is saturated or to the top of the zone of saturation if the E-stratum is only partially

saturated.

MR. RATHE: Is the hydraulic conductivity variable at the West Chicago site?

DR. GRANT: Yes.

MR. RATHE: Can you explain for my purpose so I understand what hydraulic conductivity is?

DR. GRANT: Hydraulic conductivity is a measure of the ability of a sand, in this case, to transmit water.

MR. RATHE: Is the -- does the fact -- did you perform modeling of hydraulic conductivity in the E-stratum?

DR. GRANT: No. We evaluated hydraulic conductivity data, but we did not perform a computer model of -- our computer models are flow models, not hydraulic conductivity models.

MR. RATHE: Well, how does hydraulic conductivity come into play then in terms of modeling terms?

DR. GRANT: It is an input parameter. A parameter input to the model.

MR. RATHE: So the fact that it is variable, what is -- what significance does that have in terms of modeling?

DR. GRANT: The way we model the site, because the hydraulic conductivity was variable, we use different values for the hydraulic conductivity at each point in the model area.

MR. RATHE: Did you use the input parameters of hydraulic conductivity in any of the other stratum?

DR. GRANT: We didn't model any other stratum.

MR. RATHE: Is the hydraulic gradient variable at the West Chicago site?

DR. GRANT: Yes it is.

MR. RATHE: And does this affect modeling in any way?

DR. GRANT: The hydraulic gradient again is another parameter or another condition that is taken into account in the modeling that we did at the site.

MR. RATHE: Excuse me, Judge. If I could have just one second.

Does the change -- does the variability of hydraulic conductivity make modeling more difficult?

DR. GRANT: Yes, I think it does.

MR. RATHE: Can you tell the Board why?

DR. GRANT: Because you have to take into account that variability. If it's not variable it's a single number. And it's I think easier to deal with a single number than it is with a hundred numbers or a hundred and fifty numbers.

MR. RATHE: Does that make the modeling then less reliable?

DR. GRANT: Not necessarily. It could. It makes it more difficult to be certain that you accurately characterize the modeling but it may or may not be more accurate.

MR. RATHE: Is -- can you tell us what is dispersivity?

DR. GRANT: Dispersivity is a measure of the mixing characteristics of an -- acquifer for material.

MR. RATHE: And how was that a factor in modeling?

DR. GRANT: It is a parameter that is an input to a transport model, a dilution model.

MR. RATHE: And is that quantity difficult to measure?

DR. GRANT: It is difficult to measure in a field situation, yes.

MR. RATHE: And why is that?

DR. GRANT: Because of the -- really because of the property that is -- because of the property that is measuring it, it measures the mixing of a material as it goes from one point to the other and that mixing is a factor -- is a function of other hydraulic properties and also the distance between the points that you're measuring.

MR. RATHE: So of the parameters or hydrology factors that I've mentioned, certainly hydraulic gradient and hydraulic and dispersivity are difficult to measure, is that difficult to measure?

DR. GRANT: Hydraulic gradient and dispersivity?

MR. RATHE: Yes.

DR. GRANT: Hydraulic gradient actually serves one of the more easier hydraulic conductivity.

MR. RATHE: I'm sorry. I meant hydraulic conductivity.

Is that true that of the factors that I've mentioned, hydraulic conductivity and dispersivity which are inputs into

the modeling are difficult to measure?

DR. GRANT: They are more difficult than the other parameters that we have been speaking about, yes.

MR. RATHE: Can you give the Board an estimate how reliable your modeling is; I mean, is it 95 percent reliable?

DR. GRANT: We have no such estimates in terms of exact percentages.

MR. RATHE: You can't tell the Board today that trust my model, it has a 99 percent factor reliability?

DR. GRANT: No, I can't express it in that way.

DR. FETTER: May I add something?

MR. RATHE: Yes sir.

DR. FETTER: The reliability of a model can be determined by comparing model results of the hydraulic head with the measured results of hydraulic head and that's how you determine the accuracy of the model. And what Dr. Grant was, he made the comparison, looked at it and said that this looks like a good match. He could have taken the differences in various points between computed head and observed head and actually found a percent difference. It just was something that wasn't done.

MR. RATHE: Okay then, but why then can't in light of what you're just telling me, why can't Dr. Grant tell the Board that this has a 99 percent, 99 and six factors after that reliability? If you tell me that we can now come up with a

reliability scale here.

DR. FETTER: Well, the reliability to that extent is reliability of the flow model. I think he probably has it in terms of reliability of the transport model because of the fact that we didn't have something to calibrate that against, the transport model. I think about that because that was calibrated against the existing distribution of contaminants in the groundwater.

MR. RATHE: Is the transport model important to the Board's concerns here?

DR. FETTER: Yes.

MR. RATHE: Why is that?

DR. FETTER: Well, because the transport model is what was used to determine the concentrations of various constituents at the site boundary.

MR. RATHE: So you're telling me it's the transport model the Board has to be concerned with, but you can't give the Board a percentage of confidence that model really works.

DR. FETTER: I'm not sure that we can't. I just don't think that -- we probably didn't.

DR. GRANT: I know of no way of making those kinds of estimates with any degree of certainty.

MR. RATHE: Thank you for your candor, Dr. Grant.

Dr. Fetter, is the E-stratum missing at the B-9 bore hole?

DR. GRANT: Yes.

MR. RATHE: And does that make the E-stratum a variable or irregular in some way?

DR. GRANT: Well, it makes it not present in the B-9 bore hole.

MR. RATHE: So at some point this E-stratum simply disappears?

DR. GRANT: Yes, that's true. That bore hole, by the way, is outside of the site boundary.

MR. RATHE: Are you telling the Board that the contaminants never leave the site boundary?

DR. GRANT: No.

MR. RATHE: Dr. Grant, are there confining layers under the West Chicago site?

DR. GRANT: Yes, sir.

MR. RATHE: What are confining layers?

DR. GRANT: Confining layers are layers of low permeability, less able to transmit water which overlie higher permeability layers.

MR. RATHE: Were the confining layers important in your considerations in modeling this site?

DR. GRANT: They were considered in the modeling of the site. They were important in our definition of the stratum that we modeled. We did not model the confining layers.

MR. RATHE: Well, do the confining layers reduce the

ability of dissolved solids to move through the stratum?

DR. GRANT: They reduce the ability of the dissolved constituents to move through the confined layers. And they reduce the mobility of the water, the ability of water to move through the layers.

MR. RATHE: Well, does that -- do the confining layers reduce the ability of the dissolved solids to eventually make their way to the Silurian dolomite?

DR. GRANT: Yes, influence that.

MR. RATHE: What would be the significance to the assumptions you've made with regard to the movement of water at West Chicago site if the confining layers were missing at any point?

DR. GRANT: If the confining layers were missing, then the thickness of the stratum that was supported on top by that confining layer would increase. If the confining layer were separating two water bearing stratum, those water bearing stratum would go less.

MR. RATHE: So then you would have contact between two water bearing stratum and that would make movement of dissolved solids easier.

DR. GRANT: That's right.

MR. RATHE: Are any of the confining layers discontinuous under the site?

DR. GRANT: The D-stratum, the confining layer to the

E-stratum is discontinuous under the intermediate site.

MR. RATHE: Dr. Grant, is it true that the modeling that Kerr-McGee undertook was limited to the E-stratum?

DR. GRANT: That is correct.

MR. RATHE: Why?

DR. GRANT: That's the proximate aquifer to the disposal cell.

MR. RATHE: Is it true that no modeling was done of the Silurian dolomite?

DR. GRANT: That's correct.

MR. RATHE: Is it accurate to state the Silurian dolomite is used for drinking water?

DR. GRANT: It is used for drinking water in the site area, yes, sir.

MR. RATHE: Is it accurate to state that at least some of the leachate that moves through the disposal cell that enters the E-stratum also enters the Silurian dolomite?

DR. GRANT: I think that's accurate to say, yes, sir.

MR. RATHE: Your modeling of the E-stratum only involved two dimensional modeling, is that correct?

DR. GRANT: That's correct.

MR. RATHE: Can you tell the Board what is the difference between two and three dimensional modeling?

DR. GRANT: Two dimensional modeling averages properties in the vertical direction and calculates in this case

movement of water and contaminants in a planer direction. Three dimensional modeling considers independently the movement in the two horizontal directions as well as movement in the vertical direction.

MR. RATHE: I'm sorry, I may have misunderstood your answer.

Did you suggest that there was a vertical component to two dimensional modeling?

DR. GRANT: No, I didn't intend to.

MR. RATHE: Okay. I may have misunderstood.

The two dimensional modeling only yields the horizontal movement, at least in this case.

DR. GRANT: That's correct.

MR. RATHE: And three dimensional modeling would include a vertical component, is that correct?

DR. GRANT: That's correct.

MR. RATHE: Did you do three dimensional modeling?

DR. GRANT: No, sir.

MR. RATHE: Did you have sufficient data to undertake three dimensional modeling?

DR. GRANT: I believe that we did. Without having done that modeling I would -- in sometimes doing modeling you will identify data deficiencies, but I believe we had the information to do that modeling.

MR. RATHE: Can you tell the Board why you didn't do

three dimensional modeling of the E-stratum?

DR. GRANT: Yes, I can. We were interested in assessing the probable impacts of the disposal cell on the -- in this case, the groundwater at the site. We looked at the groundwater that would be most impacted by the disposal cell determined through our two dimensional modeling that those impacts were, at least in our minds, minimal, well below the standards that applied to those impacts and we didn't pursue the matter further. If the impacts were small in the first stratum, they will by nature be smaller in deeper stratum.

MR. RATHE: Isn't it true that the reason you didn't do three dimensional modeling is because you deemed that the E-stratum was too thin to do three dimensional modeling?

DR. GRANT: That's why we didn't do three dimensional modeling of the E-stratum, yes, sir.

MR. RATHE: So you not only did not do three dimensional modeling of the entire site, you didn't even do it of the E-stratum?

DR. GRANT: We didn't do it of the E-stratum. We thought it was too thin to make that practical.

MR. RATHE: As I asked you before, isn't it true that portions of the E-stratum were 43 feet in height or more?

DR. GRANT: Not the portion that we -- as I answered before -- the portion that we modeled was not 43 feet.

MR. RATHE: So you didn't model all the stratum?

DR. GRANT: We didn't model all the stratum, that's right.

MR. RATHE: Is it correct to state that three dimensional modeling is more costly than two dimensional modeling?

DR. GRANT: It usually is. It's more time consuming.

MR. RATHE: Isn't it true it generates more numbers to interpret and therefore it's a more difficult modeling to undertake?

DR. GRANT: Both of those compound statements are true. I don't want to comment on how you hook them together. But taken as two questions, I would agree with each one of them.

MR. RATHE: Okay. So whether I phrased it independent and separate from each other or together, that statement's accurate.

DR. GRANT: Separate, I have no problem answering true to both of them, but together I'm not sure that one causes the other.

MR. RATHE: Judges, could I just have a minute or so break at this point? I need to take a two minute recess. I'm almost done.

JUDGE FRYE: Are you almost finished with this topic? I was going to suggest, why don't we, if you are almost finished, why don't we wait and then we'll break for lunch after you've finished.

MR. RATHE: All right, that's fine.

JUDGE FRYE: So you want a two-minute recess, at this point.

MR. RATHE: And we'll finish this topic and then we'll --

JUDGE FRYE: Then we'll break for lunch.

MR. RATHE: I just have a few questions.

JUDGE FRYE: Fine.

MR. RATHE: I'll be done very shortly.

Dr. Fetter, isn't it important to know the results of the model predicted leachate concentrations immediately beneath the disposal cell in order to be able to evaluate the reality of the predicted concentrations at the site boundary?

DR. FETTER: No.

MR. RATHE: That's not necessary? Can you explain why?

DR. FETTER: Well, the model gives you the concentrations at the site boundary. It also gives you the concentrations below this disposal cell.

MR. RATHE: Does your model predict what the concentrations are immediately below the disposal site?

DR. FETTER: Yes, it does.

MR. RATHE: And can you refer where it predicts that?

DR. FETTER: I'm sorry.

MR. RATHE: Can you tell us where in your materials that it predicts this?

DR. FETTER: I don't believe that information was included in the final report.

MR. RATHE: Well, is it set forth in one of your engineering reports?

DR. FETTER: Dr. Grant could answer that.

MR. RATHE: I'll let Dr. Grant answer that, if you know.

DR. GRANT: I don't believe it is, sir.

MR. RATHE: You don't believe that number is included in the engineering report?

DR. GRANT: That's not a number. That's an entire set of numbers.

MR. RATHE: Okay. So that set of numbers is not included in the engineering reports?

DR. GRANT: I don't believe that it is.

MR. RATHE: Where would we find it so we could bring it -- so we could review it?

DR. GRANT: If it were in the engineering report, you could find it in the engineering report. Are you asking me which volume or --

MR. RATHE: No, you've already told us that it probably isn't in the engineering report.

DR. GRANT: Yes.

MR. RATHE: So where else would it be -- Dr. Fetter has said such numbers exist.

DR. GRANT: The model outputs are in my files which have been gone over and stirred up in great detail several years ago by the Attorney General's Office.

MR. RATHE: So it's not in the eight volume engineering report, these numbers that I'm referring to?

DR. GRANT: I don't think that it is.

MR. RATHE: And it's not in the final testimony you've submitted to court?

DR. GRANT: That's correct.

MR. RATHE: Is it necessary, Dr. Grant, to know the dilution immediately beneath the disposal cell?

DR. FETTER: Could we just take a minute -- the engineering report --

MR. RATHE: Sure, absolutely, if that's all right with the Board, I have no problem with that.

JUDGE FRYE: You're still looking for the --

DR. GRANT: I gave you an incorrect answer, sir. In Appendix D of Volume 2 of the engineering report, there are at least representative model outputs from our computer simulations. I didn't recall those being included, but they are.

MR. RATHE: I'm sorry, I was talking, Doctor, what were you saying?

DR. GRANT: I said I gave you an incorrect answer about the presence of these modeling results. In Appendix D of Volume

2 of the engineering report there are at least representative model outputs included from our simulations.

MR. RATHE: Dr. Grant, in order to calculate the dilution at the site boundary, is it necessary to know the dilution immediately underneath the disposal site?

DR. GRANT; If you were going to try to make a hand calculation, a hand calculation, you would need to know the concentration of whatever it was you were diluting at some point. I'm not sure I understand your question beyond that.

MR. RATHE: Well, in order to determine what percentage of dilution that takes place -- in order to calculate the dilution at the site boundary, is it necessary to know the percentage of dilution that takes place immediately under the disposal cell?

DR. GRANT: I still don't understand your question. Do you mean the percentage of the dilution that occurs at the site boundary or -- I just don't understand what you're saying.

MR. RATHE: In order to calculate the dilution at the site boundary, is it necessary to know the percentage of dilution that takes place immediately as the leachate enters the E-stratum?

DR. GRANT: The dilution at the site boundary is a function of the flow in the aquifer and the location and the rate and the way that the thing that you're diluting would be introduced into the aquifer. That's -- those are, I think, I

believe are the parameters that determine the dilution of something in transit from one point and the other.

MR. RATHE: I'm having problems communicating my questions to the witnesses. I think the witnesses are having some problems understanding them. What I would like to do is during the lunch break just try to see if I can more sharpen these questions. I'd like to come back to this area briefly.

JUDGE FRYE: Please follow up with one question.

DR. GRANT: Yes, sir.

JUDGE FRYE: You testified that your model assumed immediate dilution once the material entered into the E-stratum vertically.

DR. GRANT: Immediate mixing.

JUDGE FRYE: Immediate mixing, I'm sorry. So does your model assume that there is dilution which takes place from the point where it enters the E-stratum to the site boundary?

DR. GRANT: Yes, sir, and calculates that. That is the dilution that the model calculates.

JUDGE FRYE: I see.

MR. RATHE: I have two or three more questions, then I would like to stop for a lunch break if we could.

JUDGE FRYE: You want to ask those now.

MR. RATHE: Yes.

JUDGE FRYE: Surely.

MR. FRYE: Dr. Grant, will the geologic or

geohydrologic conditions at the West Chicago site contribute to the immobilization of the waste?

DR. GRANT: To a certain extent, yes. Again, I'm not sure what -- I'm not sure exactly what you mean by your question. The -- could you help me.

MR. FRYE: I'm not sure I can help you; I'll restate it. Perhaps a slightly different --

MR. FETTER: I'm confused what you mean by immobilization. Perhaps Dr. Grant is too with that --

MR. FRYE: Immobilization means that there won't be any movement of the waste, or any significant movement of the waste off site.

DR. FETTER: Physical movement of particles of waste or movement of dissolved solutes coming from the waste?

MR. RATHE: I would say either one could be answerable, if you can't --

DR. GRANT: In that sense yes, the hydrogeologic conditions contribute to the immobilization of the waste.

MR. RATHE: Can you tell me how this is possible if the waste then leaches into the glacial drift aquifer and eventually end up in Kress Creek, to a certain extent?

DR. GRANT: Well, it's possible because the hydrogeologic conditions control or contribute to the control of the rate of that. For example, the site's not in the flood plane. If the site were in a flood plane, there would be much

more -- the possibility of much more infiltration and much more washing away of the materials.

MR. RATHE: It can be worse, but, is that true, that it always --

DR. GRANT: It could be a lot worse, yes.

MR. RATHE: But it's also true that because of the movement of the water through the E-stratum, the fact that it enters into Kress Creek, in fact the dissolved solutes are not kept on the site because of the nature of the hydrogeology.

DR. GRANT: The nature of the hydrogeology is such that once the materials have dissolved and have reached the water bearing stratum, they will move with the groundwater. I think that's the case at every site.

DR. STAUTER: Excuse me. They may move at different -- I'm having trouble with your question.

MR. RATHE: Sure.

DR. STAUTER: They may move at different velocities or rates of movement as they adsorb or absorb, either one, and then stay on a particle and later on are resolubilized and moved out. In other words, you will get a migration of a constituent through the groundwater. The rate that that constituent moves will depend to a large extent on its chemistry, what it will sorb on. Is that what you're getting at?

MR. RATHE: Well, I guess what I'm really getting at is that because of the nature of the hydrogeology, that in fact

dissolved solutes move both laterally, and as Dr. Grant has testified to, move vertically into the Silurian dolomite, and is that an accurate statement?

DR. STAUTER: Those constituents will move through those gradients, but it depends on the chemistry, their rate of movement.

DR. GRANT: Let me try to just deal with the problem. Again, if you knock off the because, what you're saying is true. The materials that leach from the soil and move into the groundwater system, will move horizontally and to a certain extent, will move vertically.

The way I interpreted your question, you made that sound like that happened because of some particular quirk of this site, and that's not true. That would happen at any site.

MR. RATHE: But there's some sites that there would be more homogeneity to the hydrogeology and therefore there wouldn't be as much movement?

DR. GRANT: Again, you're asking questions that link things together that I don't know how to deal with. Yes, there may be more homogeneous sites in Illinois.

MR. RATHE: And that would more immobilize the waste.

DR. GRANT: No. That would be a more homogeneous site.

MR. RATHE: Okay. Then I'm linking, as you say --

DR. GRANT: You're linking two concepts together.

MR. RATHE: Are there sites that would immobilize the

waste better than West Chicago?

DR. GRANT: By better I presume you mean more. That the rate of movement of those might be less than the rate of movement once something got into the groundwater system. Well, yes, not all sites have as rapid a rate of groundwater movement as the West Chicago site.

MR. RATHE: Okay. Judges, if I could ask that we take a lunch recess now, and then, we do not have, I believe, a great deal in the afternoon. I think we're pretty close to being done with our questioning.

JUDGE FRYE: For this panel.

MR. RATHE: Yes.

JUDGE FRYE: Fine. Why don't we take a recess and you all are familiar with the area around here. How long do you think would be appropriate? An hour and fifteen minutes?

MR. RATHE: Well, there is a federal cafeteria building. I'm not sure that there are fast food restaurants. I think if people went to actual restaurants where there's waiter service, I can see that they would take at least an hour and fifteen minutes. Whatever the Board wishes.

MR. NICKLES: I would say that wouldn't provide enough time.

JUDGE FRYE: An hour and a half then.

MR. NICKLES: The other question I have then is the court secure so we can leave materials here while we are at

lunch?

JUDGE FRYE: I really cannot answer that for you. Mr. Rathe you may know better than I.

MR. RATHE: I -- the answer is usually there would be a bailiff here who could lock up during the lunch hour and I don't know --

JUDGE FRYE: I don't think there is one.

MR. RATHE: If there's not a lockup, I wouldn't represent anything secure.

JUDGE FRYE: I don't think we have any -- no one has told me that there will be anyone here to lock up.

MR. RATHE: I would just ask, I don't know if I'm imposing, I would prefer that we try to get back at 2:00, knowing for a fact we're never going to get started quite at 2:00. If we start at 2:15, it's going to be 2:30. I mean, just the way things work.

JUDGE FRYE: Let's start at 2:00.

MR. RATHE: Thank you.

(Whereupon, at 12:43 p.m., the hearing was recessed for luncheon, to reconvene this same date at 2:00 p.m.)

AFTERNOON SESSION

(2:15 P.M.)

JUDGE FRYE: Can we go back on the record? It's now 2:15, time to resume. Mr. Rathe.

MR. RATHE: Dr. Fetter, is it your opinion that the waste that comes through the disposal cell never enters the Silurian dolomite?

DR. FETTER: Well, I'm sorry. You're asking me if the waste that comes through the disposal cell, the disposal cell hasn't been built.

MR. RATHE: Well, the predicted disposal cell, the model that predicts the behavior of this disposal cell. Does the model predict, or is it your opinion that the waste that will go through the disposal cell, enter the E-stratum, never enters the Silurian dolomite?

DR. FETTER: There will be a percentage of the leachate which is generated within the cell, which would eventually reach the Silurian dolomite.

MR. RATHE: Okay. Can I again ask you to turn to Table 4 of your testimony that you've offered.

Okay, before we get to 4, can I ask a brief question on 5, which is just, I guess, the next table.

Okay, Dr. Fetter, do those numbers on Table 5, are they exclusive of background concentration of radiation?

DR. FETTER: They're exclusive of background

concentration of radiation and they also are exclusive of any effects of retardation, that is dilution alone. And so in a sense they're a little bit misleading in the fact that thorium, for example, is so highly immobile that when the NRC did their model, they didn't even bother to model for thorium because of the extremely high KD values for thorium. So that this is simply a dilutional model without taking into account any impact of radiation, or the retardation in any of these that would be retarded.

MR. RATHE: Not that I want to get into this, but just so you could clarify for the record, what does KD mean?

DR. FETTER: Well, it's a way of expressing the interaction of a solute which is dissolved in water with the soils and it's the affinity for that particular solute to sorb onto the surface of the soil and so to prevent its movement through the groundwater.

MR. RATHE: Thank you. What are the background concentrations of radiation for this area?

DR. FETTER: I don't have an answer to that question. Perhaps one of my fellow panelists does.

MR. RATHE: One of your what panelists?

DR. FETTER: Fellow panelists.

MR. RATHE: Dr. Grant, do you have the knowledge?

DR. GRANT: No.

MR. RATHE: Dr. Stauter?

DR. STAUTER: I can't recall.

MR. RATHE: Okay. Can we go back to Table 4 then, and I would refer you to Case 1. In Table 4 you have predicted a dilution factor of 0.0017 or a dilution ratio of 5,882 to 1, at the site boundary. My question to you is what amount of that dilution is a result of the immediate vertical mixing that is predicted by the two dimensional model immediately below the disposal cell?

DR. FETTER: Well, the vertical mixing that's predicted by the -- that's assumed by the model, is assumed by the model because of the fact that in fact there will be vertical dispersion as flow moves laterally and so the judgment that we applied to this model was that if in fact you had this -- well, you will have this vertical dispersion which will cause the mixing over the entire thickness of the E-stratum.

MR. RATHE: Okay.

DR. FETTER: And so the dilution factor obviously is going to require the vertical mixing throughout the entire thickness of the E-stratum.

MR. RATHE: Okay. I'm looking for a number or percentage. What amount of the dilution is a result of the immediate vertical mixing?

DR. FETTER: I don't think I can answer that question because I don't understand. I mean, it sounds like a simple question, but it doesn't have a bearing in reality.

MR. RATHE: Why is that?

DR. FETTER: Well, because the vertical mixing that's taking place is taking place due to the dispersion which occurs as the groundwater moves laterally and the dilutional factor that you get is the result of the mass of leachate which is being generated, mixing with the total mass of groundwater which is flowing beneath the site on an annual basis.

MR. RATHE: Okay, you conclude -- is it accurate to say that you conclude, in Case 1, that there's a dilution ratio of 5,882 to 1. Is that an accurate statement that I'm making to you?

DR. FETTER: Well, I did not check the -- if your arithmetic is --

MR. RATHE: If my arithmetic is correct, would that be an accurate statement?

DR. FETTER: That would be an accurate statement, okay.

MR. RATHE: What percentage of that 5,882 to 1 dilution takes place immediately below the disposal cell?

DR. FETTER: Well, you have a large disposal cell with the waste a footprint of 6 or 700 feet by a thousand feet, and it's a thousand feet in the vertical direction. And you've got a circumstance whereby leachate is entering the aquifer underneath that entire footprint, and so you've got all sorts of mixing taking place at different areas.

MR. RATHE: Does the --

DR. FETTER: It's not a percentage kind of thing.

MR. RATHE: Does the Kerr-McGee model assume a uniform leachate through the disposal cell?

DR. FETTER: You mean a uniform concentration of leachate everywhere in the disposal cell?

MR. RATHE: Yes, is that your -- does your model make that assumption?

DR. FETTER: The way that we determined the leachate concentration was to look at the area of distribution of the wastes that would be put down, to look at the mixing of the various wastes that would go into each area, to look at the concentration of leachate from each type of waste and come up with a composite value for each part of the cell.

We then looked at the maximum value of those composites to come up with a composite maximum. So the model did assume a uniform value of leachate, and that uniform value was the worst case scenario for the composited --

MR. RATHE: If we -- if there's a uniform dispersal of leachate through the cell, can you envision the cell as a rectangular block?

DR. FETTER: Yes.

MR. RATHE: And if we remove the center block of that rectangle where there would be uniform dispersal of leachate as there would be in every other part of that rectangular block, what I want to know is what percentage or what number of your

dilution ratio occurs immediately under that center block.

DR. FETTER: Well, let me explain to you how the dilution works. If you look at the whole mass of the waste, at the upstream end you've got a certain volume of water flowing through per year. And so if you look at the very first row of waste, normal to the -- well, perpendicular to the flow path, you're going to have a very large amount of dilution, because you've got all the water flowing past, with only the first row of waste mixing with it.

The next row of waste, you're going to have the same volume or mass of leachate moving in and it's going to mix with the volume of water which already has some leachate in it. So, as you go along from the upper end of the flow towards the lower end of the flow, you're going to find that beneath the waste cell, the concentration of the leachate in the waste is low, or which is of course extremely low, is going to increase as you get to the end of the cell, because of the fact that you have the same volume of water moving under it, you just have slightly -- you just have more and more leachate mixing with it as you go towards the end.

MR. RATHE: Dr. Fetter, your model assumes there's an -- as soon as the leachate hits the E-stratum, there's immediate mixing in that stratum, is that correct?

DR. FETTER: That is the model assumption, yes.

MR. RATHE: And you're assuming that taking Case 1,

that at the site boundary you're eventually going to have a dilution ratio -- again you'll have to bear with me and assume my arithmetic is correct, or math or whatever -- that at the site boundary there's going to be a 5,882 to 1 dilution ratio.

DR. FETTER: Okay.

MR. RATHE: What I am asking you is if you're assuming immediate mixing, and at that site boundary you now have 5,882 to 1 dilution ratio, as soon as it strikes the E-stratum, what percentage of that 5,882 to 1 occurs at that point? Do you have 90 percent, do you have 80 percent, do you have 70 percent? Give me a number.

DR. FETTER: Well, I don't have a number.

MR. RATHE: Why not? Doesn't your number assume a total immediate mixing?

DR. FETTER: Well, first of all, it does assume immediate mixing, which is a good assumption. I am aware of landfills where you have a homogeneous aquifer beneath them such as the E-stratum --

MR. RATHE: A what, a homo what?

DR. FETTER: Homogeneous.

MR. RATHE: Aquifer?

DR. FETTER: Aquifer, relatively homogeneous, such as the E-stratum, that is 50 to 70 feet thick and by the edge of the landfill you have complete mixing from top to bottom of the leachate, because of the vertical dispersion.

So, when we take into account the complete mixing, it's not a hypothetical that we wish it would occur. It in fact is a something that does occur. We know that it occurs in landfills. It occurs as predicted by your model, or it occurs in fact in reality, it occurs in reality.

MR. RATHE: So you're saying that at the moment that the leachate hits the E-stratum, you almost have -- you have the 5,882 to 1 dilution ratio at that moment?

DR. FETTER: Well, you might have more -- if you're looking at -- first of all, it's not instantaneous, okay. It does take some lateral movement in the aquifer to get the vertical dispersion taking place. But if you look at the very upstream end of the waste cell, you're going to have more dilution than that taking place.

MR. RATHE: Dr. Fetter, you're making an assumption that there in fact, from the top, that there's going to be immediate mixing the moment the leachate hits the disposal cell, from the top of the E-stratum to the bottom of the E-stratum, is that accurate?

DR. FETTER: Well, we actually are not making that assumption because we know that there will be mixing taking place within a few feet of flow.

MR. RATHE: Okay. Are you saying just several feet away from the point where it hits?

DR. FETTER: Yes.

MR. RATHE: And what is the thickness of the E-stratum underneath the disposal cell?

DR. FETTER: Underneath the disposal cell -- underneath the footprint of the waste it varies from about 5 to 20 feet thick.

MR. RATHE: And is that a homogeneous layer, stratum?

DR. FETTER: Well, it has a variation in thickness, and it's not totally homogeneous. In fact, the heterogeneities will promote the vertical mixing through dispersion, in a vertical direction.

MR. RATHE: Okay. Dr. Fetter, isn't it in fact your computer model predicts almost instantaneous mixing of the waste, is that correct, with the E-stratum waters?

DR. FETTER: Well, that's an assumption of the model, yes.

MR. RATHE: Isn't it a fact that in reality that as the water goes -- that as the leachate goes through the disposal, the bottom of the disposal cell, when it strikes the E-stratum, is going to travel along the top of the E-stratum and eventually as it moves laterally it's going to begin to mix, but there's going to be lateral movement in a relatively small confined portion of the E-stratum, and it's only as it begins its lateral movement will there begin to be mixing, isn't that a fact of reality?

DR. FETTER: Well, as a matter -- let me start that

again.

If the leachate is more dense than the water that it's moving through, then you will get an immediate vertical sinking due to the density effects. And, if it were a fairly concentrated leachate, that might be the case. I don't specifically know what the density differences in this particular leachate would be. But it is in fact possible to have vertical movement of the leachate without any horizontal movement.

MR. RATHE: I need one more -- I'm almost done with this area.

Do you expect density difference in the West Chicago site?

DR. FETTER: I really haven't given that much thought to the fact whether or not there would be density differences or not there because the length of the flow path beneath the cell, which is about a thousand feet, is roughly 100 times the thickness of the aquifer, which is about ten feet, on the average. And when you have that 100 to 1 ratio of flow length to thickness in the aquifer, you will have complete, true vertical mixing of the waste because of diffusion and dispersion within a very few feet, perhaps anywhere from 10 to 50 feet, something like that. So, it wasn't necessary to assume any kind of vertical movement because of density differences.

MR. RATHE: Okay. And if there were density

differences, wouldn't that require the use of a three dimensional model?

DR. FETTER: No.

MR. RATHE: Okay. I just have one other issue that I'm going to briefly touch upon, that the Board has raised and then I'm going to turn this over to Mr. Sisul, and that's dealing with the Board's question, I believe it's Issue 5 of these -- the differences between, well, basically the staff, and the NRC staff said there was 38 percent recharge in this prior to dolomite. Kerr-McGee said 36 percent, there was a qualitative assessment to that, and the Board asked to comment on that. So that's the only other area I'm going to touch on. The other issues I'm not going to ask any questions on. The other intermediate issues I'm not going to ask any questions on.

Dr. Grant, is it true that 36 percent of the recharge to the E-stratum enters the Silurian dolomite?

DR. GRANT: As an average value over the site area in this region, yes, that's our estimate.

MR. RATHE: Is there any reason to believe that the specific recharge to the dolomite under the West Chicago disposal site is any different from the recharge throughout the general area?

DR. GRANT: In terms of total recharge or the recharge per unit area, no.

MR. RATHE: Well, you seem to qualifying that, so the

question is, is there any reason, within reason I'm looking for --

DR. GRANT: No, I understand your question, and the recharge, so far as we know, the recharge to the Silurian dolomite in and around the site, in the site area, is similar. It doesn't vary so far as we know, to any appreciable degree.

MR. RATHE: Okay. So as far as you know, then about 36 percent of what is underneath this disposal site at the E-stratum, 36 percent of that enters the Silurian dolomite?

DR. GRANT: Yes. And I answer that question yes. I believe that that's true. I want to make the point that that is not our estimate of the amount of recharge that would come through the soil or that is now infiltrating to the glacial aquifer through the surficial soils.

MR. RATHE: Well, I'm talking about from the glacial aquifer down to the Silurian --

DR. GRANT: From the glacial aquifer to the Silurian --

MR. RATHE: In other words, 36 percent --

DR. GRANT: -- 36 percent of the --

MR. RATHE: Let me finish with Dr. Grant and then you can add what you want.

36 percent of the waters under the disposal cell will eventually enter the Silurian dolomite, that's your position.

DR. GRANT; Yes.

MR. RATHE: Yes, Dr. Fetter.

DR. FETTER: I think that what, the issue is this. If you look at the B-stratum, which separates the C-stratum, which is saturated in the glacial aquifer, is a glacial aquifer from the Silurian dolomite. Immediately beneath the disposal cell, you would have about an inch to an inch and a third of water flowing vertically. The water in the C-stratum there is not being recharged from the area above it where you have the disposal cell, because you have the intervening B-aquifer or confining layer, so that what Dr. Grant is saying is absolutely true. If you go beneath the disposal site, straight down, you're going to find about an inch to an inch and a third of water moving from the C-stratum to the Silurian dolomite aquifer.

But that water in the C-stratum is coming from the upgraded recharged area, it's not coming from the disposal cell, so you can't make the leap in logic that 36 percent of the leachate which is going to be generated from the disposal cell will ultimately end up in the Silurian dolomite aquifer.

The intervening D-stratum, which is more or less continuous as you go towards Kress Creek, is going to laterally -- is going to deflect that flow laterally towards Kress Creek so that most, and we have not quantified it, but most being more than two-thirds, of the water which enters the E-stratum, the leachate which enters the E-stratum from the

disposal cell is going to ultimately discharge in Kress Creek.

MR. RATHE: I heard Dr. Grant saying something different, and if I'm wrong, then either you or Dr. Grant can correct me. I understood him to say that approximately 36 percent of the water that's in the glacial drift aquifer, which we know as the E-stratum, will end up in the Silurian dolomite. It may not be exactly 36 percent, but it's to be roughly that percentage.

And it's 36 percent of the waters in the E-stratum under the disposal cell. That's what he -- that's what I heard him say. Are you saying something different?

DR. FETTER: Well, I think that's what I heard him say too. And I believe he got confused in the question you asked, to be honest with you.

MR. RATHE: Well, are you speaking for him?

DR. FETTER: No, I won't speak for him.

DR. GRANT: May I speak for myself?

MR. RATHE: Yes, sir.

DR. GRANT: I think that's exactly what I said and I think that that's --

MR. RATHE: I'm sorry. What is exactly what you said?

DR. GRANT: That of the water in the glacial aquifer, that the recharge to the glacial aquifer -- to the Silurian -- now I'm getting confused myself -- to the Silurian dolomite, beneath the disposal site, is approximately 36 percent of the

recharge to the glacial aquifer over the basin, on a per square foot or per unit area basis.

I tried, apparently not successfully at all, to point out that the water that is recharging the dolomite beneath the disposal site is not the water that is recharging the glacial aquifer at the disposal site.

MR. RATHE: Excuse me for one second.

Dr. Grant, did you ever testify in a deposition on December 6th and I asked you questions and you gave answers?

DR. GRANT: Yes, sir.

MR. RATHE: Okay, starting with, and I'll read several questions, several answers. Question: Let's just talk about at this point, Kerr-McGee's numbers, just to put in context, this is again, is the recharge to the Silurian dolomite. Answer: Okay. Question: Say 36 percent of the E-stratum, the recharge of the E-stratum will enter the general area of the Silurian dolomite, is that correct? Answer: That is a general statement in the area that is the, seems to be the average recharge, yes. Question: Do you know the specific recharge underneath the site? Answer: I have no reason to believe that the specific recharge below, beneath the site is any different. We calculated recharge through the, or leakage I should say, through the fine grain strata at the site, and arrived at a number very similar to the regional number reported in the literature. So the recharge the dolomite below the site should

be around 36 percent as well. Answer: Of the general recharge.

Were those questions I read and your answers?

DR. GRANT: Yes.

MR. RATHE: If I can have one minute, I think I'm done with my portion of the questions. Okay, Judges, thank you. Mr. Sisul has, I think, not many questions.

JUDGE FRYE: Mr. Sisul.

MR. SISUL: Yes, he's correct, I have very few.

JUDGE FRYE: Could you let us know which topic.

MR. SISUL: Yes. With respect to the wells surrounding the site --

JUDGE FRYE: I'm sorry, I can't hear you.

MR. SISUL: With respect to the wells surrounding the site.

JUDGE FRYE: Uh-hum.

MR. SISUL: Dr. Fetter, with respect to the 60 wells that were identified within the two mile radius, does the draw down at the wells, or those wells, -- those wells are basically in the bedrock aquifer --

DR. FETTER: They are --

MR. SISUL: -- in the Silurian dolomite aquifer?

DR. FETTER: There are two bedrock aquifers, the Silurian dolomite aquifer and then the deeper Cambrian-ordovician aquifer. I don't recall what proportion of each of those -- of the 60 is in each aquifer.

MR. SISUL: It is true that the silurian aquifer is a dominant supplier for drinking water for that area, is it not?

DR. FETTER: It's a supplier of drinking water for that area, yes.

MR. SISUL: Would an increase, at the present time, do these wells have any effect on the water passing through, under the site, in the glacial aquifer under the site?

DR. FETTER: Yes, they do.

MR. SISUL: And would an increase in those wells have any effect -- an increased effect on the recharge of the silurian aquifer?

DR. FETTER: An increased pumpage from the wells?

MR. SISUL: Yes.

DR. FETTER: No, they wouldn't and it's sort of confusing to understand that and I can explain it to you. Can I be a professor for a minute?

MR. SISUL: Please, go right ahead.

DR. FETTER: Okay. I sometimes in my classroom do what I call mental experiments because they are a lot less messy than real experiments. But, if you have a, we have a basic principal in groundwater called Darcey's Law which says that the amount of flow through an aquifer is proportional to several things, one of them being the hydraulic gradient.

And the hydraulic gradient is just the difference in head divided by the distance over which it's measured. And

we're going to do a mental experiment here, we're going to take a bucket of sand, and we have a hole in the bottom of our bucket, and we're going to fill it up with water, then we're going to submerge it in a bathtub so that the level of water in the bucket and the sand is equal with the level of water in the bathtub.

We have no flow either into or out of the hole in the bottom of the bucket because there's no hydraulic gradient. As we start to pull the bucket out of the bathtub, the water level inside the bucket is going to be higher than the water level in the bathtub. So, we're going to start to get water dripping out, or flowing out the bottom of the hole into the bathtub.

The volume that flows is proportional to the hydraulic gradient which is simply the depth of the saturated sand in the bucket, divided by the height of the water in the bucket, the difference in the height and the water in the bucket and the height of the water in the bathtub.

We're going to pull a little bit further out of the bathtub and we're now going to have more flow going out that hole because we've increased the hydraulic gradient. If we have say a one foot thickness of sand and we pull the bucket six inches out of the water, we have a hydraulic gradient of .5, a half a foot difference in head divided by the one foot difference in sand.

If we pull it out another three inches, we now have a

hydraulic gradient of .75, we've increased the hydraulic gradient by 50 percent, and we've increased the volume of water dripping out of the bucket by 50 percent.

Well, as we continue to draw the bucket out of the water -- the bucket out of the bathtub, we will continue to increase the head difference, just like when you pump the water from the Silurian dolomite aquifer and pull the head in that aquifer down below the glacial aquifer, you increase the amount of vertical leakage.

And that increase is in total point in time when we pull the bucket out of the water. As soon as we pull the bucket out of the water, we have a vertical gradient of one. We now have head difference of one foot from the bucket, water level in the bucket, to the water level in the bathtub. And we have twice as much vertical leakage as we had when we had it half submerged.

If we raise the bucket two feet above the level of the bathtub, we have not increased at all the rate at which water drains out of the bucket, because once we reach this vertical gradient of one or unity, that's the maximum vertical gradient that we can sustain, and no matter how high we raise that bucket, the same volume of water is going to flow out of it.

The exact analogous situation takes place if you pull the water level in the aquifer down, the water level in the Silurian dolomite aquifer down, so that you have a hydraulic

gradient of one or more across the confining layer, which is the D-stratum at this site -- no, B, the B-stratum at this site, and that's the circumstance today.

An average vertical gradient across the B-stratum is in excess of one and therefore we have the maximum vertical leakage taking place. Any further pumpage from the Silurian dolomite aquifer would lower the water level in the aquifer, but it would have absolutely no effect on the rate of vertical flow from the glacial aquifer down to the Silurian dolomite.

MR. SISUL: So the glacial aquifer wouldn't recharge at any increased rate into the Silurian dolomite aquifer then?

DR. FETTER: That is correct, you get an A.

MR. SISUL: So, we would still maintain the 36 percent or the 38 percent recharge level?

DR. FETTER: That's correct.

MR. SISUL: Even though there would be a cone of depression, would that increase the cone of depression below the site?

DR. FETTER: That's correct.

MR. SISUL: So, it doesn't matter how many wells you sink into this Silurian aquifer on site, or how large the City of West Chicago gets or how many additional residential wells or what goes into that area.

DR. FETTER: Well, not from the standpoint of increasing vertical leakage. I mean, if you put in so many

wells that you pump the Silurian dolomite aquifer dry, then it would matter because you'd run out of water supply. But that's a different issue.

MR. SISUL: And that would be true, even though there would continue to be water in the glacial aquifer?

DR. FETTER: certainly.

DR. GRANT: I'd like to add something to that. I believe we're talking here about -- you said it wouldn't matter how many wells were put in there. We're speaking about the same size area. If you go to an area where the Silurian dolomite has not been pumped down, where it's at original, whatever pristine conditions were, and you duplicated the conditions in the West Chicago area, then certainly you'd certainly, as you were pulling the water level down toward the conditions such as they are in and around the site, you would stimulate increased recharge in that part of the aquifer.

Our response has to do with conditions as they are in this site, in and around this site.

MR. SISUL: Excuse me one minute.

Would your bucket analogy remain the same if you put a fine grain layer of sand at the bottom of the bucket, set a fine layer at the bottom of your bucket, and had your coarse grain sand above it?

DR. FETTER: Yes, there would be no difference.

MR. SISUL: Would be no difference at all.

I believe in your testimony there was some reference to the City of West Chicago perhaps getting Lake Michigan water, is that correct?

MR. FETTER: No, there was no reference to that. There was just simply reference to Lake Michigan water in DuPage County.

MR. SISUL: Okay. Do you know whether or not the City of West Chicago will be getting Lake Michigan water?

DR. FETTER: My information is that at the present time, the City of West Chicago was granted an allocation of Lake Michigan water. That they are probably going to lose that allocation because they've made no attempt to claim it. But at some time in the future if they would wish to claim it, then they could reapply and get the allocation.

MR. SISUL: Reapply say 1992 or later?

DR. FETTER: Well, whenever they might wish to.

MR. SISUL: Okay. And your information comes from?

DR. FETTER: I contacted a gentleman I know at the Illinois Department of Transportation Division of Water Resources who's in charge of the Lake Michigan allocation program.

MR. SISUL: Okay. So he would know whether or not the information you just gave me is correct.

DR. FETTER: Well, he is the person I got the information from, that's the source of the information.

MR. SISUL: I have no further questions.

JUDGE FRYE: Well, Mr. Greenwalt, did you want to -- do you have any questions?

MR. GREENWALT: Yes, I do, just a few.

The first concerns the area of leachate. I'm intrigued that the disparity, the viewpoints between yourselves and the NRC. The NRC uses a formula to determine the concentration of the, how would you say that, constituinant?

DR. FETTER: Constituent.

MR. GREENWALT: Constituent, okay, in the leachate, and you do not. Could you explain to me why? Why there is such a difference between your two addressed bodies?

DR. FETTER: Well, I could give you an explanation, I think Mr. Stauter could give you a more complete explanation if you would want him to try, or want me to try.

MR. GREENWALT: Please.

DR. STAUTER: The difference arises from two approaches. Kerr-McGee used the approach of having the materials there that would be stabilized, and we did actual leach tests on those using the EP toxicity test that's described in the Hazardous Waste Regulations in Part 261, Chapter 40, of the Code of Federal Regulations.

We used that leach test because it provided a standard across the board, and secondly, it maintained, in a city condition, that would be a little more severe than what

rainwater PH would be if we leached the materials in that.

We ran those tests so that we would have, so we would generate what we felt was a conservative leachate for that type of system, and those are the values we had.

The alternate approach that the NRC used was to assume, take the concentration of a constituent in the waste, assume that that material -- that that constituent was fully available and then a review of the literature base of the distribution coefficients for those elements as they were fractionate between the solids and the leachate, that generated their concentrations.

We had experimental numbers, the difference probably arises in the difference because they took a situation and assumed that there was a total available concentration of a constituent there available for leach and then used a distribution coefficient and made their calculations.

They could just as easily have assumed that of that total concentration in the waste, maybe only 90 percent of that would be available and then use a different KD. In other words, they could generate leachate. Their approach was conservative and they indicated such, based on their method.

Now, I believe our approach is also conservative in that we use, not only do we use the actual materials, but we used a leachate that is stronger than what we would expect to have come through the cell and actually be the leach solution.

And that's the difference.

MR. GREENWALT: Then your tests were hypothetical situations. That is, they were actual laboratory tests.

DR. STAUTER: Our tests were not hypothetical, they were actual.

MR. GREENWALT: But they were done in the laboratory.

DR. STAUTER: Yes, they were.

MR. GREENWALT: Under hypothetical conditions.

DR. STAUTER: They were done under conditions of the EP toxicity test, yes.

MR. GREENWALT: As opposed to actual analysis from the site itself. There's leachate being generated right now, is there not?

DR. STAUTER: No, we had to generate the leachate from the waste. We took waste samples and leached those.

MR. GREENWALT: Now, is the formula used by the NRC basically a statistical type of formula?

DR. STAUTER: I don't know enough about their process to address that.

MR. GREENWALT: Well, you quoted it in your paper.

DR. FETTER: I can answer that question.

MR. GREENWALT: All right.

DR. FETTER: It's not a statistical formula. The real difference in the results is simply this. The theoretical approach taken by the NRC assumed that for these materials,

whatever was analyzed, and when you run a chemical analysis you basically destroy all of the chemical compounds that are there to get the elements. And they assumed that, for example, for lead, all of the lead which is tied up in a number of different chemical compounds or minerals in the waste, would be available for leaching and could contribute to leachate. In fact, that's not true.

Most of the lead is tied up in insoluble chemical compounds that will never leach. And, so, by taking the extreme, extremely conservative position they did, in assuming that all of these insoluble compounds were available, they came up with much stronger leachate than in fact will be generated because the majority of these compounds are either insoluble or have a very low solubility.

By running the laboratory tests that Kerr-McGee ran, using the actual wastes and other materials from the site, the soils and so forth, and subjecting them to leaching, which in essence is a test of their solubility, that takes into account the fact that many of these compounds are insoluble or have a very low solubility and so you see the ten to hundred fold difference in leachate values between the NRC staff's approach and the Kerr-McGee approach.

The NRC staff approach was overly conservative in this respect.

MR. GREENWALT: In that regard, and the next question

then would be more related to the model, is if you use the NRC numbers of the concentration in the leachate, would your model fail?

DR. FETTER: No.

MR. GREENWALT: Last question. There has been talk about the drinking water or the water supply to West Chicago. Do you know the nearest town that's a part of that system?

DR. FETTER: A part of which system?

MR. GREENWALT: The Chicago water system, or proposed system --

DR. FETTER: No.

MR. GREENWALT: -- which was mentioned.

DR. FETTER: The Lake Michigan allocation?

MR. GREENWALT: No, it's a water system. They're putting in a very expensive pipe which you have --

DR. FETTER: I do not know which particular communities in DuPage County.

MR. GREENWALT: If I would suggest to you that it was Wheaton, approximately seven miles away, would that --

DR. FETTER: We didn't --

MR. GREENWALT: You didn't check into that.

DR. FETTER: -- research that, no.

MR. GREENWALT: About how far away, if you can, will the dolomite aquifer be affected by the materials that would remain on site in West Chicago. That is, when are they going to

reach the dolomite aquifer?

DR. FETTER: Well --

MR. GREENWALT: How far downstream?

DR. FETTER: Our model predictions are such that we don't think there will be an adverse impact on the dolomite aquifer.

MR. GREENWALT: Detectable?

DR. FETTER: It could be detectable for some compounds, I don't know.

MR. GREENWALT: Okay. Then about how far downstream could a detectable material be found?

DR. FETTER: We didn't research that.

MR. GREENWALT: All right. How about the E-stratum, how far downstream do you go before you start detecting the residue or the --

DR. FETTER: Well, we believe that the West Branch of the DuPage River and Kress Creek are the discharge areas for the E-stratum, and that any impact on the E-stratum would not extend beyond those water bodies.

MR. GREENWALT: Okay, but the East Branch of the DuPage River is a few hundred feet from your site.

DR. FETTER: Yes.

MR. GREENWALT: The water in that creek would be affected by this?

DR. FETTER: Well, that's the, again, we don't believe

that we will have an adverse impact in terms of the use of the water at the boundary of the site. The further you go from the boundary of the site, the less impact there would be because you're getting additional dilution and additional retardation as the water moves through.

MR. GREENWALT: Are you aware just slightly south of the factory, the City of West Chicago has a park and a swimming pond where they dam up that creek and use it for swimming?

DR. FETTER: Which creek are we speaking of now?

MR. GREENWALT: The Kress Creek.

DR. FETTER: No, I'm not aware of that.

MR. GREENWALT: Would that make a difference in any of your findings?

DR. FETTER: I would find it highly improper to, in an urban area such as West Chicago, to consider damming a creek up of any kind for swimming, whether or not it's adjacent to this particular facility, because of the kinds of contamination of surface water that you can get from the discharge of any kind of surface run-on in that area.

MR. GREENWALT: As far as your study goes.

DR. FETTER: It was not taken into consideration, no.

MR. GREENWALT: No other questions, thank you.

JUDGE FRYE: Ms. Hodgdon?

MS. HODGDON: I don't have any questions for the panel.

JUDGE FRYE: Mr. Meserve.

MR. MESERVE: Well, I just have a few questions on redirect of these three witnesses.

Gentlemen, I believe there was a discussion we had with Mr. Rathe this morning about the possible existence of cracks in the cell. There was some testimony having to do with the role of freezing and thawing and wetting and drying.

And I believe that the testimony may have been left with the point that you didn't consider those facts.

Did you consider freezing and thawing and wetting and drying?

DR. GRANT: I'll answer that.

I believe the question was, or as I recall the question was did our -- did our HELP model consider those, those kinds of effects.

And the answer was that the HELP model did not consider those effects.

The cell cover has been designed to avoid those effects in the -- the clay layer that forms the basal part of the cover and that is the primary layer responsible for retarding infiltration. The -- the clay layer is constructed below the depth of frost penetration in this area; it is protected by the -- the gravel drain and -- and vapor barrier -- or a capillary barriers from desecation caused by drying and -- and evaporation and transpiration at the soil surface.

So, they were designed -- the cap had design features

to avoid those things. And so for that reason, we did not consider them in the modelling.

MR. MESERVE: There was also some discussion this morning about the effects of subsidence. And I believe that one of you was asked whether you considered subsidence of landfills. And the answer was that you did not.

Why didn't you?

DR. GRANT: Well, this isn't a landfill. There were -- and so landfills' kind of subsidence were not considered in the design or in the evaluation of the cover.

There was a great deal of effort in characterizing the subs -- the geotechnical properties of the subsurface materials at the site. And the -- the waste materials that would go into the cell to avoid significant amounts of settlement that might damage the cell cover.

So again, that is a -- a design feature of the -- of the disposal cell. And was not incorporated into performance evaluation.

MR. MESERVE: There were also a series of questions you were asked about whether there had been caps that had been constructed that were caps substantially similar to the one proposed for West Chicago, that had been constructed at other sites. And I believe your testimony was that you knew of only one, and that was at the site at Cannonsburg, which is a tailings site of somewhat similar -- somewhat similar cap.

If in fact there are not other sites at which similar caps have been constructed, why are you confident that the cell cover will work?

DR. GRANT: Well, the -- the cell cover, the construction of the cell cover is -- makes use of -- of well-understood construction techniques and -- and geotechnical principles. It's not a -- it is not a new idea to construct covers of earth. The -- the uniqueness of this, if it is unique, is in the way that the -- the various layers are -- are constructed to -- to provide complementary functions and to protect one another.

But the -- the process of building a cell cover or compacting earth to achieve certain permeabilities is not something that is -- is unproven; people have been doing it for hundreds of years.

And it's been done in -- under controlled conditions, such as we're talking about, for a long time, 50, 75 years.

MR. MESERVE: Well, are you confident that the cover will work?

DR. GRANT: Yes.

MR. MESERVE: There was some discussion about this -- this morning as well about the aquifer in which you did your modelling. And you testified that you had done your modelling in the E-stratum.

Why did you limit your model to the E-stratum?

DR. GRANT: Well, the E-stratum is the aquifer -- the first aquifer, the first significant water-bearing zone, beneath the disposal cell. Anything that leaves the disposal cell will go first into the E-stratum. Any impact to that is cause to groundwater, will be most severe in the E-stratum.

We felt that we had to meet -- that our impacts on the E-stratum could not be significant. And if the -- if the cell is provides -- or controls releases from -- from itself, from the cell, to levels where the impact of the E-stratum are insignificant or are not detrimental to the environment, then just as a logical consequence, impacts to the deeper water-bearing zones will be even less.

Because anything that leaves the E-stratum will be mixed with -- with more water, concentrations will be decreased.

MR. MESERVE: Are any of you aware of the uses of covers in situations other than tailings piles, which have been analyzed and with which there is familiarity?

DR. FETTER: There have been a number of landfill covers constructed in the State of Wisconsin over municipal landfills. These are generally made of a single layer, five feet thick, of compacted clay. And there have been some studies done of the infiltration rates through those covers.

They are -- I don't recall the exact numbers, but the -- the covers severely restrict the amount of infiltration which occurs. And they've been in place and monitored for about ten

years now.

MR. MESERVE: Dr. Grant, do you recall that during your deposition on December 6th that I asked you some questions at the conclusion of the deposition?

DR. GRANT: Yes, sir.

MR. MESERVE: I'm referring to Page 174 of the Grant Deposition.

MR. RATHE: Is that December 5th?

MR. MESERVE: December 6th.

Page 174.

Mr. Rathe just asked you a moment ago about some questions and answers that -- that you had given him earlier in that deposition.

I'm going to ask you whether you have -- recall having been asked this question -- these questions and giving these answers.

MR. RATHE: Your Honor, I object. You can't rehabilitate a witness by doing what Mr. Meserve is attempting to do.

MR. MESERVE: Your Honor, there's been an implication that -- I don't think there truly is a conflict, but there's an implication that -- that Mr. Grant, at the time of his deposition, had testified as to something different than he's testified here today. And I believe it is completely common in a -- in such a situation to point to other elements of the

transcript which show that at the very time of the deposition, that the -- the testimony of the witness was identical to what he's testified here to today.

MR. RATHE: Your Honor, --

MR. MESERVE: And that's what I'd like to -- what I'd like to introduce.

MR. RATHE: Your Honor, with all respect to Mr. Meserve's opinion, I believe that to be incorrect; you cannot rehabilitate a witness with a consistent statement. That is not -- what you can't use, a piece of evidence or a deposition testimony that is consistent with what Mr. Meserve thinks the witness should have been saying in order to rehabilitate the witness.

I don't think that's a proper rehabilitation technique. I would object.

JUDGE FRYE: I have some question about it.

MR. MESERVE: Let me --

JUDGE FRYE: Ask -- ask him the question without referring to the deposition then.

MR. MESERVE: Dr. Grant, is it your view that 36 percent of the dissolved constituents from the proposed disposal cell will go to the Silurian dolomite aquifer?

DR. GRANT: No. I did not testify to that.

MR. MESERVE: And why don't you think that?

DR. GRANT: Because of the proximity of the disposal

site to the discharge area of the E-stratum, represented primarily by Kress Creek.

Relatively more of the infiltration that occurs to -- or the recharge to the E-stratum that occurs at and downgradient of the site will discharge in to Kress Creek than the average over the entire drainage basin, over the entire groundwater basin, and relatively less of the infil -- of the recharge that occurs at the disposal site to the E-stratum will eventually become recharged to the glacial aquifer than occurs, as an average, over the entire groundwater basin.

That's what I tried to testify to at the deposition; that's what I tried to say a moment ago. Apparently I wasn't -- I didn't do a very good job of making myself clear. But I --in my mind, there's no inconsistency between what I said in the deposition and what I said a moment ago. Or right now.

MR. MESERVE: It's your view that less than 60 -- 36 percent of the dissolved constituents from the disposal cell will enter the silurian aquifer?

DR. GRANT: That's correct.

MR. MESERVE; Your Honor, I have just one final area that I'd like to deal with on redirect.

Mr. Rathe had some conversations with you, and I believe that you testified, that you could give or had given or at this moment could give no estimate of the percentage error with regard to the output of your groundwater model.

Can you inform us what degree of confidence you have the cell will not adversely impact groundwater?

MR. RATHE: Objection, Your Honor.

(Whereupon, a discussion was had outside the hearing of the witness panel.)

JUDGE FRYE: Overruled.

MR. MESERVE: You may answer the question.

DR. GRANT: Well, I'm -- I'm totally confident that the -- that the construction of this disposal cell, as it's been designed and is presented in the engineering report and the SFES, will not cause any adverse impacts to the groundwater in the -- in the site area or anywhere else.

The question that was asked was a very narrow question re -- as I understood it, regarding a definitive numerical percentage of some sort of performance, some sort of -- of -- of closeness or -- or reproducibility of nature by mathematical model. I -- I have no way of knowing that.

The model that we used and the model -- and -- and reported in the -- in the engineering report represents fairly, as -- as current state-of-the-art represents, allows now, what we consider to be the salient points of the groundwater system relative to the thing that we're analyzing. The model -- the -- the viability, the usefulness of the model, has been well-documented in the literature by the people who developed it and by others who've used it.

And I think it's a good model; I think it's repre -- its outputs, its predictions, are representative of what will happen at the site. And I have no reason to believe, no reason whatsoever, to believe that this -- the construction of this cell will have any adverse affects on the -- on the groundwater.

MR. MESERVE: Dr. Fetter? Dr. Fetter, what degree of confidence do you have that the cell will not adversely impact groundwater?

DR. FETTER: I have the same hundred degree certainty that it will not.

MR. MESERVE: Thank you.

Your Honor, I have no further questions.

JUDGE FRYE: Thank you.

MR. RATHE: Do I get recross?

JUDGE FRYE: You do.

MR. RATHE: I have about four or five questions.

JUDGE FRYE: Why don't you go ahead now, and we'll ask our questions afterwards?

MR. RATHE: Dr. Grant, are you suggesting that the Atomic Safety and Licensing Board basically accept your gut feeling that this is going to work, as a reason to cite or allow the permanent disposal of waste in West Chicago?

DR. GRANT: I'm not suggesting any such thing.

MR. RATHE: But you're saying that based on your best judgment, without any way of demonstrating a confidence in this

model other than you think it's the right thing, you think it's going to work, you think it could support the mathematics. That's what you're asking this Board to accept?

DR. GRANT: No, that's not -- that's not what I said, not by any stretch of the imagination.

MR. RATHE: You tell me what you said.

DR. GRANT: You heard what I said.

MR. RATHE: Dr. Grant, is it fair to say that during the lunch break you and your attorney discussed the answers to questions you had just given then?

MR. NICKLES: Objection, Your Honor; that's not appropriate cross examination, as to what --

MR. RATHE: I'm not asking the substance of what they discussed.

MR. NICKLES: I don't think it's appropriate to ask that.

JUDGE FRYE: No. Sustained. Sustained.

MR. NICKLES: Thank you.

MR. RATHE: Dr. Grant, isn't it fair to say that it was the HELP model -- you -- Mr. Meserve asked you some questions in terms of areas of concern that I addressed in terms of cracks and subsidence. And you said those factors weren't considered in the HELP model; is that correct?

DR. GRANT: That -- that's the way I answered Mr. Meserve; yes, sir.

MR. RATHE: And you gave reasons why you thought that the cover cell would work as -- as designed; is that right? In terms of -- in response to Mr. Meserve's questions?

DR. GRANT: Yes.

MR. RATHE: Isn't it true, Dr. Grant, that again, in terms of the infiltration rate, that was calculated based on the HELP model? Is that correct?

DR. GRANT: That's correct.

MR. RATHE: And it's that infiltration rate that you're submitting to the Board as reason that there's not going to be a great amount of leachate that's going to come out of the bottom of the disposal cell, because of the relatively minimal rate that has been provided to you by the HELP model. Is that accurate?

DR. GRANT: I think that's accurate, yes.

MR. RATHE: Now, you said that you were aware of -- that you were confident in this design because there are things that have been in existence hundreds of years. I may not be exactly saying what you said, but you did use the phrase hundreds of years.

And I'm wondering what you're referring to.

DR. GRANT: Well, I said people have been constructing soil structures for hundreds of years.

MR. RATHE: Okay.

DR. GRANT: And that they've been constructing, under

controlled conditions, soil structures for many years.

MR. RATHE: How many years would you say, under controlled --

DR. GRANT: Under controlled conditions? Certainly, since the -- the twenties or thirties.

MR. RATHE: Are those --

DR. GRANT: And maybe -- maybe beyond -- before that.

MR. RATHE: And are these soil structures disposal cells like the one that's going up in West Chicago?

DR. GRANT: Within a hundred yards of the one that we're proposing? No, they're not.

Not for the most part.

MR. RATHE: I'm just saying that since the 1920's, is there anything else in this country that you can point to that's similar to what's going up or was proposed to go up in West Chicago?

DR. GRANT: I can point to a number of things that are -- that perform similar functions, at least parts of similar functions.

MR. RATHE: And what are those?

DR. GRANT: Dams.

MR. RATHE: Dams are made of cement?

DR. GRANT: Dams are made of soil, a lot of them are.

MR. RATHE: We're not talking about a dam here, are we?

DR. GRANT: We're talking about earth construction. I

think.

That's what I was talking about; I'm not sure what you're talking about.

MR. RATHE: Okay. Do dams subside?

DR. GRANT: They can.

MR. RATHE: And so earth -- earthen constructions do subside; that's a characteristic of earthen construction, isn't it?

DR. GRANT: That's right. They subside more or less and -- and depending on the amount of care and the way they're constructed, they may subside a lot more or a lot less.

MR. RATHE: Are you aware that -- you cited Cannonsburg as something that's analogous to this?

DR. GRANT: That's -- that is the -- the thing that I am most -- I'm familiar with that is most like the disposal cell we propose.

MR. RATHE: Are you aware that -- that the -- those who put up the Cannonsburg facility bought out the residents around the area because of problems of living in the area?

DR. GRANT: I have no knowledge of that.

MR. RATHE: Okay. If you were aware -- if that was in fact true, would that be of concern in putting up the site at West Chicago?

MR. NICKLES: Objection, Your Honor. The gentleman has no knowledge on this contrary fact. I don't think it's

appropriate to speculate on an assumption that has no basis in fact.

JUDGE FRYE: Sustained.

MR. RATHE: I believe that's all I have on recross. Thank you, Judge.

JUDGE FRYE: Thank you.

(Pause.)

JUDGE CARPENTER: I have just a few questions. To a certain extent, -- curiosity.

But the Board has been focused on the estimates of the infiltration rates for quite some time. And the -- as I read the volumes through the engineering report, at that point in time the best estimate was 0.01 and there isn't any reason for that estimate not to change as thinking proceeds.

But apparently today we're looking at 0.1 inches per year as a best estimate. Based on -- according to your testimony on a revision of the HELP model.

I'd like to ask what -- what -- what's the nature of that revision? What happened to the HELP model?

DR. GRANT: Okay.

The -- the change is not caused primarily by a revision of the -- of the HELP model. The revisions that were -- were made between, roughly 1986 and -- and sometime this year, had to do with making the model more -- more easy -- making the model easier to use with supplying a -- a synthetic climatic generator

to allow longer records to be examined more easily. And improving, as I understand it, some of the -- the algorithms that the -- that the -- that the program used.

Those changes did not, to my mind -- to my knowledge, cause any very large changes in the estimates of the HELP model The -- the numbers that you're referring to were recorded -- were derived for the engineering report, and they were based -- first of all, the .01 inches per year was based on building the cell and -- and having essentially no weathering of the -- no loosening of the surficial soils over time. And I believe we reported that as our best estimate of the cell cover as -- as it would be constructed.

We -- we made another estimate that was essentially .1 inches per year, that allowed for some loosening and loss of -- loss of or increase in permeability of the surface layer of the soil. And that was the .1 inch per year estimate. And I guess we're referring to that as our conservative best estimates of -- of infiltration.

If the cell -- if the cell cover were built and performed -- were built exactly as it is proposed and if it did not deteriorate with time, then our estimate of the -- of the infiltration is something like .01 inches per year. If the surface of the soil, the upper layers weather and loosen and become more able to absorb water, there will be an increase in -- in infiltration through the cell cover. And that is

represented by the .1 inches per year.

JUDGE CARPENTER: Well, not having looked at the HELP code at all.

Looking at the engineering report at Table 2-29. The hydraulic conductivity of Layer 5 is so small that, without looking at the equations, I'm mystified as to why a little bit increase in hydraulic conductivity of Layer 1 or 2 has such a big effect.

DR. GRANT: That -- that --

JUDGE CARPENTER: Why the dominant term isn't the clay layer?

DR. GRANT: Right. Could I -- could I ask you to look at Figure 2 in our -- in our recent testimony?

Figure 2 was prepared by -- prepared using the new HELP model that -- that allowed synthetic generation of climatic parameters, to generate infiltration through the, what in the engineering report is the point -- let me refer to it as the .1 inch cover. For a period of a hundred years.

And if you look at it, it has -- there are two infiltration regimes here. On the left side in the dryer years, the infiltration is controlled by the ability of this surficial layer, the root zone layer, to capture moisture, hold it until the -- until the weather warms and gets dry and plants remove that moisture from the -- from the root zone.

During wetter years, there are enough periods in time

where the -- where there's sufficient moisture in the cap that the infiltration is controlled by the bottom two-foot layer, the -- the layer that you referred to, Layer 5, that has a very low permeability. So to the righthand side of this, of this curve, we have essentially a low permeability layer limiting infiltration. To the lefthand side, we have infiltration being limited by evapotranspiration.

The evapotranspiration side is -- is very sensitive to the -- to the permeability, the ability of this root zone to allow water to enter.

The low permeability side of the curve is not sensitive to that. And so if you allow more water to enter the -- the surficial layers, in essence you move the lefthand side of this -- you move the -- the low permeability side of this -- of this curve further to the left, you have more of your -- more of your infiltration control being provided by the lower-permeability layer and less by the evapotranspiration layer.

JUDGE CARPENTER: I think the bottom line on that is the -- is the 0.1 inch here is, as you say, is -- perhaps bides time.

It still doesn't explain why the numbers get so much bigger, as time went on.

I agree with the shape. I think you could have done the same analysis with a different -- different structure of the

cover. And gotten the same probability distribution.

And there's something that's moving the infiltration rate up.

DR. GRANT: You mean, -- calculated.

JUDGE CARPENTER: The surface layers of the cover. Why is it so sensitive to the surface layers of the cover?

DR. GRANT: Because those layers are the layers that control which regime the cover is acting in.

If I make a very low permeability surface layer, I get almost all of my control by evapotranspiration. If I increase it, if I put sand there, then all of my control would be by the -- by the low permeability clay layer. And I'd have a flat -- essentially a flat curve.

JUDGE CARPENTER: Let me be sure I understand your answer.

The clay layer would be controlling if the water ever got there.

DR. GRANT: Exactly. yes.

JUDGE CARPENTER: If it doesn't, it isn't.

DR. GRANT: It isn't. That's -- that's correct.

JUDGE CARPENTER: Thank you.

DR. GRANT: Thank you, sir.

(Pause.)

JUDGE CARPENTER: As you -- turning away from this infiltration issue that the other -- the other big issue before

us, namely the concentration of materials that might emerge from the bottom of this cell.

The -- in your testimony, you stated the --"the NRC assumptions in the modelling were conservative, thus yielding results that overestimate the impact on the site."

Looking at both the introduction to Appendix A to Part 40, then we're only going to have to look at -- will only come down to some sort of comparison between the cost and the benefit. And when I see the word conservative, it isn't very helpful to me because conservative which way? Conservative to me is synonymous with bias.

It would be very facetious if I was doing a cost estimate that involved pickup trucks; I might assume the pickup truck was going to be $100,000. And that's conservative, for that purpose. But if I'm doing a cost benefit analysis, to prejudice or bias something one way or the other, I've got to keep track of that bias.

So I keep the perspective that, just casually bias estimates high or low. At least there's some confusion when you go to do the cost benefit comparison. So I'm a little hesitant about being that reluctant with that.

Yes?

DR. FETTER: Well, I -- would it help if I explained that when we used the term conservative, we meant that the effect would be to make the impact on the aquifer worse.

JUDGE CARPENTER: The estimated impact.

DR. FETTER: The estimated impact on the aquifer worse, yes. Thank you.

JUDGE CARPENTER: Well, turning to the -- the issue that we raised for hearing. The name of this estimate of what the concentration would be in a leachate.

The Staff's testimony takes the position that these leachate tests which Kerr-McGee performed are not equivalent to the in-site do leaching of the waste a would occur in the proposed action, by means of any precipitation percolating through the cell cover.

And I want to ask why there wasn't an attempt to simulate what would really happen in the cell, as a basis for evaluating the proposal.

DR. STAUTER: The reason that the type of testing we did, the EP toxicity testing, was to provide a conservative basis. In other words, what we considered would be a maximum concentration that would be generated from the materials we had on-site. Rain water certainly will have PH greater than five, but we decided to use the EP tox test as what we felt was a worst type of case.

Furthermore, the test was -- was standardized, and we did not have to worry about variability in the test. In other words, the PH range -- PH always stayed the same, and we could correlate. You don't get that if you -- in a lot of cases, if

you leach -- if you use a water test or simulated rainfall leachate test, with a varying type of material that would go into the cell. In other words, one material may -- the test may end up with a PH of 6; another material might end up with a PH of 7, and it's kind of hard to correlate.

So it had a balancing point with the test.

And it was also conservative. For -- for example, the materials like the tailings had been subjected to a very severe processing step with sulfuric acid to begin with to get the constituents in the solution, the thorium and the rare earth. Therefore, those materials were very refractory that were left. And again, by leaching those with the test we felt that we did have a test that would provide us with the confidence that we could assert that this is the maximum that we could end up with.

And that's why we did the test we did.

Jim, you might want to say how we further utilized those in the model.

DR. GRANT: Well, let me -- let me also say that a lot of the choice here was between -- was a choice between doing a very detailed test on a small test or a lot of -- a lot of the EP tox test on -- on a lot samples to better characterize the variation of the materials that we were testing.

And we did, the engineering report reflects this. We did do other testing on -- on composite samples of the tailings to try to determine the effects, for example of different

amounts of leaching solution and whether that would materially impact the concentrations of any of these constituents. And -- and so, the method that we selected was one that we thought was, as Dr. Stauter said, conservative, would allow us to test a lot of -- a lot of samples from each kind of waste, give us a good feeling for the solubility of these materials over the site that we were going to put into the waste.

And we thought, also, that the -- although there's no claim that the EP tox test is representative of the leaching process that will go on in the cell, it is exactly representative that it, again that it provides the basic -- the basic aspects of leaching that will occur. It has a leaching fluid that is -- that is placed in immediate contact with the -- with the materials that are being leached. And -- and the -- the fluid is given a chance to dissolve in the soluble materials in the tailings.

JUDGE CARPENTER: You mentioned that you've done some other tests with a composite of the waste. How do the results of those tests compare with this EP test?

DR. GRANT: They are -- are generally -- they generally give less -- lesser concentrations of, particularly the more insoluble materials, the heavy metals and the radionuclides, than the EP toxicity test.

And the reason for that I think is that those tests did not use the same acidic leaching fluid; the tailings in some of

those tests were neutralized with lime, as were the tailings that are placed in the cell, before the test was run.

There's a, in the testimony, a table. Let me see if I can find it. Table 3, that -- that summarizes the values of the -- of the various leachates, including a recent leachate test that was done from a very large composite of material. This test was performed after the -- after the engineering report was prepared.

And I believe in -- I believe in every case the -- the test from that recent, what is called the Recent Leachate Test, the constituents -- constituent concentrations are smaller than the ones that we used in the engineering report.

JUDGE CARPENTER: Well, there's a difference, and it's not a small difference.

You know, somebody -- you're going to build a cell and somebody's going to pour dilute vinegar down it, I would understand the EP test.

DR. GRANT: Yes.

JUDGE CARPENTER: I'm not aware that there's going to be any vinegar on -- site.

DR. GRANT: We certainly hope not.

The EP test were also available, they were also run, as a part of the program that was undertaken to demonstrate that there were no RCRA regulatable materials at this site. And so they served a dual purpose: the purpose of -- of demonstrating

that, as well as providing estimates of leachate.

JUDGE CARPENTER: Well, to the extent that the EP leachate results have been used and you've been cross examined about leachate coming out of the cell in terms of comparisons with Illinois Water Quality Standards. Are those comparisons that are in that table valid in view of your recent leachate test result?

DR. GRANT; I think they're -- I think they overstate the case, but I -- I don't -- I don't think I feel comfortable, and I don't believe that Kerr-McGee would feel comfortable in telling you that we don't believe that the leachate, for any constituent, would ever exceed the -- the Illinois General Water Use Standards without any dilution or anything else. You know, if that were the case then we would be talking about a total non-problem here; that -- that would be groundwater issues.

If the leachate itself meets the Water Quality Standards, then there's no need for a -- any groundwater protection. And we don't think that's true. We think that -- that the concentrations of the leachate will be at least near enough to the standards that there needs to be some limit on infiltration, some control on mixing and -- and an engineered disposal.

JUDGE CARPENTER: In my little remarks about certainty, is it -- this Board's got to make findings of fact. And we like to make the most realistic findings, and state what the

uncertainty is of those findings, rather than conservative, bounding guesses as to what some limit might be. Because by and large, the Commission starting back with 1 NRC 227, about 40 or 50 references in case law, has encouraged Staff to make realistic computations and state the uncertainty in those computations rather than picking some bounding value to multiply by a bounding value to multiply by a bounding value, to the point of losing all contact with realism. And we're trying to go in the direction of, what is the most realistic estimate? And what is its uncertainty?

And to the extent that the concentration of potentially toxic materials is overestimated by the EP test, it is causing, perhaps unnecessary concern. That's the other side, you see. I quite agree with what you said earlier.

DR. GRANT; Yes.

JUDGE CARPENTER: About -- you're sure not going to be nonsensically overassurant, but to be intimidated the other way, by overestimating what may be coming out of the cell isn't -- isn't useful either.

And that's my point about the confusion of the word conservative, you see. It cuts both ways.

But come back to my question. Is it the panel's position that the recent measurements are the most representative analyses --

DR. STAUTER: I believe --

JUDGE CARPENTER: -- for what may come out of the cell?

DR. STAUTER: I believe they are.

I believe that that testing is demonstrated --

JUDGE CARPENTER: I've got two sets of numbers; which ones do I look at?

DR. STAUTER: The recent leachate test.

DR. GRANT: The recent leachate test were performed on a sample composited from a large volume of -- of the materials tested. And they were leached with water, not with -- not with vinegar or acid. And the tailings that were used as a part of those -- those materials when they were -- for the composite sample and for the tailings themselves in the tailings leachate were neutralized with lime, as they will be before they were placed into the -- in the cell. That's the --this is the most realistic leaching -- these are the most realistic leaching numbers that we have to date.

JUDGE CARPENTER: Thank you.

JUDGE KLINE: I'd also like to explore the -- the distinction between realism and conservatism in another aspect.

My understanding is that the modelling that you've done of the infiltration does not take account of an unsaturated portion of the E-stratum; is that correct?

DR. GRANT: That's correct.

DR. STAUTER: That's correct.

JUDGE KLINE: I want your realistic view as to whether

an unsaturated stratum within the E-stratum would actually exist after the cell is built.

DR. GRANT: Yes, sir; it will.

JUDGE KLINE: Is there any realistic mechanism by which that unsaturated zone can ever become saturated once the cell is in place?

DR. GRANT: The -- the ways that I can see that that would happen would either be for a -- for a rise in groundwater -- in the level of water in the E-stratum to intrude into the -- into the cell. And that's very unlikely because the bottom of the cell is essentially at ground surface, so that would -- would almost mean that the E-stratum was saturating the -- the surface of the site.

JUDGE KLINE: Yes.

DR. GRANT: The other mechanism would be if infiltration through the cover were so large that -- that it -- it generated -- it allowed enough water to infiltrate that it would actually saturate the bottom of the cell.

JUDGE KLINE: Well, under the -- under the most realistically likely conditions, where you've estimated say a tenth of an inch a year of --

DR. GRANT: That will not happen. That's --

JUDGE KLINE: Is there any hydraulic connection between the bottom of the cell and the top of the saturated zone?

DR. GRANT: Just the unsaturated zone, but the --

JUDGE KLINE; I mean, is that hydraulically connected in any meaningful way? That is, can any movement of solubles take place between those?

DR. GRANT: It can through the unsaturated, through unsaturated zone.

JUDGE KLINE: But what -- is there a mechanism for unsaturated flow, is I guess what I'm getting at.

DR. GRANT: I -- we think so, we think that --

JUDGE KLINE: Or transport of solubles.

DR. GRANT: Yes, we think that whatever water comes in the top of the cell, will go out the bottom. We've gone to great lengths to avoid creating something that would -- would lead to the kind of saturation that you're -- that you're concerned about.

JUDGE KLINE: Would you define saturation then? Because I -- I may be --

DR. GRANT: Okay, when we're -- when we're talking about saturation, we're talking about all of the pore spaces in a soil being filled with water, or fluid.

JUDGE KLINE: Yes, but --

DR. FETTER: And having -- and having a pore water pressure positive.

JUDGE KLINE: But -- but isn't, in the -- that is, where there is a system that's -- that's unsaturated, the capillary pressure and the -- and the gravitational force are

more or less in equilibrium?

DR. GRANT: In balance, but if we have a net infiltration --

JUDGE KLINE: Oh, I see.

DR. GRANT: -- through, then eventually that net will -- will establish itself as a --

JUDGE KLINE: So it sits at the threshold.

DR. GRANT: It sits at the threshold, exactly.

JUDGE KLINE: A hundredth of an inch at the top can still transport --

DR. GRANT: And -- and it comes out like a putty gun. You put a hundredth of an inch on the top and it will come out very quickly on the bottom; it's not the same --

JUDGE KLINE: Yeah, I understand it's not the same water. But --

DR. GRANT: But they're --

JUDGE KLINE: But even though it's referred to as an unsaturated zone, it sits at the threshold of saturation such that any input at the top will transmit --

DR. GRANT: It's an unsaturated zone, not a dry zone.

JUDGE KLINE: Yeah, okay. Okay.

DR. FETTER: It's not necessarily at the threshold of saturation. In unsaturated flow, it turns out the water is moving through the smaller capillary pores, which in fact are saturated.

JUDGE KLINE: Yeah.

DR. FETTER: If you want to think of it in totality, the -- it's unsaturated, but there are some saturated connections across the zone, and that's where the water is in fact flowing.

JUDGE KLINE: Okay. Okay, I understand.

Okay. Thank you.

JUDGE FRYE: Anything else from anybody? Thank you gentlemen for testifying. We appreciate your efforts.

Why don't we take our 15 minute break at this point and when we come back we'll come back to Dr. Warner.

(Whereupon a 15 minute break was taken.)

JUDGE FRYE: Back on the record please.

Mr. Rathe? Proceed.

MR. RATHE: Your Honor, I need to address a couple of procedural matters at this point. One, we have introduced a certain impeachment testimony by deposition. I would ask Mr. Meserve would you stipulate were I to call the court reporter she would testify that those questions were asked and those answers were given to perfect the impeachment.

MR. MESERVE: I'd be happy to. I haven't had a chance to consult with the witnesses as to whether they think it's an accurate transcript though. I think it is myself. Why don't we work together on that. I'm sure we can --

MR. RATHE: I'm sure we'll just end up stipulating. If not, if need be we'll call the court reporters to come back for impeachment.

JUDGE FRYE: Have the witnesses seen the transcript of the deposition?

MR. RATHE: Yes, they have it available to them.

MR. MESERVE: The transcripts, I believe, arrived very early this week.

JUDGE FRYE: Well it doesn't sound to me like it should be a problem then.

MR. MESERVE: I don't think it's a problem.

MR. RATHE: It's not a problem. I don't anticipate a problem.

The second thing is the matter of basically indulgence I'm going to ask of the three board members. Our only witness is Dr. Warner who lives in central Missouri and it's very difficult for him to commute, it's not easy. I know we were planning to work only to 5:00 and maybe that's when we'll have to stop.

But if we're reasonably close to being done, I would ask them to work past 5:00 if we could get him out of here tonight, I would like to, if we could do that. I'm not saying we have to say to 7:00, but if it's 5:15, 5:20, I'd ask that we do that.

JUDGE FRYE: We have no problem about that. I don't

know though, I have to say in all candor, whether there's a problem about staying in the building for an extended period of time.

MR. RATHE: I don't know that either.

JUDGE FRYE: Mr. Meserve, do you anticipate very lengthy cross?

MR. MESERVE: No, I don't your Honor.

JUDGE FRYE: I see and Ms. Hodgdon?

MS. HODGDON: No, I don't.

JUDGE FRYE: So I would say there's probably a very good chance we'll get through.

MR. RATHE: Right. I would appreciate it, if the board could accommodate us with Dr. Warner.

JUDGE FRYE: Surely.

MR. RATHE: He is our only witness. We'll do this later, just to preserve our record and maybe it's already part of the record, we're going to instruct -- but we want to make an offer of proof that --

JUDGE FRYE: Surely.

MR. RATHE: But we'll take care of that --

JUDGE FRYE: I think that you can assume that it is part of the record now and if it's not we'll be sure that it is.

MR. RATHE: Just for purpose of exhibit, if it's not in the record.

JUDGE FRYE: Surely.

MR. RATHE: Thank you. Dr. Warner, would you take the panel please.

JUDGE FRYE: Would you raise your right hand please.

DR. WARNER: Yes.

JUDGE FRYE: Do you swear that the testimony that you will give will be the truth, the whole truth and nothing but the truth, so help you God?

DR. WARNER: I do.

JUDGE FRYE: Thank you very much, please be seated.

MR. RATHE: Sir, would you state your name?

DR. WARNER: Don E. Warner.

MR. RATHE: And Doctor, would you just tell the Board briefly what your background is?

DR. WARNER: Well, professionally I'm a geological engineer. I did my undergraduate work for the Colorado School Mines, graduate work there also and obtained my doctoral degree from the University of California, Berkeley.

I worked in the environmental area since 1964 and since, I've worked for five and a half years with the predecessors for the present USEPA in groundwater matters, land disposal matters.

Since 1969 I've been at the University of Missouri in Rolla as a Professor of Geological Engineering.

MR. RATHE: And your present position there is?

DR. WARNER: I'm Professor of Geological Engineering

and I also administer the School of Mines.

MR. RATHE: Judges, unlike the Kerr-McGee presentation, since Dr. Warner's testimony has now been basically reduced to two pages in light of the Court's rule or the Judge's ruling, I am not going to ask him to summarize it. I think it's relatively straightforward and speaks for itself, so I'm just going to tender Dr. Warner for questioning?

JUDGE FRYE: Any objections to the introduction of the testimony?

MR. MESERVE: No, your Honor. No objection as to the introduction of the testimony is the Contention 4A.

MR. RATHE: I'm sorry, I should have asked for it to be moved that that -- so.

JUDGE FRYE: Staff have any?

MS. HODGDON: No objection.

JUDGE FRYE: Fine. So ordered. Mr. Meserve?

MR. MESERVE: We have no questions of this witness, your Honor.

JUDGE FRYE: Mr. Greenwalt, do you have any questions?

MR. GREENWALT: No, I do not.

JUDGE FRYE: Ms. Hodgdon?

MS. HODGDON: Staff has no questions, your Honor.

JUDGE KLINE: Yeah, in Paragraph 1 of your comments about the middle of the paragraph you state that you believe that the national rate of infiltration for the area of 3.6

inches per year should be assumed at the conservative or worst case value.

Having looked at the record and the various estimates of staff and licensee, do you have a realistic view of what the infiltration rate should be and if you could state, if you do have such a view, state it in terms of a point estimate in whatever boundaries around it you think might pertain.

DR. WARNER: I'm sorry, I really don't have that, a view of that value because I unfortunately haven't had the time and opportunity to generate any calculations myself, so I'm operating on the basis of the calculations that others have made that I've had any opportunity to look at.

I suspect that the estimates of, for example, that have been made using the HELP model are ones that are a realistic based on the assumptions that have been input into the model.

The concern that I have with those kinds of estimates is the experience that I've had over the last 20 or so years in looking at land disposal sites where I've yet to see one which is performed in the way that people have suggested it would prior to its construction. I have yet to see a cap which is maintained its integrity over a sustained period of time and I'm not certainly in a position to say that the one at this site will not.

I just haven't seen a record of performance that would indicate that in previous cases that it has and therefore it

makes it difficult to accept the results of modeling that are based on the idealized characteristics of those various cap layers.

JUDGE KLINE: But if we were to accept by your view of it, it would apply, would it not, that we would give no credit whatever to the clay liners, that is either the one at the base of the cell or the one that's called the cap, the one that is over the top of way.

DR. WARNER: Well, I think that probably that would be correct, but I have said and would only say that what I'm suggesting that number for is a worst case, because I didn't have the opportunity to generate more realistic estimate. I'm not able to suggest what that number would be and therefore having the experience that I have had in this area and my own style, choosing to like the bound the results so that one knows what you may be dealing with under the worst circumstances, that's the only number that I suggested one would use simply just to see what the results of that would yield and in fact I don't think that's not unusual because, in fact, Kerr-McGee in their own engineering volume too did exactly the same thing.

I believe they did. They used a five inch infiltration rate to test an upper bound and that's basically all I'm suggesting.

JUDGE KLINE: Do you have from your actual experience instances where such a clay layer has failed?

DR. WARNER: Well, as I said, I have yet to see a circumstance in my own experience where they have, where they in fact performed the way that they were suggested to or designed to specifically in the same geographic vicinity.

I worked for some ten years with the State with respect to Sheffield Low Level Waste Disposal site and one of the first things that was done in the decommissioning of that site was a four foot or so compacted clay cap was then placed on it and that cap immediately began to show instances of failure through subsidence and collapsing of the underlying structure which allowed the cap to then fail.

And I'm not aware that anybody had monitored the specific overall rate of infiltration over that site for example, but indeed the infiltration that was occurring was certainly not in the order of, I would not believe in the order of a tenth of an inch, it was, it certainly would have been much higher based on these localized areas of failure to cap.

JUDGE KLINE: In the Sheffield case, isn't it true that there were in effect waste adages of something buried there?

DR. WARNER: Yes, sir, that is correct. Those were trenches.

JUDGE KLINE: Was the subsidence through the collapse of these packages.

DR. WARNER: I don't know that any analysis was made, but it would be of the compaction of the materials that were put

into the burial trenches, yes.

JUDGE KLINE: Do you expect a similar subsidence in this Kerr-McGee cell?

DR. WARNER: No, I would not. But I certainly wouldn't. Clearly they expect some subsidence to occur, as I would, and so they suggested that they would not cap the burial cell for some period of time to which they allow the subsidence to occur, although I didn't succeed in finding, although it may be there, any specific length of time that they proposed to wait.

Certainly that would assist in the matter. I don't know, and I haven't seen the engineering estimate of exactly how much additional compaction, consolidation might be expected to occur over a very long period of time. Whether that would be enough to, well not cause a catastrophic type of subsidence and failure, the type that occurred at Sheffield for example, sufficient to crack a clay cap and/or liner and it really only takes relatively small cracks in such a liner to transmit a significant quantity of water.

JUDGE KLINE: Whatever compaction is done as a matter of engineering during construction, after construction is completed, isn't the weight of the overburden itself enough to cause compaction of these clay layers?

DR. WARNER: I would expect there would be some continued consolidation or compaction of the cell and the

materials in it and in fact the ground underneath it, yeah, for some period of time and all I'm saying, suggesting is, and I don't have direct evidence to show that it would happen, suggesting is that this continued consolidation could indeed over time be sufficient to cause cracking, not catastrophic failure but perhaps just cracking of these compacted clay layers.

And that's, those kinds of, the kinds of cracks that could develop would be sufficient to transmit a significant quantity of water and therefore all I'm saying is that the initial estimate that would be based upon the intact materials of these caps is predicted by the HELP model would be a lower bound to the amount that would infiltrate and then I would think, I'd suggested what an upper bound might be and somewhere in between the two would be the probable reality.

JUDGE KLINE: I'm having trouble visualizing the cracking of this layer and, the clay layer particularly. Given their position in the cell, I mean there doesn't appear to be much room for movement once everything is buried and there is a tremendous weight and material overlying both layers, what is the mechanism for an open crack as opposed to one, that is one that would transmit water?

DR. WARNER: Well, the vertical or the displacement between one side of a crack and the other to allow the transmission of a significant body of water only has to be in

micro-inches. I mean an extremely small displacement will allow that and, in fact, let me give the kind of analogy that leads me to believe this sort of thing can happen.

I've been involved in the investigation of a number of sites in glacial till similar to this, and similar to the deposits underlying this site. Those glacial tills are in the order of 10,000 years old. When they were first deposited there they were compacted under a great weight of overlying ice and there, in their original condition very impermeable and samples of those are taken into a laboratory and analyzed for permeability, the values are in the range, that are proposed for these compacted clay layers.

And early in my experience in looking at sites in those glacial materials, the capacity of those natural till layers to retard the flow of water was based on these, those kinds of laboratory estimates.

Yet experience in examining the sites and looking at what physically was happening there indicated then indeed those laboratory obtained estimates were not realistic and in fact the real field permeabilities of those glacial till layers tend to be on a basis of natural rates of infiltration that can be observed, tend to be anywhere from 100 to 1,000 times greater than the laboratory obtained values.

And it appears that that, those natural rates of actual relatively much higher permeability are a result of the cracking

of those tills, jointing of those tills over this long period of time.

Now what physical phenomena led to those creations of joints, I don't know myself. A variety of natural mechanisms undoubtedly led to that, but what I'm saying is the same kinds of cracks may indeed be able to occur over a long period of time in clay layers based on that analogy. And that's compacted clay liners and cap.

And I guess I would simply suggest that the overlying clay cap, for example, is sloped over this cell and whatever compaction of the cell that occurs under it will then, this is an intact membrane have the ability to cause relative displacements in that cap over this large site and I can visualize that being a sufficient stress to introduce cracks.

Now, whether it will be or not, I don't know. But I think there's no experience to say that it won't.

JUDGE KLINE: So this is, in a sense, a kind of, you're visualizing a kind of fracture flow, correct?

DR. WARNER: That would be correct.

JUDGE KLINE: Rather than a crack? Homogenous --

DR. WARNER: Porus media flow, that's correct. That's right. That would be the mechanism by which the compacted clay cap or clay liner could have much higher permeabilities than those that are predicted by the laboratory tests of those kinds of materials.

And it would be the mechanism by which you could get infiltration rates that would lie somewhere between the number that's been proposed and an upper number of a natural infiltration.

JUDGE KLINE: But from actual observation are you able to give us a numerical estimate of how far fracture flow might mediate from, I don't know what you call it, homogenous --

DR. WARNER: Porus medium flow. Well, I wish I could and probably one could generate those kinds of estimates, although I'm not sure how worthwhile they would be, by considering just that.

In other words, the presence of finite specific cracks at a certain spacing in a clay cap or clay layer, but I haven't done that and so therefore I couldn't give you the estimate and again I'm only bounding, saying I believe certainly within these values that that number would lie and I think that's, to me that's just instructive to, if using the upper level of number yields values of groundwater contamination that are a concern, then it's worthwhile to look at what the more realistic number might be.

If it doesn't, then it doesn't matter. It simply bounds the upper, in my view it simply bounds the upper limit of what may or could possibly, realistically happen.

JUDGE KLINE: My understanding now is that Kerr-McGee came up with a number for infiltration of .01 inches per year

and then moved it for conservatism to .1 and you're now telling us that there should be an upper bound of 3.6 inches per year.

It's fair to assume that it lies somewhere in that interval I guess.

DR. WARNER: Well that's, yes, that's basically what I would say. And I think that the movement of that estimate from 100 to one-tenth was based I believe, as I understand it, on a change in the permeability of that uppermost layer by some factor which is one that comes out of the documentation for the HELP model.

In other words, if a layer in which you have routed grasses, if your upper layer has routed grasses, then that causes you to, then you choose that option with the model, it causes you to increase the permeability of that uppermost two foot layer by some fact of three or whatever that may be.

And, but I wouldn't believe, I mean if one just wants to look at that, I wouldn't believe that that would be the probable ultimate long term high value permeability for that uppermost two foot layer.

JUDGE KLINE: That's what I'm trying to get at. Their having moved the number by a factor of ten doesn't help you with your problem, is that --

DR. WARNER: No, because I think that number could very logically still be moved additionally and then I am suggesting that from a very conservative point of view that one could

speculate that this clay cap that's going to be constructed first of all won't be perfect, it will most likely have imperfections in it over a site that's 900 feet or so in length and 600 or 400 or 500 feet in width and so those imperfections would cause there to be some higher rate of permeability than an ideal compacted layer to begin with and then over a very long period of time it's certainly possible that additional, that cracking of the type that I described could happen.

I'm not saying that it will. I'm only saying that it's certainly possible, I believe, and therefore I would say that any design which would use the initial conditions of the cap would be the best scenario for that facility and that the real value would probably be somewhat greater than that, certainly if not initially, over a period of time.

JUDGE KLINE: Thank you.

JUDGE CARPENTER: Turning your comments about our issue number six, which to a certain extent reflects the limited information, records concerning the movement of shallow aquifer waters the deeper aquifer, the dolomite aquifer.

DR. WARNER: Yes.

JUDGE CARPENTER: In your opinion if there were increased withdrawal water, there would be an increase flux from the shallow aquifer to the deeper aquifer, in direct contrast to Dr. Fetter's testimony?

DR. WARNER: That's correct.

JUDGE CARPENTER: Can you help the Board understand the reason for the differences?

DR. WARNER: I think, well, I can try. Let me start with Dr. Fetter's analogy and suggest a modification to that and explain how that bears on my view and the written testimony that I've provided. If you took that same bucket of sand that Dr. Fetter proposed and instead of a uniform bucket of sand you introduced at the bottom of it a finer grained material that had a lower permeability and you began to raise that bucket of sand out of the tub of water that he had it placed in, and you got it about half way out of the tub of water, you'd have a circumstance somewhat similar to what exists at the West Chicago site now. You don't have a hydraulic radiant of one all the way through the glacial materials. You have a hydraulic radiant that's greater than one across a narrow interval, the B layer, toward the bottom of those glacial materials.

The rate of head dissipation across a layered force media is not the same as it is through a homogenous forced media. That is if you consider the hydraulic radiant of one through a uniform forced media the dissipation of that -- is uniform through -- would be uniform through that whole bucket of material.

If you have a finer grained layer in that, and in the case of the site and in the case of the bucket analogy toward the bottom, the relative dissipation of the head across the fine

grain layer is much much greater than it is through the course grained materials, through the sandy part. And therefore although the limiting gradient for the whole bucket is one as Dr. Fetter has stated, there is no such limiting gradient for the fine grain material.

The distribution of head loss is proportionate to, inversely proportionate to the hydraulic conductivity. So that if you were to take the hydraulic conductivity of the course grain material and divide that into one, in other words take the inverts of it, make it a resistance instead of a conductance, you're dividing a relatively large number into one taking the adverse of that and you're very low conductive materials will have a very large resistance. In other words, if you have a conductivity of ten and conductivity of one, the conductivity of ten will absorb only a tenth of the hydraulic gradient that's being dissipated, whereas the conductivity of one will absorb one as compared to one-tenth.

In other words, the fine grain layer -- most of the head will be dissipated across the fine grain layer. There's a very simple equation that can be used to demonstrate this. Unfortunately we don't have a blackboard, so I can't do that, but the point is that you can continue at the West Chicago site the total hydraulic gradient that's being dissipated is not one. It's more like .5 through the whole sequence of glacial materials. You can continue to increase the amount of head

that's dissipated through the whole sequence and again, most of that will be dissipated across the fine grained interval.

So that you can have a relative amount of loss of the head, 80 percent of it can be across that fine grain sequence at the bottom, and you'll continue to increase that amount of head that's being dissipated until you finally reach the point where you do have a hydraulic radiant of one across the whole sequence.

So you can increase the graining across that fine grain layer at West Chicago to perhaps twice what it presently is. And you'll then therefore have twice the amount of water flowing through it. Is that helpful?

JUDGE CARPENTER: Yes, that was my bottom line question, what are the quantitative aspects.

How competent are you in your seat of the pants estimate that it might be as large as a vacuum tube?

DR. WARNER: I really didn't -- I think that the -- let me back up. I think that the relative amount of head being dissipated now across that B layer is about one to one. I think it's about 26 or 27 feet across a layer that's about that thick. That could easily be doubled, yes.

JUDGE CARPENTER: Thank you.

JUDGE FRYE: Any questions from any of the parties?

MR. RATHE: Can I ask some recross?

JUDGE FRYE: Yes, he's your witness.

MR. RATHE: -- redirect --

JUDGE FRYE: Redirect we'll allow.

JUDGE KLINE: Let me ask one more question.

JUDGE FRYE: We have one more question first.

JUDGE KLINE: At the bottom of the first page you have a statement indicating mechanisms other than ion exchange between water and absorbing surfaces may be important for both the release and transport -- what mechanisms did you have in mind there?

DR. WARNER: That statement is from a quote that came out of the paper by Gilbert and others, it's not my words. They were referring to the mechanisms. The reasons that they were doing that is that's the mechanism that they assume in their modelings, that's the mechanism they assumed would occur and so that's what led to this model modification that the NRC has used. In the NRC model, that's an implicit assumption.

JUDGE KLINE: I thought their assumption was that mechanisms of ion exchange would be --

DR. WARNER: Yeah, that's right, and that's what this is saying. They assumed that ion exchange would be the mechanism. They're saying other mechanisms could also be involved. The actual authors of that model, that Gilbert and others -- I used that as the mechanism by which they were getting the exchange the solids and the solids. And they are saying that they could have used other assumptions but they

didn't.

JUDGE KLINE: Okay. Rather than debate what they thought, what do you think? What is the role that ion exchange plays in retarding the movement of solubles in the infiltrating water?

DR. WARNER: Well, it almost certainly would do that with respect to the heavy metals.

JUDGE KLINE: It would retard it?

DR. WARNER: Yes.

JUDGE FRYE: -- follow up questions?

MR. MESERVE: Your Honor, I think we ought to probably be entitled to cross examine before redirect occurs.

JUDGE KLINE: -- yes.

JUDGE FRYE: We're not through yet.

MR. MESERVE: Oh, I'm sorry. I saw you looking at Mr. Rathe and I thought that was a signal to him.

JUDGE CARPENTER: Since Judge Kline raised the issue -- model, I'd like to ask your opinion as to whether you think it's appropriate for the kind of materials and the kind of cells proposed at West Chicago?

DR. WARNER: No, sir, I do not.

JUDGE CARPENTER: For what reason?

DR. WARNER: Well, I've stated that in the affidavits that I've submitted and also in this document. I think that the fact is that the mechanism of introduction of the wastes and

then following that the transport process in the saturated zone are really not appropriate to that kind of site and that kind of circumstance that we have at West Chicago. I really don't feel that the model that the NRC used was an appropriate one. No, and it was -- at all a model, they modified the original code that was developed by Dr. Yea (phonetic).

JUDGE CARPENTER: Well, can you be a little bit more specific about what you think? What aspects of it do you think might lead to significant error in terms of estimating concentration of materials in the water at the site boundary?

DR. WARNER: Well, the mechanism by which the waste is being introduced into the saturated zone through this one dimensional infiltration model that was utilized is a uniform lowering of a single block of saturated contaminants into the groundwater system and it doesn't allow for a, it doesn't allow for continuing leachating of these contaminants into the groundwater system over a period of time. It's a finite block of contaminants that's being lowered and uniformly over the whole site without taking into consideration that there are indeed parts of that cell which are going to contain materials that are more concentrated in contaminants than others. And without taking into account the fact that there will be parts of that cell through which the water will be moving more rapidly than it will through other parts of it.

And then the dilution of those contaminants once

they've been introduced into the groundwater system, the modeling results which have been generated by the NRC seem to me to be unrealistic and unexplainable and therefore, suggest to me that there are inherent assumptions in that saturated transport model which yield results that don't coincide with what I would think is common sense in terms of hydrology, don't make sense to me technically.

And I've commented on those modeling results as being ones which I don't understand the reason for and, therefore, wonder or believe that the model has a peculiarity to it which is causing those results to be generated and which I question.

Let's look at --

JUDGE CARPENTER: May I interrupt just a second.

DR. WARNER: Surely.

JUDGE CARPENTER: You're using the word model, let's go back to the word equation.

DR. WARNER: Yes.

JUDGE CARPENTER: The first equation, the conservation of mass. What problems do you see in the NRC formulation of that?

DR. WARNER: From a mathematical point, none.

JUDGE CARPENTER: Okay. So where does the problem arise?

DR. WARNER: Well, in the way that the model operates. In other words, the fact that you start with basic principles

and arrive at an equation which you then use doesn't mean that the equation approximates that the direct results of using the equation approximates reality.

The equation is correct for the physical circumstance that it's supposed to replicate. But the physical circumstances are consistent with the assumptions that went into the model in the first place. Then the results that the model generates are not realistic with regard to the real field prototype that you're attempting to model. And that's a concern that I have more than any other.

JUDGE CARPENTER: Well, the problem I have, you were saying that in your eyes, the results of this computation were -- with your sense of common sense.

DR. WARNER: That's right.

JUDGE CARPENTER: And to a layman, I have to look at the equation and wonder whether the -- coefficients are the right size -- or the horizontal velocity is the right size, whether the source term is the right size, that's the only way that I can look to see if it has some physical -- and if they're unrealistic -- coefficients, that to my common sense, would suggest a serious error. That's what I'm trying to get a feel for, specifically what you felt were the weaknesses. The bottom line, you don't like, but I'm trying to trace how you get there.

DR. WARNER: Well, the input -- one can question the input numbers, but I haven't really done that. What I said that

accepting the input numbers the output doesn't make sense. And the reason why I'm saying that is if you visualize with me for a minute this block of contaminants being uniformly lowered into the groundwater system as they one dimensional modeling that's being used here does. Now there's some retardation of those contaminants as being lowered through the clay, through the compacted clay layers, and that I don't disagree with. I mean, I believe that that kind of retardation will occur.

But as the, say a contaminant that isn't retarded, is being lowered into the groundwater system, then we see NRC saying that this is a uniform rectangular block that's being lowered over the entire disposal site. And yet the numbers that they are generating from this are such that they are saying that the amount of dilution that will occur to this uniform block of leachate as it's lowered into the groundwater system, is exactly the same precisely at the edge of the cell as it is down gradient some 70 additional meters at the edge of the site.

Now, first of all, it doesn't make physical sense to me that these contaminants have been diluted 660 fold at the edge of the cell. Where indeed they're being lowered into the groundwater system, or imposed on the groundwater system at the strength of the leachate that the NRC has said exists.

Now, it's difficult for me to understand how that 660 fold dilution has occurred immediately at the edge of the cell which is where the block of leachate is being lowered into the

groundwater system. But given that that made some sense, one would certainly expect additional dilution to occur between that point and another point further down gradient away from the edge of the cell.

The amounts of dilution, first of all, are I think relatively large. It's being suggested that that amount will have occurred immediately at the edge of the cell and then it's being further suggested that that same amount of dilution would also exist at the edge of the site.

A series of, to me, relatively illogical facts, or facts that if one's logical, then the next one is not. They don't tie together.

JUDGE CARPENTER: Well, to the extent that this 900 foot wide source is producing a plume that's moving on site, I think -- reference to the center line of that plume -- can be additional dilution between the edge of the disposal cell and the site boundary. At the edges of the plume.

DR. WARNER: Um-hum.

JUDGE CARPENTER: Without anything necessarily decreasing concentration along the center line of the plume in that distance as I recall.

DR. WARNER: Well, perhaps that is true, but again, I don't find it consistent that a dilution of the centroid of that plume -- well, first of all, it shouldn't be a plume because it shouldn't be a slug. I mean, it -- excuse me, it shouldn't be a

plume that's based on a single slug entering the system because that's not physically the way it's going to happen. But if you say, well, all right, we'll let that go by, let it be entered as a slug and we'll have a plume with a centroid where it's moving.

Then how that dilution of that centroid, how that centroid was caused to be diluted 660 times at the edge of the cell and then not receive any further dilution between the edge of the cell and the edge of the site, it still doesn't make any physical sense to me.

JUDGE CARPENTER: Well, we're not going to resolve it here, thank you.

JUDGE KLINE: Even granted that it doesn't make physical sense, that it seems that it's true for the moment, or I will assume that it's true for the moment for the purpose of the question, are there compensating errors, that is to say, your comment appears to be that as the slug enters the groundwater the dilution is too rapid and then subsequently there's no dilution at all. Well, what if you reversed it and said well, there's very little dilution to start with, there should be dilution down stream. Do you end up with compensating errors that make the numbers realistic in any event?

DR. WARNER: Well, I couldn't answer that, I don't know. The thing that troubles me is really the fact that we've got two -- well, we've got a modeling analysis by the NRC which

appears to have been the basis for their judgment that the site was unacceptable and, yet, the modeling results are ones that on the fact of th'm, seem difficult to accept. And, therefore, I simply would be uncomfortable in basing the judgment site as acceptable on data which to m are inherently understandable.

JUDGE FRYE: Mr. Meserve, do you have very much?

MR. RATHE: May I address the Court Reporter --

JUDGE FRYE: Sure.

MR. RATHE: -- reserve as questions -- Judge, I'm just a little curious, Mr. Meserve and everyone else has waived cross and now there is to be cross. It seems like either there should have been cross before -- of where we stand in terms of why is being allow now.

JUDGE FRYE: Typically, there is precedent within the NRC to allow cross based on Board questions. It may not be the best precedent in the world, but it is there. And I want to find out what the extent of it is.

MR. MESERVE: Well, Your Honor, could I have just a moment to confer with our experts, it may be very very brief. In fact, there may be no cross but I would like a moment to confer with him. There's a number of issues that the Board has raised that are not within the scope of his testimony, admitted testimony that the Board has inquired into.

And I'd like to have a moment, if I may, to consult with our experts. I won't be long and I don't suggest that we

adjourn, it would just be a moment -- corner.

JUDGE FRYE: That's fine. Ms. Hodgdon, do you anticipate any questions at all?

MS. HODGDON: I might have one --

JUDGE FRYE: All right, fine. Why don't you consult with him.

MR. MESERVE: Thank you, Your Honor.

MR. MESERVE: We've lost Ms. Hodgdon.

Your Honor, I just have one or two questions.

Dr. Warner, it's the case, isn't it, that the only part of the Engineering Report that you examined was Volume 2 of the Engineering Report?

DR. WARNER: That's correct.

MR. MESERVE: You've had no occasion to examine the analyses of subsidence that were in other parts of the Engineering Report, have you?

DR. WARNER: No, I have not.

MR. MESERVE: Thank you. That's all, your Honor.

JUDGE FRYE: Ms. Hodgdon?

MS. HODGDON: I don't have any questions.

JUDGE FRYE: All right.

MR. RATHE: I think I have maybe two questions.

JUDGE FRYE: Fine. Proceed.

MR. RATHE: Dr. Warner, you were talking about the difficulties you are having with the NRC staff dilution model,

is that correct?

DR. WARNER: The extent to which their model showed dilution to have occurred, where it occurred, yes.

MR. RATHE: Do you have a similar problem with the Kerr-McGee dilution model?

DR. WARNER: Well, I have a problem with the methodology that they used in that I believe that it has resulted in a relatively large dilution of the leachate as it was introduced into the groundwater system very quickly through the mixing throughout the entire saturated thickness of the E-stratum and I can't separate the result of that kind of instantaneous mixing which is a model generated mixing and not a physical reality in my view. I can't separate that from the more physically realistic mixing that would have occurred as these leachates were transported to the groundwater system and mixed by dispersion as they moved.

MR. RATHE: So you're saying that the model and reality don't jive?

DR. WARNER: I don't know the extent to which the model differs from reality because I don't have what I would think of as a more realistic modeling result to compare it with.

MR. RATHE: Well, what would you need to have a more realistic model result?

DR. WARNER: Well, one could have modeled the system in such a way that the inherent stratification of the contaminants

as they first move into the groundwhere the system would have existed and that you could see the result in dispersion that would occur as the contaminants were transported laterally in the groundwater system and could then obtain a feel for the dispersing effects and how much polysensity those effects were to the assumption for example for value of dispersivity and you could then understand how much you would influence those model results by varying the model parameters to test them and their sensitivity. And it can't do that when you have an inherent perhaps overriding dilution which is being cause by the characteristics in the model itself rather than the physical system which you're trying to model.

MR. RATHE: Dr. Warner, are you aware of any studies that model similar sites to West Chicago in terms of the movement of waste through -- the unexpectedly quick movement of the waste through the stratum?

MR. MESERVE: Your Honor, I object to this. This is well beyond any area of question the Board has gone into. The Board has asked us to leave technical questions about this mall and we're getting off into never, never land of the excluded testimony now.

JUDGE FRYE: Judge Kline recalls asking about that. Overruled.

MR. RATHE: Dr. Warner, could you just briefly tell the Board what studies you're aware of that suggest that in

something analogous to West Chicago there has been much more rapid movement of waste through the stratum than was ever predicted?

DR. WARNER: Well, I think that what you're asking about is a study that I'm aware of that was conducted by the U.S. Geological Survey at an abandoned waste disposal, former waste disposal site, that was associated with the Argon facility. It was a site that was on the very west edge of Cook County in which there was disposal of low lever radioactive materials into a pit and where it was subsequently found some 30 or so years later that tritium had migrated from that pit through about 120 feet of glacial materials into the silurian dolomite bedrock aquifer in a probable period of about 20 years. And the vertical rate of migration that was predicted by or found to have occurred at that site as a result of the detailed studies by the U.S. Geological Survey was about two meters a year of vertical movement through this 120 feet of glacial material which included layers that were fine grained as they are at the West Chicago site.

MR. RATHE: So you have an actual case study that suggests that the movement of, in this case tritium, was much quicker than predicted through the various strata?

DR. WARNER: Well, it wasn't --

MR. MESERVE: Your Honor, I think it's inappropriately leading an expert. Especially -- this is the man's own witness.

As counsel testified, as counsel mentioned, that's not a proper question.

JUDGE FRYE: Yes, I think you are leading a bit.

MR. RATHE: I apologize.

DR. WARNER: I don't think that the results of what was seen at that particular disposal site or model that all that was done was to observe what actually did happen.

MR. RATHE: And was the movement through the various layers to the dolomite, was that rapid movement?

DR. WARNER: Well, what it resulted in was that the hydraulic conductivity of the overall sequence was estimated on the basis of that rate of travel to have been something like six times ten to the minus six centimeters per second, which is probably a hundred times more permeable than you would have estimated it based on laboratory tests.

MR. RATHE: I have no further questions, Judges.

JUDGE FRYE: Dr. Warner, thank you very much for your testimony. We appreciate your being here.

DR. WARNER: Thank you, sir.

JUDGE FRYE: That leaves us then with staff's witnesses to hear tomorrow. Do you have any estimate, Mr. Rathe, of how long you will require for that?

MR. RATHE: It will be no more than Kerr-McGee's panel, but likely less.

JUDGE FRYE: Likely less. About half a day, in other

words?

MR. RATHE: I -- well -- as Mr. Meserve and I have gone back and forth over the depositions, my estimates aren't too good, so I'm not going to get pinned down here, half a day.

I think that would be the outside, honestly.

MR. MESERVE: That's an issue on which we can agree.

JUDGE FRYE: I see.

Do you anticipate very long Mr. Meserve?

MR. MESERVE: No, I don't.

JUDGE FRYE: And Mr. Greenwalt, do you anticipate very much?

MR. GREENWALT: Minimal.

JUDGE FRYE: Very minimal? Okay.

Well, we will be upstairs. I apologize for the fact that we couldn't keep the same courtroom for this session. It will be the Court of Appeals in Courtroom 2781 tomorrow morning at 9:00 o'clock. We will stand adjourned until then.

(Whereupon, the hearing adjourned at 4:55 p.m.)

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission

in the matter of:

NAME OF PROCEEDING: KERR-McGEE CHEMICAL CORPORATION

DOCKET NUMBER: 40-2061-ML

PLACE OF PROCEEDING: Chicago, Illinois

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

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