UNITED STATES OF AMERICA

BEFORE THE

NUCLEAR REGULATORY COMMISSION

In the Matter of: HOUSTON LIGHTING & POWER COMPANY Allens Creek Nuclear Generating Station, Unit 1	)))))))	Docket No. 50-466CP

Capricorn Room
Ramada Inn
7787 Katy Freeway
Houston, Texas

Friday,
May 22, 1981

PURSUANT TO ADJOURNMENT, the above-entitled matter came on for further hearing at 9:00 a.m.

APPEARANCES:

Board Members:

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P R O C E E D I N G S

JUDGE WOLFE: All right. The hearing is resumed.

In attendance this morning, representing Applicant are Messrs. Copeland and Rozzell; for Staff, Messrs. Sohinki and Dewey; Mr. Scott and Mr. Doherty.

We will proceed with the cross-examination by Mr. Scott.

MR. DOHERTY: Mr. Chairman.

JUDGE WOLFE: Yes.

MR. DOHERTY: I wanted to report one matter that is still outstanding.

I have talked with Counsel Sohinki and Witness Brooks. We have set up a time for a conference or a telephone call next week, unfortunately, with regard to Contention 21, which was filed for reconsideration.

That's our progress on that at this point. We have a time set up. We are going to discuss it.

I will attempt expeditiously to do something, to notify the Board of some results, where it stands after that.

I regret the lateness of this, but we went over yesterday how that happened.

MR. SOHINKI: I might add that we had anticipated getting together last night, but because we went so late and because we have a full day today, we just didn't think there would be time to engage in that discussion.

JUDGE WOLFE: All right.

We will hear from one or both of you, then, sometime next week, in writing.

All right. Mr. Scott.

MR. SCOTT: Yes, Your Honor.

Whereupon,

KEVIN HOLTZCLAW

RICHARD WILLIAMS

the witnesses on the stand at the time of adjournment, having been previously duly sworn, resumed the stand and were examined and testified further as follows:

CROSS-EXAMINATION (Continued)

BY MR. SCOTT:

Q. Gentlemen, on page 10 of the prefiled testimony on Contention 39, you mention that the Loss of Coolant Accident is the most severe accident so far as cladding ballooning, essentially, because it's got the largest differential pressures across the clad.

What is the pressure at the worst case during this scenario inside and outside of the cladding?

BY WITNESS WILLIAMS:

A. Outside the cladding would be the system pressure, which would be in the range of, oh, 40 PSI.

Q Now, why is it that this accident can't get to a situation whereby the system pressure, as we call it I guess, is at the atmospheric pressure?

BY WITNESS WILLIAMS:

A. Because you have steam in the reactor.

Q Okay, but I have steam in the kitchen, too.

BY WITNESS WILLIAMS:

A. The kitchen isn't a pressurized vessel.

Q Well, neither is the reactor if it's got a big hole in the side of it.

BY WITNESS WILLIAMS:

A. You are driving water and -- water, basically, back into the reactor.

Q Through that same hole?

BY WITNESS WILLIAMS:

A. No.

Q There's still a hole, isn't there?

BY WITNESS WILLIAMS:

A. Yes.

Q How big is it, roughly?

BY WITNESS WILLIAMS:

A. Whatever the diameter of the --

Q What's that?

MR. COPELAND: Would you let the witness finish his answer.

JUDGE WOLFE: Finish your answer.

WITNESS WILLIAMS: Whatever the diameter of the design basis accident break would be.

BY MR. SCOTT:

Q. And I'm asking you what that would be for Allens Creek?

BY WITNESS WILLIAMS:

A. It depends on what LOCA scenario you are looking at again. It's a range --

Q. I'm talking about the one that would get you the worst case that you've talked about.

BY WITNESS WILLIAMS:

A. I don't know.

Q. What is the diameter of the feedwater coolant pipe?

BY WITNESS WILLIAMS:

A. I don't know.

Q. Approximately?

BY WITNESS WILLIAMS:

A. I don't know.

Q. Do you know whether or not it's more than one inch?

BY WITNESS WILLIAMS:

A. Yes.

Q. Do you know whether it's more than ten foot

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in diameter?

BY WITNESS WILLIAMS:

A. It's in the range of 12 inches.

Q. Okay. In this Loss of Coolant Accident scenario which you've gone through, have you assumed that throughout the accident you are going to be able to be adding water to the reactor vessel?

BY WITNESS WILLIAMS:

A. Yes.

Q. What happens if you have an operator who decides to turn it off? Isn't that a real possibility that could occur? Isn't that realistic?

MR. COPELAND: I'm going to object to that question, Your Honor.

What we're here to discuss is the contention that was admitted by the Board, and that contention specifically directed the question to us of whether we had complied with the requirement in Appendix K that required us to address swelling and rupture of cladding.

It seems to me that Mr. Scott has spent the entire cross-examination this morning addressing other parts of Appendix K which are not at issue in this contention.

MR. SCOTT: I just don't understand that. Loss of Coolant Accident definitely involves the coolant leaving the reactor, and we have got real world experience

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to show that it is realistic to believe that someone might, for whatever reasons, including the operator turning off the supply water to the reactor, that you might not get any water coming into the reactor.

MR. COPELAND: That is not in issue in this contention, Your Honor.

JUDGE WOLFE: Well, what are you saying, Mr. Scott?

MR. SCOTT: Well, for example --

JUDGE WOLFE: Just a moment. Let me finish.

Are you saying that Applicant will comply with Appendix K, that even if Applicant complies with the requirements of Appendix K, that a situation might arise wherein an event that might compromise health and safety might occur?

Is this what you're getting to?

MR. SCOTT: No, I'm saying that they might not comply with Appendix K.

JUDGE WOLFE: Now....

JUDGE LINENBERGER: Off the top, Mr. Scott, this looks as though you are raising questions about operator errors or inadvertent actions that might alter what has been defined as a design basis accident here; and, therefore, you are asking whether we can get into something else that would question the ability of conforming

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with the requirements of Appendix K.

Now, to the extent that you are probing the mechanism for more serious accident scenarios, I think that's -- we can't go along with; but to the extent that you're probing whether inadvertent actions during an accident might compromise the ability to conform to the requirements of Appendix K, to that extent I would recommend we hear a little more on this line of questioning.

JUDGE WOLFE: All right.

I will overrule the objection at this time, subject to a motion to strike or another objection, Mr. Copeland.

MR. COPELAND: Thank you, Your Honor.

JUDGE WOLFE: Proceed, Mr. Scott.

BY MR. SCOTT:

Q Gentlemen, what type of assurance does the Allens Creek plant have that an operator cannot override any automatic emergency core cooling system?

BY WITNESS WILLIAMS:

A We have 13 separate pumps that drive water into the reactor. It would be extremely difficult to stop water going into the reactor.

Q I can appreciate that, but are there or are there not overrides that an operator can by manual actions turn each, any one, any combination of those pumps off if they wished to?

BY WITNESS WILLIAMS:

A. I'm not familiar with the control systems that would be employed in Allens Creek.

Q. How about the other gentleman?

BY WITNESS HOLTZCLAW:

A. Likewise.

Q. So then you don't know but what it would be possible to turn them each one off?

BY WITNESS WILLIAMS:

A. Again, you've gone beyond the design basis event.

Q. Could you explain where in Appendix K it says that this accident assumes certain flow of water at a certain pressure at a certain time sequence, that it's all very cut and dried and there's just a computer model that determines whether or not you conform with Appendix K, as opposed to using judgment?

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MR. COPELAND: Well, Your Honor, I'm going to object to that line of questions. He's asking the witness to show him where there are 20 different things in Appendix K.

The Appendix K limit -- or the accident scenario, that's required by Appendix K is right there in the requirement.

We're right back into arguing now about compliance with Appendix K on matters that are completely outside of the scope of Paragraph Roman I(b), which is this contention.

I don't think that we're advancing the ball any. These gentlemen are not here to defend the entire spectrum of the LOCA analysis.

They're here to address one specific part. I think it's very unfair to start dragging them through the entire Appendix K.

(Bench conference.)

JUDGE LINENBERGER: Obviously, the Board has been conferring. It is a tough one, Mr. Scott.

And you and Mr. Doherty both are going to result in my sharpening my pencil quite a bit in the future.

I have to, in all candor, say that I wrote the language in our March 10, 1980 Order admitting that contention, at Page 26 thereof.

And I will quote what the Order says, in part ... it quotes -- the Part (b) of Appendix K and then goes on to say in the context of this part: "We narrow the scope of this contention and restate it to allege that the Applicant has not provided an adequate showing that the degree of swelling and incidence of rupture are not underestimated. So restated, this contention is admitted."

Okay. The problem here is that what I didn't say in writing this was that we had in mind the ability of the Applicant to comply with Appendix K under the circumstances that would follow from a loss of coolant design basis accident.

Unfortunately, you could not read our minds when you read the March 10 Order; but, nevertheless, that was the intent of that Order. And I'm afraid we are constrained to stay within that intent.

Your line of questioning is really changing the nature of the accident in a way that was not envisaged here, and not intended here, in admitting this contention.

So I really have to recommend that we not continue on this line of questioning, Mr. Chairman, because it does involve a revision to the definition of design basis accidents that was not -- we did not intend to permit when we wrote this.

MR. SCOTT: Mr. Chairman, can I say a little something?

JUDGE WOLFE: Yes.

MR. SCOTT: I appreciate -- and I think I knew ahead of time that that was all probably your intention.

But as I understand the Board's responsibilities, they've got a lot of power. And for whole lots of reasons ... require changes and things to make the system safer ... or determine that it's not reasonably possible to make sufficient changes and, therefore, deny the license.

And I hope that the Board will, whether it's part of a contention or ... is on their own -- I don't think it makes a lot of difference -- look closely at this issue.

I think it's very bad policy, frankly, to take the position that it can be determined that Applicant has met their burden by the very artificial means of deciding, "This is the terms that we'll plug into a computer equation, and this is as hot as we're going to allow it to get. We're sure the water is going to get there"... especially when that can be shown to be contrary to fact and this sort of thing.

And just as an example, the Appendix K is awfully -- you know, specific in some cases, but generally it's quite general.

If you try to be nit-picking ... you know, there's nothing in here, for example, on what kind of heat co-efficients they're allowed to use for an 8x8 fuel assembly array, because this thing written in '74 ... they only had 7x7 fuel assembly arrays.

And that sort of thing.

I hope we don't worry too much about the literal words in Appendix K.

JUDGE LINENBERGER: We appreciate your comments, Mr. Scott. You've made a couple of points here that I want to respond to.

First off -- and not so incidentally -- your line of questioning was getting into areas involving the control system and the flexibility to do unintended things with it that these witnesses are the wrong ones to get those answers from.

So that's no small problem in itself. But going to the bigger point you were making, Appendix K and the whole body of the Regs, really represent what the Applicant has to live with ... has to meet.

Now, certainly, the Three Mile Island, Unit 2 event indicated some -- that there are some degrees of freedom that the Regs don't accommodate ... degrees of freedom to get into trouble (if you will) that the Regs don't accommodate well enough.

So far the Commission has not chosen to rewrite or amend Appendix K, but it has chosen to do -- and to acquire quite a number of things of Applicant's in the aftermath of the TMI-2 event.

And there is a whole slug of requirements that this Applicant (and all others) are going to have to meet because of the kinds of things that happened at TMI-2.

And some of those things are specifically addressed to the kind of off-normal behavior that you were talking about here.

So what I'm really saying here is that the kind of worries that you are expressing are legitimate; they're logical; but they are being dealt with, but not at the moment through any revision to Appendix K.

Now, you have specifically mentioned 7x7 versus 8x8 fuel assemblies. And Appendix K, as far as you read it, doesn't accommodate that change in fuel design.

But it turns out it does. The ultimate requirements that have to be met for Appendix K have to be

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met, whether it's a 7x7 fuel assembly array or 6 1/2 x 7 3/4.

The Appendix does not need to spell out the details of the fuel assembly. It puts limits on clad temperature. It puts limits on time and temperature.

It puts limits on all sorts of things that a changed fuel design will have to meet, even though Appendix K does not anticipate those specific design changes.

So to repeat myself and hurry this up, your worries are logical, well founded, the kinds of things you're talking about now are primarily dealt with through the TMI aftermath requirements that are being placed on applicants and through the implications of living with Appendix K that are not specifically bound to fuel design, but to fuel and system performance.

So this is a long way of saying that what you're concerned about is not being overlooked, but it's also a long way of saying that it's inappropriate for us to continue on that -- in that direction here and especially with these witnesses.

JUDGE WOLFE: All right. So the Board's ruling is that we sustain the objection, and you will terminate this line of questioning, Mr. Scott.

BY MR. SCOTT:

Q Gentlemen, why is the -- You've mentioned the 40 pounds per square inch -- I assume that was an approximation -- pressure outside the fuel rods. What is the pressure inside the cladding -- inside the cladding -- at the point that we're talking about here where we've got the largest differential pressure?

BY WITNESS WILLIAMS:

A. It's dependent on what power the rod had been operating at. Typically, the hoop stress would be in the range of 1500 psi.

Q What kind of stress?

BY WITNESS WILLIAMS:

A. Hoop stress.

Q Hoop?

BY WITNESS WILLIAMS:

A. Hoop.

Q Spell it?

BY WITNESS WILLIAMS:

A. H-o-o-p.

Q I guess I'll have to ask, what's that?

BY WITNESS WILLIAMS:

A. It's the internal diameter divided by twice the thickness times the pressure differential ... across the cladding.

Q If I stick my little pressure gauge inside the cladding, what is the pressure going to be?
BY WITNESS WILLIAMS:
A. It's about 230 psi ... in that range.
Q So is it fair to say then that the largest differential is approximately 190 psi?
BY WITNESS WILLIAMS:
A. For that hoop stress.
I'm sorry. That 230 was the pressure differential. So the internal pressure would be 270 psi.
Q Okay.
At what temperature is this taking place? I guess I'm making the assumption that -- tell me if I'm wrong -- that the largest differential pressure is at the point of highest clad temperature.
BY WITNESS WILLIAMS:
A. Less than 2200° Fahrenheit.
Q That's a wide range.
BY WITNESS WILLIAMS:
A. Between 1600 and 2200.
Q Okay.
Fahrenheit?
BY WITNESS WILLIAMS:
A. Yes.
Q What is the pressure inside the cladding before

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it's operated any -- first, putting in a fresh fuel rod?

BY WITNESS WILLIAMS:

A. It says on Page 12 of the testimony, Line 6 -- sorry, Line 5 -- that the internal fuel rod pressure of the unirradiated fuel is three atmospheres.

Q. Is that about 44 pounds per square inch?

BY WITNESS WILLIAMS:

A. Roughly, yes.

Q. Okay.

About how long is it taking this system to go from roughly 44 psi to 270 psi internal pressures, under the scenario that ya'll have calculated ... that has got all sorts of assumptions as to power capacity that the reactor is operated at?

BY WITNESS WILLIAMS:

A. The numbers quoted were for a typical end-of-life rod pressure.

Q. Is that three years?

BY WITNESS WILLIAMS:

A. It would be a burn-up in excess of 30,000 megawatt days per ton.

Q. Okay. Now, once again, I hope you don't think I'm nit-picking, but that answer covers the whole spectrum of everything --

BY WITNESS WILLIAMS:

A. With worst-case result that you have there.

Q. Well, if the answer covers everything above 30,000, which is an infinite number -- and --

BY WITNESS WILLIAMS:

A. Everything below 30,000.

Q. I think you said it should be some number greater than 30,000 megawatt days per ton.

BY WITNESS WILLIAMS:

A. That's a typical end-of-life exposure.

Q. Excuse me. But your answer was that it was greater than a certain number. That's unbounded. I'd like you to put some bounds on it.

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MR. COPELAND: I think you misunderstood his answer, Mr. Scott. I don't believe he said that.

He said below 30,000.

MR. SCOTT: No --

WITNESS WILLIAMS: Greater than thirty, below thirty-five.

BY MR. SCOTT:

Q. Okay, that's all I needed.

Does that number -- Which kind of ton is that?

BY WITNESS WILLIAMS:

A. Pardon?

Q. Which kind of ton is that?

BY WITNESS WILLIAMS:

A. Metric tons.

Q. Metric ton.

Once before, the gentleman used "short tons."

BY WITNESS WILLIAMS:

A. There's a ten percent difference.

Q. Okay.

Describe for us the history of this pressure increase from 44 to 270. Is it a linear function of the burn-up?

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BY WITNESS WILLIAMS:

A. It's a very complex function of the burn-up.

Q. Describe this complex function to us in some detail.

BY WITNESS WILLIAMS:

A. I can't describe it.

Q. Okay. Let's approach it this way then.

After a 10,000 burn-up, what's the pressure going to be? If you don't know the exact number -- is it a third of the way there or --

BY WITNESS WILLIAMS:

A. I can't address individual points.

Q. Is that because you've never looked at any individual points?

BY WITNESS WILLIAMS:

A. It's because I'm not familiar with the individual points along the way.

Q. Do you have no idea of the internal pressure as a function of time -- function of burn-up?

MR. COPELAND: Objection, Your Honor. The witness has answered; he's not familiar with specific points along the way.

MR. SCOTT: Now I'm asking if he is --

JUDGE WOLFE: Wait. Let Mr. Copeland finish, and then you'll have your turn.

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MR. COPELAND: He has answered that the 30,000 it the worst case, that he's not familiar with each specific point below that; and he has also answered that he can't explain the complex linear relationship in simple terms.

And it seems to me that's as far as we can go along this line of cross-examination.

MR. SCOTT: I have accepted those two answers, and now I'm asking him another. Another question is: Can he give me any information about the history of this internal pressure versus burn-up.

You had better be careful.

MR. COPELAND: I don't know what the term "any information" means, Your Honor.

JUDGE WOLFE: It's a rather wide-searching question.

MR. SCOTT: Right. That's why it should be easy for him to say, "Yes, he can."

JUDGE WOLFE: Well, that -- your question doesn't call for that sort of answer. You're asking for a -- yours is a broad-enveloping question which doesn't call for "Yes, I can," or "No, I can't."

It calls for -- if he can ... it calls for a broad answer. And what I'm asking you to do --

(Bench conference.)

JUDGE WOLFE: I will sustain any objection, or the Board on its own motion, will not allow the question.

It's much too broad. You're going to have to make your question more specific.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q. Gentlemen, after 15,000 megawatt days per metric ton burn-up, would you expect that the internal pressure would be -- that the increase in internal pressure would have been more or less than half of that pressure increase that would be derived at 30,000 megawatt days per ton burn-up?

BY WITNESS WILLIAMS:

A. I've already stated that I don't know what individual points are.

Q. That's not an answer to that question.

MR. COPELAND: Yes, it is, Your Honor; and I now object that the question has been asked and answered.

JUDGE WOLFE: Yes?

MR. SCOTT: The state of the record right now is such that the Board -- the Judges or anyone else could look at this and say, "Well, yes, he has answered that he don't know specifically what the point is at any

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place."

But he would leave open the possibility that it's clear that the pressure would be less at lesser burn-up than it would be with more burn-up, when, in fact, that point is not yet in the record.

And I'm trying to find out if he knows that.

We've got a real problem here if it turns out that the pressure goes up for a while with burn-up and then actually decreases with burn-up.

JUDGE LINENBERGER: Well, the simple way to get at that, Mr. Scott, is not to ask him for specific points in between, which he has said that he does not have information or, but to ask him whether or not the pressure increases monotonically with temperatures or is there any temperature regime with burn-up ... or is there any regime in which the pressure reverses itself.

At least --

MR. SCOTT: That's what I've tried to ask him, but --

JUDGE LINENBERGER: Well, but you were asking about specific points, and he has said he doesn't know the details of the curve.

Now, your concern is maybe he knows the overall shape of the curve without knowing exact points.

So I think you ought to rephrase that question.

JUDGE WOLFE: I'll sustain the objection.

BY MR. SCOTT:

Q Do you know the overall shape of the curve, without knowing the individual points?

BY WITNESS WILLIAMS:

A The burnup increases -- The pressure increases monotonically with burnup.

Q What does "monotonically" mean?

BY WITNESS WILLIAMS:

A The higher the burnup, the higher the pressure.

Q Okay.

What predominant -- if there are any that you know of -- that causes this monotonic increase to abruptly -- this rate to abruptly change anywhere during the burnup times of a normal reactor?

BY WITNESS WILLIAMS:

A I'm not aware of any abrupt changes.

Q Okay.

Do you know of any changes, abrupt or not?

BY WITNESS WILLIAMS:

A Yes. As I said, the burnup increases with --

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the pressure increases with exposure.

Q No, no. I guess I didn't make it specific enough.

Do you know of any changes in the rate of burnup? Obviously, we've got it established that it increases over time.

But does this rate change any as a function of time?

MR. COPELAND: The rate of burnup, Mr. Scott?

MR. SCOTT: No, the rate of the pressure increase.

MR. COPELAND: The witness has answered that question, Your Honor.

He has answered that it's monotonic.

MR. SCOTT: That doesn't answer the question. We're talking about the rates of this monotonic.

MR. SOHINKI: Mr. Chairman, I have another objection --

(Bench conference.)

MR. SOHINKI: My objection is that once the witness testified, as he has, that the rate of increase is monotonic and has given us a worst case, I don't see how it's productive to inquire any more about the range,

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from low to hot.

(Bench conference.)

MR. SOHINKI: So the objection is: Irrelevant. This line of questioning is irrelevant.

MR. SCOTT: Well, not for impeachment purposes.

(Further Bench conference.)

JUDGE LINENBERGER: Mr. Scott, when the witness says there is a monotonic relationship, that means that the slope of the curve is either always positive or always negative; it never reverses.

So that means that the curve can't go along for a way and then take a dip and then start back up again. It can't go along for a way and then go flat for a while and start back up again.

If it's a monotonic function, the slope is always positive or is always negative.

Well, maybe it's always zero. But we've established that it's positive already.

So now I think you're asking, "Well, are there places where the slope of the curve changes for some reason?"

Is that your question?

MR. SCOTT: Essentially, yes.

JUDGE LINENBERGER: Well, you can ask the

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witness if he knows whether there are any reasons -- and I presume you're tying this to the duration of a LOCA. Is that correct?

Are you tying this to the duration of a plant operation -- of normal plant operation?

MR. SCOTT: Both.

JUDGE LINENBERGER: Well, you've got to separate them and take them one at a time. And then ask the witness for each case if he knows whether there are any occasions or any conditions that would cause significant changes in the slope of this curve.

So I think you'll have to rephrase your question and put it in that form and address normal operation separately from the LOCA behavior.

JUDGE WOLFE: I'll sustain the objection, but you may rephrase.

BY MR. SCOTT:

Q. Okay.

Considering only the issue of burnup before any loss of coolant accident takes place, do you know of any reason that this monotonic increase would change over the operating life of the 30,000 burnup?

BY WITNESS WILLIAMS:

A. No.

Q. Well, I'm confused now. We started out with a very complex function, and now it's linearly increasing, which doesn't sound very complex.

BY WITNESS WILLIAMS:

A. We didn't say "linearly increasing."

Q. Well, if the slope don't change, it's linearly increasing.

MR. COPELAND: Is that a question or an argument, Mr. Scott?

MR. SCOTT: That's a statement of fact that no one can deny.

MR. COPELAND: Well, Mr. Scott, I suggest you pose a question to the witness --

JUDGE WOLFE: If you want something to be ultimately found by the Board, it has to be on something more than your statement. If you wish to confirm what you believe to be a fact, you have to establish it on the record through sworn testimony or through admitted documentation.

MR. SCOTT: I don't mind if you strike it. It doesn't --

JUDGE WOLFE: Is there a motion to strike?

MR. SOHINKI: I made a motion to strike.

JUDGE WOLFE: Granted.

BY MR. SCOTT:

Q. Do you remember the question?

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MR. COPELAND: No, there wasn't a question.

MR. SCOTT: Yes, there was --

JUDGE WOLFE: Well, restate it.

BY MR. SCOTT:

Q Why -- Where was this complexity? That's what I asked.

If it's a linearly increasing rate, where's the complexity?

BY WITNESS WILLIAMS:

A I didn't say it was a linearly increasing rate.

Q And that's when I asked you how is it that the scope does not change if it's linearly increasing?

BY WITNESS WILLIAMS:

A We didn't say the slope didn't change. What we said was the slope didn't change from positive to negative. It could become more or less positive.

Q That's not the way I heard the last several minutes' discussion.

JUDGE CHEATUM: You weren't listening, Mr. Scott.

MR. COPELAND: That's exactly right.

JUDGE LINENBERGER: Maybe there's some confusion in your mind about the meaning of the word "monotonic."

All that means is the slope doesn't change sign, but, for instance, 1 Y equal E^x is a monotonically increasing function. And the slope is never constant, and it's not a linear relationship.

So I didn't mean that term to mislead you there.

MR. SCOTT: No, it didn't. I asked another question.

I asked if he had any reason to believe that this rate of increase would change any over the operating life; and he said no.

Now, that directly means that it's linear. Did you want to -- Have I mischaracterized your statement? Do you want to change it?

WITNESS WILLIAMS: I don't think that was the question.

BY MR. SCOTT:

Q What question did you answer?

MR. COPELAND: I'm going to object, Your Honor. It's in the record. Let's move on to something else.

(Bench conference.)

MR. COPELAND: I don't know why we have to waste time educating Mr. Scott about the fundamentals of this business. You know, he clearly can't understand

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anything that's going on here.

All we're doing is wasting everybody's time explaining terms that he ought to know about, if he's going to cross-examine witnesses in this highly technical area.

MR. SCOTT: Mr. Chairman, I'm trying to see if this witness knows what he's talking about.

MR. COPELAND: That's the most incredible --

JUDGE WOLFE: What he has testified to is a matter of record. So, that being so, just proceed with your questioning.

MR. SCOTT: Fine.

It may when we're through ... what he has got in the record is not worth much.

MR. COPELAND: Well, it's for sure your cross-examination isn't worth much.

MR. DOHERTY: Counsel --

JUDGE WOLFE: All right. Just a moment, hold it.

I'm not having these sorts of arguments between counsel. Stop it, and let's proceed with the questioning.

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BY MR. SCOTT:

Q. Okay, gentlemen, at what points, if any, during this burnup, do you know of any changes in the rate of the pressure buildup?

MR. COPELAND: Asked-and-answered.

MR. SCOTT: He's not answered that. He can't say that there's changes where it changes slow, from different amounts and claim that it is -- I mean, that he doesn't know the general path.

(Bench Conference.)

JUDGE WOLFE: It is the Board's opinion that the question has been put and responded to.

However, in an effort to clarify what's troubling you, without wasting too much more time, we'll overrule the objection.

Answer, please.

WITNESS WILLIAMS: The general trend with burnup is increase in pressure.

BY MR. SCOTT:

Q. We've --

BY WITNESS WILLIAMS:

A. I've already stated that I don't know of any abrupt changes in the slope.

Q. Do you know of any changes, abrupt or not? I'm asking if you know of as opposed to --

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BY WITNESS WILLIAMS:

A. This presupposes my knowledge of individual points along on the burnup path which I have already stated I don't know.

Q. No.

I'm talking about only of the general shape of the curve.

BY WITNESS WILLLIAMS:

A. I have already stated that the general trend is increasing pressure with burnup.

Q. Well, I will let you off the hook in the interest of time.

MR. COPELAND: I ask that that comment be stricken from the record.

JUDGE WOLFE: It is stricken.

Don't comment on testimony or evidence. This is a waste of time and we're not persuaded by your comments.

So, stop it.

All right, proceed.

BY MR. SCOTT:

Q. Okay.

During this LOCA accident, I take it that you have modeled this on a computer and seen charts of temperature and pressure versus time?

BY WITNESS WILLIAMS:

A. We modeled it both on a computer and performed experiments.

Q. And, you have seen, in both of those cases, the results of that experiments and computer simulation.

Is that correct?

BY WITNESS WILLIAMS:

A. Yes.

Q. Describe for us, at first in a general way, the path of the clad temperatures during this LOCA accident analysis.

BY WITNESS WILLIAMS:

A. The cladding temperature starts off at the normal cladding temperature, which is in the range of 650 Fahrenheit, and increases at roughly 5 degrees F. per second until either rupture of the cladding or the point that the temperature transient is turned around by cold respray and reflood.

Q. And, what temperature -- Oh. I guess you've already answered that. between 1600 and 2200 degrees. Is that the turn around point?

BY WITNESS WILLIAMS:

A. Yes, that's correct.

Q. Okay.

That's a good answer. That's the kind I'm looking for.

MR. COPELAND: I ask that that comment be stricken from the record.

JUDGE WOLFE: It is stricken. And, I have asked you not to comment, Mr. Scott.

Don't do it again.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q. Now, what is that same path through the average temperature of the water in the core?

During the same period of time, the same accident?

BY WITNESS WILLIAMS:

A. I don't think I understand your question.

Q. The water inside the core at any time has got an average temperature.

Is that correct?

BY WITNESS WILLIAMS:

A. The water goes to steam in the reactor because by definition: The loss of coolant accident, you lose the coolant.

Q. Is it not true that there's also water in the reactor?

BY WITNESS WILLIAMS:

A. There will be some water in the bottom of the reactor.

Yes.

Q. Okay.

I am asking you what is the temperature of that water?

BY WITNESS WILLIAMS:

A. I don't know.

Q. Okay.

Is the temperature of the water higher or lower than that of the cladding?

BY WITNESS WILLIAMS:

A. Lower.

Q. Is the temperature of the cladding higher or lower than that of the gas inside the gap?

BY WITNESS WILLIAMS:

A. We assume that the gas inside the gap i, the same temperature as the peak axial location in the cladding.

Q. Okay.

Then, can you answer the question as what it really is instead of what you have assumed?

BY WITNESS WILLIAMS:

A. I think that is a good assumption.

Q. Okay.

What is the temperature of the fuel?

Is it higher or lower than that of the air gap?

BY WITNESS WILLIAMS:

A. The temperature of the fuel decreases throughout the transient.

Q. (Pause.)

Okay.

So, it decreases.

But, I still want to know: During the period of time that the cladding temperature is rising between 650 degrees F. and roughly 2000 degrees F., whether or not the fuel is at a higher or lower temperature than the cladding?

BY WITNESS HOLTZCLAW:

A. During the loss of coolant accident, the course of the event is you are losing coolant on the outside of the cladding.

The fuel internal stored energy is being redistributed so that, initially, the fuel temperature is higher.

The heat, then, is lost to the cladding, raising the cladding temperature until they are in equilibrium.

Q. Is that another way of saying that fuel is always a higher temperature than the cladding?

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BY WITNESS HOLTZCLAW:

A. No.

It is just as I stated it. Where it starts out higher and then they go into equilibrium.

Q. What condition in that scenario would allow the cladding to be at a higher temperature than the fuel?

MR. COPELAND: He just testified that it was not.

He testified that they were at equilibrium.

MR. SCOTT: That was at the end that there was an equilibrium. Not at the whole course of the transient analysis.

(Bench Conference.)

JUDGE LINENBERGER: Mr. Scott, I'm sorry, but your questions indicate that you are not listening or thinking about the answers you're hearing.

Now, this is causing us all a great problem, a great expense, time and money.

Concentrate on what the answers are that you are getting, and use that information in your next question.

You seem to be ignoring what you're hearing.

Please, Mr. Scott. Sharpen up.

JUDGE WOLFE: Sustain the objection.

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BY MR. SCOTT:

Q Well, if the fuel temperature is initially higher than the gap temperature or the cladding temperature.

Is that not correct?

BY WITNESS WILLIAMS:

A That is correct.

Q Okay.

What is this fuel temperature, initially?

BY WITNESS WILLIAMS:

A It has a radial distribution. It depends on what power the fuel is operating.

Q If it wasn't already clear, we're talking about the loss of coolant accident analysis that you have done for Allens Creek.

Let's just give that as the given so I don't have to keep repeating it.

Now, in doing that, you have no doubt assumed certain things; but with those assumptions what was the initial average fuel temperature?

Realizing it differs between the center and the edges.

BY WITNESS WILLIAMS:

A It does differ between the center and the edges.

Q. Sure.

BY WITNESS WILLIAMS:

A. It is roughly 3000 at the center; and approximately 1700 at the surface.

Q. Okay.

Is that centigrade or Fahrenheit?

BY WITNESS WILLIAMS:

A. Fahrenheit.

Q. Okay.

Now, initially the cladding was at 650 degrees Fahrenheit. Is that right?

BY WITNESS WILLIAMS:

A. It's probably a little lower.

It is probably in the region of 600.

Q. Okay.

Now, is the heat that has been turned off at the fuel and starts escaping through the fuel and through the gap to the cladding to the steam and water outside, is it not true that the fuel temperature drops during that period of time?

BY WITNESS WILLIAMS:

A. Yes.

Q. Is it not true that the cladding temperature, at least in general, will keep increasing during that period of time?

3-10 BY WITNESS WILLIAMS:

A. It will increase to a limit.

Q. Right.

Now, is there any point during this time that the fuel temperature would be lower than the cladding temperature?

BY WITNESS WILLIAMS:

A. I think you'll be breaking the second law of thermodynamics if you can do that.

Q. Okay.

That's the only point I'm trying to make.

MR. COPELAND: It has been made, and I objected to that same question five minutes ago; and I'm going to move to terminate this cross-examination if this continues.

We're really wasting time this morning.

MR. SCOTT: Mr. Chairman, we're ready to make a point now.

BY MR. SCOTT:

Q. Why did you assume that the gap temperature would be the same as the cladding temperature?

BY WITNESS WILLIAMS:

A. Can you restate that question?

Q. Why in your analysis have you assumed that the gap temperature --

MR. SCOTT: Your Honor, we're having a problem with the consulting without it being on the record.

I don't mind the consulting, but I'd just like for it all to be in the record.

So, you know, anyone can answer that wants to, but --

The question is why did you use the gap temperature to be the same as the cladding temperature?

WITNESS WILLIAMS: I don't believe that is what is in the testimony.

BY MR. SCOTT:

Q. Oh. You disagree with that?

BY WITNESS WILLIAMS:

A. It's the cladding gas temperature.

Q. What's the cladding gas --

BY WITNESS WILLIAMS:

A. Or the temperature --

Q. Go ahead and explain.

BY WITNESS HOLTZCLAW:

A. We testified earlier under the conditions of peak clad temperature during the LOCA, your question was: What would we assume was the gas temperature? And, under those conditions, that is at the peak axial plane where we're at a maximum possible value of 2200 degrees Fahrenheit, it was under those conditions that the gas temperature was assumed the same as the cladding temperature. Not for the conditions prior to the onset of the LOCA, which we have been answering questions on lately.

Q Okay.

The time frame I am concerned about is in between those two points. The gap gases had a certain temperature. And, what was that temperature assumed to be?

BY WITNESS WILLIAMS:

A We don't know the trajectory of the gas temperature. We worst case everything in the analysis which is what we've just stated.

But, we have an idea of the gas temperature, but we don't use it in the analysis.

Q Does not the analysis during the -- During the analysis, at all times, is there not some gas gap temperature shown up in the program?

JUDGE WOLFE: Now, at this point gentlemen, Mr. Scott has asked the Board to rule. I thought we had already ruled that you may consult, in response to a question by the cross-examiner as to which one should respond to the question. Beyond that you may not confer. At Mr. Scott's request, however, if you do confer on an answer, it should be on the record. So, with that in mind

3-131 let's heed that ruling.

All right, Mr. Scott.

WITNESS WILLIAMS: Mr. Holtzclaw will take it.

WITNESS HOLTZCLAW: Dr. Williams and I came prepared to talk about one specific aspect of the loss of coolant accident analysis.

There are others who are more expert in tracking the trajectory of the accident who could give you details of those conditions.

We are primarily concerned with the clad heat-up at the end of the loss of coolant accident and that is what we're prepared to discuss.

We do have models and analyses which do track that gas temperature, but we're unprepared to give you details of what those results might be.

BY MR. SCOTT:

Q Did either one of you all run these analyses?

MR. COPELAND: Which analyses, Mr. Scott?

MR. SCOTT: The losss of the coolant accident analyses that calculated the rupture pressure and the clad temperature.

MR. COPELAND: Under worst case conditions?

MR. SCOTT: Yes.

WITNESS HOLTZCLAW: We did not, personally, run these analyses.

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BY MR. SCOTT:

Q. Oh. Who did?

BY WITNESS HOLTZCLAW:

A. The in our company responsible for running the core heat-up code.

Q. Is that the group you work in?

BY WITNESS HOLTZCLAW:

A. No, sir.

JUDGE WOLFE: Excuse me, Mr. Scott, for a moment.

My fellow members advised me that you have outstanding a motion to terminate the cross-examination of Mr. Scott.

I had only understood you to say that you would move to terminate. So, that's why I didn't act.

MR. COPELAND: That's correct, Your Honor.

JUDGE WOLFE: All right.

BY MR. SCOTT:

Q. Okay.

What was the interface between you fellows and the people who actually did this work? How did you get prepared to come here and give this testimony?

BY WITNESS WILLIAMS:

A. We are testifying -- or should be testifying on the cladding swelling and rupture.

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Q. Have you not said that you all didn't do the analysis that determines the rupture pressures and clad temperatures?

BY WITNESS WILLIAMS:

A. We interface with the group that does that. We provide them with inputs. They provide us with inputs.

Q. That's what I wanted to know.

What is you-all's relationship? What do you all supply them and what do they supply you with?

How often do you meet?

BY WITNESS HOLTZCLAW:

A. Which question do you want us to answer?

Q. Take your choice.

MR. COPELAND: Objection, Mr. Chairman.

That's a compound question and that's clearly not proper. Let's take --

JUDGE WOLFE: Sustained.

MR. COPELAND: -- the questions one at a time.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q. First, what information do you supply the -- what's the name of this other group?

BY WITNESS HOLTZCLAW:

A. The EECS Engineering Group.

Q. What group do you work with?
BY WITNESS WILLIAMS:
A. Fuel Rod Thermal and Mechanical Analysis.
Q. Now, what information -- For the Allens Creek analysis, what information do you all feed them?
BY WITNESS HOLTZCLAW:
A. We feed them outputs from the GEGAP code, which include the parameters that initialize the conditions in the fuel rod prior to the onset of the LOCA, including such things as the initial fuel and cladding temperatures, stored energy and the internal pressure of the rod.
Q. Okay.
BY WITNESS WILLIAMS:
A. We also provide them with correlations of perforation hoop stress versus temperature, and circumferential strain versus temperature.
Q. I understand how you can give them the strain versus tempera ure. That's just a function of the metallurgy, is it not?
BY WITNESS WILLIAMS:
A. No, it's a complex interaction again from tests, from -- The data is obtained from simulated LOCA tests.
Q. Okay. So after you've given them this information, do they then do the -- what I call the transit analysis,

the loss of coolant analysis, up until the rupture time; is that correct?

BY WITNESS WILLIAMS:

A. That is correct.

Q. And then they send you all back what?

BY WITNESS WILLIAMS:

A. They document these results, which are typically peak clad temperature and maximum oxidation, which show our compliance with Appendix K.

Q. Are they the experts on the metallurgy, the oxidation, or is that your group?

BY WITNESS WILLIAMS:

A. We have shared responsibilities.

Q. What pressure can these Allens Creek fuel rods take before they start -- before they exceed an elastic limit?

MR. COPELAND: That's been asked and answered in response to cross-examination by Mr. Doherty last night.

MR. SCOTT: I don't remember hearing any specific numbers.

MR. COPELAND: At page 11 of the testimony there is a discussion of the yield strength of the clad, and there was a lengthy discussion about that line of testimony last night.

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MR. SCOTT: Yes, but nowhere under that did there come an answer as to the pressure that causes the tensile strength to be exceeded.

JUDGE WOLFE: Well, to save time, overruled.

Can you answer it, please.

WITNESS WILLIAMS: It's when the plastic deformation begins?

BY MR. SCOTT:

Q. Yes.

BY WITNESS WILLIAMS:

A. Approximately 200 degrees below the rupture temperature.

Q. Do you all have any data that indicates the degree of rupture versus the differential pressure?

BY WITNESS WILLIAMS:

A. What do you mean by degree of rupture?

Q. Little pinhole rupture versus blowing the cladding into a million pieces?

BY WITNESS WILLIAMS:

A. I'm not sure I follow you.

Q. Well, the rupture pressure, is it not, is the pressure where a hole of some sort is put into the cladding?

BY WITNESS WILLIAMS:

A. It's typically in the form of a small cladding split.

Q Okay. Now, if the pressure in the cladding at the time of the split was larger, would not the split be larger?

BY WITNESS WILLIAMS:

A. Again, it depends on oxidation.

Q Okay. Everything else being equal, oxidation being equal in each case, would more pressure cause more of a rupture?

BY WITNESS WILLIAMS:

A. It will probably cause larger ballooning.

Q Ballooning is not rupture, though, is it?

BY WITNESS WILLIAMS:

A. No.

Q I'm asking about rupture.

BY WITNESS WILLIAMS:

A. I do not know.

Q Have you seen any data or do you know of any information that would, essentially, plot the degree of rupture versus the differential pressure at the time of rupture?

BY WITNESS WILLIAMS:

A. Again, what do you mean by "degree of rupture"?

Q Big versus little.

BY WITNESS WILLIAMS:

A. Are you talking about strain?

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Q. No, I'm talking about the size of the hole.

BY WITNESS WILLIAMS:

A. No, I don't know of any.

Q. Okay. Do you have any data to indicate the loss of fuel versus the -- loss of fuel from the fuel rod, say as a percentage loss of the total fuel contained therein, versus the temperature of the cladding at rupture?

BY WITNESS WILLIAMS:

A. No.

Q. Versus the temperature of the fuel at rupture?

BY WITNESS WILLIAMS:

A. Can you repeat the question?

Q. Do you have any information that indicates the -- describes the relationship between the degree of rupture and the temperature of the fuel at rupture?

BY WITNESS WILLIAMS:

A. No.

Q. Do you have any information concerning the amount of fuel loss as a function of either the fuel temperature or the gap temperature or the cladding temperature at rupture?

BY WITNESS WILLIAMS:

A. No.

Q. With that kind of answer, what's to prevent the tiniest pinhole causing all the fuel to leak out into the coolant?

BY WITNESS WILLIAMS:

A. It would be extremely difficult to get pellets through a small pinhole.

Q. If they are melted, they are not a pellet anymore, are they?

BY WITNESS WILLIAMS:

A. I don't think we said anything about molten fuel in the LOCA.

Q. Nor non-molten.

MR. COPELAND: The non-molten was just answered. He just explained that the pellets don't go out through a pinhole.

MR. SCOTT: But we don't know if we have pellets or not right now. The record just don't show that.

MR. COPELAND: The witness just answered that, Your Honor.

MR. SCOTT: I asked if he had any idea as to the amount of fuel loss versus temperature, pressure -- you know, and the answer I heard was, "We have no information."

MR. COPELAND: You asked him if there was a known relationship, Mr. Scott. That was your series of questions.

MR. SCOTT: Well, the answer should have

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been, "Yes, when there's a rupture, fuel escapes."

JUDGE LINENBERGER: Mr. Scott, either if you are testifying or if you are anticipating what answer you want to hear, you have got to lay some foundation.

There has not been any accident profiles that we have discussed so far in this testimony that indicate even approaching the melting temperature of the fuel pellets; nor have you laid a foundation for there being any mechanism for the shattering of pellets, such that fragments from them might blow out through a rupture hole.

So your questions don't form a logical framework of approach to the problem that even permits the witnesses to come close to giving you the answers to things you're looking for.

MR. SCOTT: Your Honor, I'm trying to do that by asking the witness a general question so that he can do that, and the answer I keep getting is, "I don't know."

So then we've got the possibility of he really doesn't know or maybe he just --

JUDGE LINENBERGER: Mr. Scott, again you are exhibiting a reluctance or an inability to listen, to listen to the Board, to listen to the witnesses, to fold in what you've heard and be guided by it.

Now, that's your choice, but just don't come back and argue with us.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q What test do you all know of that indicates the impacts of the rupture of a particular fuel rod upon neighboring fuel rods?

MR. COPELAND: Asked and answered.

JUDGE WOLFE: Sustained.

BY MR. SCOTT:

Q What pressure from a fuel rod is necessary to cause any deformation of a neighboring fuel rod?

MR. COPELAND: Asked and answered.

The witness has explained, Your Honor, that the tests show, and to the best of his knowledge, the failure of one fuel rod does not affect the failure of another fuel rod.

JUDGE LINENBERGER: Mr. Copeland, the witnesses said there would be no propagation of failures, but offhand, I don't think this completely rules out distortion of one fuel rod resulting in distortion of another, if by failure you mean cladding rupture.

So distortion short of rupture of one rod causing distortion of another might be a possibility.

JUDGE WOLFE: All right.

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JUDGE LINENBERGER: I would think that I want to hear the answer.

JUDGE WOLFE: Overruled.

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BY WITNESS WILLIAMS:

A. I don't know.

But, I do know with the sort of internal pressures that you'd expect at Allens Creek, the perforation of one rod would not cause to be a downage of the other fuel in the assembly.

JUDGE LINENBERGER: What about the bowing of one rod becoming so extreme as to push another rod out of alignment.

Is that a conceivable mechanism?

WITNESS WILLIAMS: That may be conceivable. Yes.

JUDGE LINENBERGER: I mean, under --

WITNESS WILLIAMS: Under local conditions.

JUDGE LINENBERGER: Okay.

Thank you.

BY MR. SCOTT:

Q. Are the fuel rods -- They are, obviously, held by some mechanism somewhere along their length to keep them separated from each other. I assume that is at least at their top -- near the top of the fuel rods.

Are there separators between the fuel rods at various lengths up and down the fuel rods?

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BY WITNESS WILLIAMS:

A. Yes.

Q. About how far apart are those separators?

BY WITNESS WILLIAMS:

A. Approximately 20 inches.

Q. Okay.

If you get a differential pressure of 230 pounds per square inch at rupture, how much force is going to be put against the fuel rods in the direction opposite the escaping fission gases?

MR. COPELAND: I'm going to object to that question, Your Honor.

I don't believe that scenario is in emcompassed within Section 1(b) of Appendix K.

JUDGE WOLFE: You don't know?

MR. COPELAND: I say, I believe it is. It's talking -- As I read Section 1(b) it is talking about fuel swelling on an individual pin, and it is not requiring any sort of interrelation -- demonstration of any relationship on other pins.

JUDGE LINENBERGER: From a purely mechanistic point of view, I would have to say that it is not completely clear that this -- a jet force reaction here from a break couldn't cause a pin to bow in amongst other pins, neighboring pins and, perhaps, upset the ability to maintain cooling. And, that is a requirement of Appendix case. So, I don't know about the feasibility of this mechanism, I just say I can postulate something like this, so, I would think the witness should be allowed to respond to that question.

JUDGE WOLFE: Overruled.

WITNESS WILLIAMS: I don't know what the actual force would be. However, coming back to our test results, we have, again, run full scale bundles under typical LOCA conditions on the affect of any perforations in the rods do not degrade the coolability of that bundle.

BY MR. SCOTT:

Q Have these experiments been done with multiple bundles?

BY WITNESS WILLIAMS:

A No.

They have been carried out with single bundles.

Q Okay.

Well, without calculating the total force, exerted against these fuel rods that have ruptures with escaping gases that are under 230 pounds per square inch pressure: What would be the pressure against those -- that fuel rod?

BY WITNESS WILLIAMS:

A. I don't know.

Q. Do you know of any reason that it wouldn't be the same equal-opposite reaction that escaping steam is causing?

BY WITNESS WILLIAMS:

A. That would probably be correct.

Q. What is the diameter of these fuel rods?

BY WITNESS WILLIAMS:

A. .483 inches.

Q. (Pause.)

And, if you round that off to half an inch, and you had twenty inches between separations, wouldn't there be a cross-sectional area of the cladding of approximately -- or of the fuel rod of approximately ten square inches?

BY WITNESS WILLIAMS:

A. I'm afraid you've lost me again.

Q. Well, you've got this rod hanging down here and it is one-half inch in diameter and it's twenty inches between supports.

Wouldn't there be cross-sectional area of one-half times twenty -- or ten square inches?

Yes or no.

BY WITNESS HOLTZCLAW:

A. That is not a cross-sectional areas.

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I don't know what area you're referring to there.

Q. The area that you see from your point of vision of this cylinder?

MR. SOHINKI: I object, Mr. Chairman. That's not going to appear on the record.

We won't be able to tell from the record what Mr. Scott is talking about.

JUDGE WOLFE: Verbalize the imagery.

BY MR. SCOTT:

Q. The area of the plane that is the sum of all diameter perpendicular to the viewers view?

BY WITNESS WILLIAMS:

A. For the purpose of the scenario, we'll agree with you that it is approximately ten square inches.

Q. Okay.

So, if pressure was escaping at 230 pounds per square inch, why wouldn't you have 2,300 pounds of pressure against this --

(Laughter.)

BY WITNESS WILLIAMS:

A. I think you've done your calculations incorrectly, Mr. Scott.

It would be 23 pounds.

Q. Ten square inches?

BY WITNESS WILLIAMS:

A. Ten square inches.

Q. 230 pounds per square inch?

BY WITNESS WILLIAMS:

A. It is not 230 pounds per square inch distributed over that. I don't see how you can get from -- you can magnify your force by a factor of ten.

Q. Well, let's back up.

Inside this cladding, was not the force uniformly 230 pounds per square inch?

BY WITNESS WILLIAMS:

A. Yes.

Q. Okay.

Was there not ten square inches?

BY WITNESS WILLIAMS:

A. Yes.

Q. Okay.

(Pause.)

What is the MPA? I know it is megapasquills? What is that in terms of pounds per square inch?

BY WITNESS WILLIAMS:

A. It is approximately ten bar, which 145 PSI.

JUDGE LINENBERGER: Did you say one megapasquill is approximately bar?

WITNESS WILLIAMS: Yes.

JUDGE LINENBERGER: Do you know precisely what it is?

WITNESS WILLIAMS: Not off-hand. No.

JUDGE LINENEBER: It is not exactly one bar?

WITNESS WILLIAMS: No.

It is 101325, in that range.

BY MR. SCOTT:

Q. Okay.

What is the melting temperature of UO-2 and, for that purpose, we'll assume atmospheric pressure?

BY WITNESS WILLIAMS:

A. I think we answered that question yesterday.

Q. What is it?

JUDGE WOLFE: Doctor, when a question is put to you, answer it. If your Counsel objects, then I'll rule on it. But, until there is an objection, answer all questions.

WITNESS WILLIAMS: 5,080 degrees Fahrenheit for fresh fuel.

BY MR. SCOTT:

Q. Okay.

And, what does the unirradiated cladding melt temperature?

BY WITNESS WILLIAMS:
A. Approximately 1830 degrees C.
Q. Did you not give uranium oxide melting temperature in Fahrenheit?
BY WITNESS WILLIAMS:
A. I did.
Q. Well, what would it -- cladding melt temperature be in Fahrenheit?
BY WITNESS WILLIAMS:
A. 3325, approximately.
Q. Okay.
What's zirconium oxides' melting temperature?
BY WITNESS WILLIAMS:
A. I'm not sure of the specific melting temperature of zirconium oxide.
Q. Do you have an approximation?
BY WITNESS WILLIAMS:
A. I don't know.
Q. Do you know whether or not it is higher or lower than the --
BY WITNESS WILLIAMS:
A. I believe it is higher, but I am guessing.
Q. Okay.
Do you know the differences between alpha and beta phases of zirconium dioxide?

BY WITNESS WILLIAMS:

A. I know it of zirconium.

I don't know it of zirconium dioxide.

Q. Okay.

How about zircoloy, the alloy?

Do you know what the melting temperature of that is?

BY WITNESS WILLIAMS:

A. As I have just said, it is roughly 3,000 degrees Fahrenheit.

Q. In other words, that is cladding temperature?

BY WITNESS WILLIAMS:

A. Yes.

Q. Okay.

JUDGE LINENBERGER: Which alloy is that, Mr. Scott.

MR. SCOTT: I always mispronounce it, but I think it is zircoloy.

JUDGE LINENBERGER: Zircoloy. Okay. Thanks.

BY MR. SCOTT:

Q. Is there a difference in those melting temperatures between zircoloy-4 and zircoloy-2?

BY WITNESS WILLIAMS:

A. I'm not sure.

5-10

Q Which one does Allens Creek propose to use?

BY WITNESS WILLIAMS:

A. I believe it is Zir-2.

Q Okay.

How much can the cladding of Allens Creek fuel rod be deformed regularly, and not, you know, exceed any plastic limit? In other words, it would spring back to its original position?

BY WITNESS WILLIAMS:

A. I don't know.

Q Do you know approximately?

BY WITNESS WILLIAMS:

A. No.

Q Does the other gentlemen know?

BY WITNESS HOLTZCLAW:

A. No. I don't know that number off-hand.

Q (Pause.)

Do you understand a mechanism that would -- Well, let's see here.

Okay. Well, in Contention 39 we are talking about rupture of cladding.

JUDGE LINENBERGER: And, keep in mind, Mr. Scott, Contention 39, we are first and foremost talking about the ability to meet the requirement of Appendix K.

5-11

BY MR. SCOTT:

Q As you gentlemen understand it, would it be possible for it to be necessary to limit the burnup times of fuel in order to limit the amount of rupture pressure that could occur?

Is that in the realm of possibility?

BY WITNESS WILLIAMS:

A For a design such as Allens Creek, no. We have adequate lodging, a more than adequate lodging to the Appendix K limits.

Q Do we have any experimental data to show that?

BY WITNESS WILLIAMS:

A Yes.

Q And, what is that?

BY WITNESS WILLIAMS:

A The data that I have already explained, which is hoop-stress versus perforation temperature,and circumferential strain versus temperature.

Q Okay.

But, I'm talking about versus burnup.

BY WITNESS WILLIAMS:

A We had a long discussion earlier this morning about pressure dependence of burnup.

Q Right.

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BY WITNESS WILLIAM

A. We det

Q. Okay.

(Pause.

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5-13

BY WITNESS WILLIAMS:

A. The mid-1970's.

Q. Has there been a number of experimental data on this issue since the mid-1970's?

BY WITNESS WILLIAMS:

A. Yes.

And, they all display the conservatisms that I have documented in NEDO 2566.

Q. Is there any plan to revise that to lower any limits?

BY WITNESS WILLIAMS:

A. There is a current ongoing program which is taking advantage of certain conservatisms that are contained in NEDO 20566.

Q. You said a certain ongoing program?

BY WITNESS WILLIAMS:

A. We are constantly devising our models.

Q. Okay.

We're?

BY WITNESS WILLIAMS:

A. General Electric.

Q. Have any revisions been approved by the Nuclear Regulatory Commission?

MR. COPELAND: I'm going to object to the question, Your Honor. It is irrelevant.

The question is what is the model that has been used for the Allens Creek fuel design, and --

MR. SCOTT: Well, it's relevant as to whether they are using the latest model or not.

MR. COPELAND: The question is: Whether the model they have demonstrates compliance. And, the witness' testimony is that it does.

MR. SCOTT: It would still be relevant to know if they are using the latest model. That's approved.

MR. COPELAND: That is approved by the NRC?

MR. SCOTT: Yes.

MR. COPELAND: I'm sorry.

I'll withdraw my objection.

WITNESS WILLIAMS: The models are currently under review. So, we did use the currently approved model for Allens Creek.

BY MR. SCOTT:

Q You mean, the latest, one and only, currently approved model?

Is that what you're saying?

BY WITNESS HOLTZCLAW:

A. In all of our analyses, we used the approved version of the model.

However, even -- We used the approved version of the model for safety analysis calculations that are utilized in support of the plant docket.

This doesn't limit us from continually updating the models and submitting them to the NRC for consideration; but the only ones we use in the analyses are the approved versions.

Q. Okay.

I'm sure I am beating a dead horse here; but you're telling me that this is the only one that is currently now approved as opposed to two or three approved models?

BY WITNESS WILLIAMS:

A. No.

What we said was that we have two or three updated versions that are currently under review.

Q. I'm talking about approved.

BY WITNESS WILLIAMS:

A. There is one approved model.

Q. And, that is this one: NEDO 20566.

BY WITNESS WILLIAMS:

A. Yes.

Q. Okay.

JUDGE WOLFE: We'll have a recess until 11:00.

(Whereupon, a brief recess was taken.)

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JUDGE WOLFE: All right, Mr. Scott.

BY MR. SCOTT:

Q At Page 12 of your testimony on Contention 39, you mention fuel rod internal pressure of the unirradiated fuel is three atmospheres. Why do you add the two extra atmospheres pressure to those things initially?

BY WITNESS WILLIAMS:

A We add it to increase the fuel conductance across the gap.

Q Okay.

Have you done an analysis to determine whether or not you gain or lose the internal pressure over the period of a loss of coolant accident by doing that?

BY WITNESS WILLIAMS:

A Can you rephrase your question?

Q Okay. I can imagine that if you got better gap conductance, the heat from the fuel could escape outside the cladding at a faster rate and, therefore, the temperature inside the cladding would not rise as fast; and that would help to keep the pressure inside the cladding down.

On the other hand, you've got two extra atmospheres -- or some 30 pounds per square inch of pressure added. It seems to me like at some point there is a cross-over where you come out ahead as far as internal pressure.

Have you done any work on that? Do you understand what I'm talking about?

BY WITNESS WILLIAMS:

A. Yes.

Q. What can you tell us about that?

BY WITNESS WILLIAMS:

A. The beneficial effect of increasing pre-pressurization far outweighs the additional two atmospheres that are initially added to the rod.

Q. Okay.

In that answer you said "beneficial effect," do you mean as to pressure; or are you also giving credit to the beneficial effect of generating more steam with less power output?

BY WITNESS WILLIAMS:

A. We're talking purely about the fuel rod heat transfer characteristics.

Q. Okay.

But I'm trying to talk about only the pressure characteristics.

BY WITNESS WILLIAMS:

A. Perhaps if I give you a brief explanation:

If you input three atmospheres, you increase the pellet to cladding gap conductance, which decreases the fuel temperature, which, in turn, increases the fission gas release, which in turn decreases your end-of-life pressure.

You have what's called a thermal feedback effect.

Q Yes, I can see that.

Your end-of-life calculation though is based upon the cooled down reactor, after it has quit operating.

How about during the loss of coolant accident?

BY WITNESS WILLIAMS:

A. I've already stated, Mr. Scott, that the pressure at the end-of-life is less with three-atmosphere fuel.

Q Was that life including some loss of coolant accidents?

BY WITNESS WILLIAMS:

A. If you initiate a loss of coolant accident anywhere in life with three-atmosphere fuel as opposed to one-atmosphere fuel, you have less initial starting pressure.

Q Well, of course, now that wouldn't be true three or four seconds into the operating life, would it?

BY WITNESS WILLIAMS:

A. No, it wouldn't.

Q. Do you know how much time it takes to reach that cross-over point?

BY WITNESS WILLIAMS:

A. It's within five to ten thousand megawatt days per ton.

Q. Okay.

You've mentioned the gas that you've added here to initially increase the internal rod pressure. What is that? Xenon? Krypton? Which gas is that?

BY WITNESS WILLIAMS:

A. Where in the testimony are you referring to?

Q. I don't know.

BY WITNESS WILLIAMS:

A. Then I can't answer your question.

Q. Do you put more than one kind of gas to initially pressurize the rods?

BY WITNESS WILLIAMS:

A. No, we just use helium.

Q. Okay. That's what I'm wanting to know.

What is its thermal conductivity at one

atmosphere?

BY WITNESS WILLIAMS:

A. I don't know the absolute value.

Q. Okay. What is it relative to air?

BY WITNESS WILLIAMS:

A. It's better.

Q. Do you know approximately how many times better?

BY WITNESS WILLIAMS:

A. No, I don't.

Q. Now, do you happen to know the relative conductivity of helium at one atmosphere versus three atmospheres?

BY WITNESS HOLTZCLAW:

A. The thermal conductivity of helium is the same at any pressure. We're putting more helium into the gap, and that is what increases the gap conductance ... through the positive feedback loop that Dr. Williams went through.

Q. You're saying the thermal conductivity of helium is not a function of the pressure of the helium?

MR. COPELAND: That's what he said.

MR. SCOTT: Okay.

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BY MR. SCOTT:

Q. Now, why do you put three atmospheres in there if you get the same conductance with one?

BY WITNESS HOLTZCLAW:

A. We just went through the positive feedback loop that results in higher gap conductance throughout the course of the fuel operating lifetime, which results in lower end-of-life pressure.

Q. I understand that.

In what way did that depend upon the numbers of atmospheres of helium initially loaded?

BY WITNESS HOLTZCLAW:

A. The helium thermal conductivity doesn't change, but the gap conductance does change, because of the higher -- because of the higher prepressurization of helium at the beginning of life. You've got more moles of helium in the gap.

Q. Don't you have more moles in the gap if you've got more pressure in the gap?

BY WITNESS HOLTZCLAW:

A. I said if we had more moles in the gap, and those moles then would be displacing -- those molecules of helium would be displacing molecules of any other gas.

Q. Okay. I'm getting lost more and more.

Are you saying that it's really just molecules of gas that we're using to increase heat transfer across the gap, as opposed to the characteristics of the individual molecules used?

BY WITNESS HOLTZCLAW:

A. We're using a higher number of molecules of helium, so that when the gases become degraded ... when fission gas is generated and released to the gap, the number of molecules of helium for a three-atmosphere condition is greater than for a one-atmosphere condition.

With a higher thermal conductivity of helium, you increase the gap conductance.

Q. Would five atmospheres be better than three?

BY WITNESS WILLIAMS:

A. There's a general tradeoff. You eventually get to a higher pressure where it's not beneficial.

The exact threshold of that pressure depends on several things. Five atmospheres may well be better than three.

Q. Okay.

If I've got me two little spheres of gas, one of them has got helium at one atmosphere pressure, and the other one has got xenon at one atmosphere pressure, and I push all those molecules into another sphere the same size as the first two, what's the atmospheric pressure of the two together going to be?

BY WITNESS HOLTZCLAW:

A. I'm sorry. We can't follow what you're getting at there ... or what your question is.

Q. Within a certain volume, if you have a certain amount of one kind of gas and you mix it with the -- a certain volume at a certain pressure and you mix it with this same volume at the same pressure of another kind of gas, and you put the two of them together in the same volume at the same temperature, what would the internal pressure -- the pressure of the two of them together within the -- the same initial volume and temperature as existed before -- be --

In other words, do the pressures just add; or does something happen when you try to add two different gases?

BY WITNESS HOLTZCLAW:

A. You're postulating that they're both at the same pressure; and I think you would just double the pressure in the same size volume.

Q. You're right about that. I did mis-speak myself. The point I'm trying to get at is would it double the pressure, or would it increase the pressure, but not necessarily double it?

BY WITNESS HOLTZCLAW:

A. For the scenario that you illustrated, I think you would just double the pressure.

Q. Okay.

What is the -- approximately -- what is the internal pressure of the unirradiated fuel at operating conditions in the reactor, if they had three atmospheres of pressure at room temperature?

MR. COPELAND: I'm going to object to that question, Your Honor. I don't see how those facts could even exist.

I don't understand how you would have unirradiated fuel in an operating reactor.

MR. SCOTT: Heat it up electrically.

MR. COPELAND: Heat it up electrically?

MR. SCOTT: Yes. When I say "operating," I mean it is at an operating temperature.

I just want him to do PB equal NRT, to jack it up from room temperature to whatever it is -- 550°, I believe.

Just approximately.

MR. COPELAND: He has changed his question, as far as I'm concerned. He has got a different question.

I still -- He has explained what he's trying

6-10

to do. That still doesn't answer my objection.

My objection is those conditions do not exist, as far as I know, in an operating reactor.

(Bench conference.)

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JUDGE WOLFE: The Board doesn't understand your question. It doesn't make sense as presented.

I'll sustain the objection. If you can, rephrase.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q. Forget reactors, whether it's operating or not.

If you take a fuel rod at three atmospheres of pressure at room temperature and you heat that fuel rod up to 550° C, what would the pressure be inside the fuel rod, assuming no ruptures?

BY WITNESS WILLIAMS:

A. You can calculate it, using the Perfect Gas Law.

Q. I realize that.

BY WITNESS WILLIAMS:

A. Without doing the calculation, I don't know.

Q. You haven't already done that calculation?

BY WITNESS WILLIAMS:

A. The calculation has obviously been done. I don't know offhand what the pressure would be.

JUDGE WOLFE: How much more cross-examination will you have on this contention, Mr. Scott?

6-12

MR. SCOTT: I couldn't imagine more than 15 minutes or so.

BY MR. SCOTT:

Q Does the Kelman temperature increase between room temperature and 550° C only by a factor of three?

BY WITNESS WILLIAMS:

A 550° F.

Q Okay.

What is that in terms of C, approximately?

BY WITNESS WILLIAMS:

A I believe it's about 280.

Q Okay, fine.

Aren't the -- Isn't krypton and xenon gases good conductors of heat?

BY WITNESS WILLIAMS:

A No.

Q Is hydrogen or helium the best conductor of heat?

BY WITNESS WILLIAMS:

A I don't know. However, it would be slightly idiotic to put hydrogen inside a fuel rod.

Q Does the other gentleman ha anything to add to that?

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6-13

BY WITNESS HOLTZCLAW:

A. If I had the choice, I would use helium, to preclude a combustion of hydrogen.

Q. Do you know anything about the relative heat transfer?

BY WITNESS HOLTZCLAW:

A. I believe helium is a better heat conductor.

Q. Okay.

JUDGE LINENBERGER: Keep your sights on Appendix K, Mr. Scott. It's not -- Well, enough said.

BY MR. SCOTT:

Q. At the bottom of Page 12 of your testimony, at Line 23, "The hottest cladding temperature is used as the fuel gas temperature during the accident."

Now I'm not clear what that means. Does that mean the maximum cladding temperature obtained during the course of the accident is used as the cladding temperature throughout the accident? Is that what that means?

BY WITNESS WILLIAMS:

A. No. It means that the temperature profile of the axial peak temperature is used as the gas temperature throughout the accident.

Q. Okay. We're back to what was bothering me while ago. If it's used at that temperature throughout the accident, during the accident, that seems to contradict your earlier statement saying that that was the temperature used at the end of the accident.

BY WITNESS WILLIAMS:

A. You've lost me again, I'm afraid, Mr. Scott. Can you rephrase your question?

Q. Here before when we were talking about the temperatures of the fuel and the temperatures of the cladding gas and the temperature -- I mean the gap gas -- the temperature of the cladding --

BY WITNESS WILLIAMS:

A. Yes.

Q. And I thought where that come down was that you had said that the cladding temperature was taken to be the same as the fuel gas temperature, only at the end of the accident.

BY WITNESS WILLIAMS:

A. No. I said that the fuel -- the gas in the gap was assumed to be at the temperature of the maximum axial peak clad temperature throughout the transient.

And that the maximum peak clad temperature at the end of the accident is the maximum gas temperature.

I think you're confusing maximum axial peak with maximum temperature.

There is a temperature distribution axially along the rod.

Q Okay. I can see what you've said.

I'm still left not able to understand then why you didn't use -- I mean you've got the gap here, right? Cladding on one side and the fuel on the other side.

MR. COPELAND: That's what the gap is; yes, Mr. Scott; and the witnesses have explained that.

BY MR. SCOTT:

Q Okay.

Given that, you've got -- during at least portions of the accident -- the hot fuel, relatively speaking, the gap and then the relatively cooler cladding.

Why would you use the cladding temperature during this accident, as opposed to the fuel temperature?

Why would the gap temperature be more dependent upon one side of the gap than the other?

MR. SOHINKI: Objection. A compound question. Take them one at a time.

JUDGE WOLFE: Can you thread and separate the questions?

WITNESS HOLTZCLAW: I can try.

JUDGE WOLFE: All right.

WITNESS HOLTZCLAW: I believe we testified that the gas temperature is utilized the same as the peak cladding temperature throughout the course of the accident because --

BY MR. SCOTT:

Q. Is that axial peak now?

BY WITNESS HOLTZCLAW:

A. Yes, sir.

Q. Okay.

BY WITNESS HOLTZCLAW:

A. -- because in the scenario, as we defined it, the fuel is redistributing its stored energy and is decreasing in temperature; and the cladding is increasing in temperature until they hit an equilibrium.

Q. Okay.

But would it not have caused higher pressures to exist throughout this transient -- this time -- if you had used the fuel gas temperature to be the -- back up -- the gap temperature to be the fuel temperature, as opposed to the cladding temperature?

It seems to me like you've minimized the case

6-16

instead of worsening it.

BY WITNESS HOLTZCLAW:

A. No, we haven't, because the fuel that's in contact with the gas gap is at a lower temperature because of the profile of the fuel.

The temperature profile across the fuel pellet -- the fuel pellet, as we mentioned to you earlier -- has a peak at the center of about 3300° F.

At the surface it's on the order of 1500 to 1700 degrees F.

Q. Yes. But at that same time is it not true that the cladding temperature is only 650° F, at the initialization of the loss of coolant accident?

MR. COPELAND: Your Honor, I'm going to object to any more questions along this line. The witnesses have already testified that what they have looked at, for purposes of the LOCA accident, is at the end of the accident because that's the worst assumptions that they could have, in terms of clad temperature.

And I don't think that it does any good to continue to try to look at every scenario that is less than that worst-case condition, which is all that Mr. Scott could possibly be inquiring into by this line of questioning.

JUDGE WOLFE: We'll sustain that objection.

MR. SCOTT: It's nonsense ...

MR. COPELAND: I would like for the record to note that Mr. Scott just said that ruling is nonsense.

MR. SCOTT: The physics is nonsense, not the ruling.

MR. SOHINKI: I ask that that comment be stricken.

That's a comment on the quality of the testimony, and it's not proper.

JUDGE WOLFE: Motion to strike granted.

MR. DOHERTY: I would like the record to reflect that I heard the comment; and I do not believe it was aimed at the Board's decision.

BY MR. SCOTT:

Q You have previously stated that initially the cladding temperature is 650° Fahrenheit, and that the part of the fuel next to the gap is 1700° Fahrenheit, and that the pressure of the gap gas depends upon the temperature of the gap gas.

So if you were trying to maximize the pressure on the system throughout the transient, why would you have not taken the highest temperature of the gap gas?

MR. COPELAND: The same objection, Your

Honor.

JUDGE WOLFE: Sustained.

BY MR. SCOTT:

Q Gentlemen, is the cladding more brittle at cold temperatures or at high temperatures?

MR. COPELAND: Objection, Your Honor, as to relevance.

We're talking about a LOCA condition that's required under the Appendix K calculation. That's the only thing that's in question, and that is as to its yield strength and potential for swelling under LOCA conditions.

MR. SCOTT: That's all I'm talking about.

MR. COPELAND: The reactor is not cold under a LOCA condition, Mr. Scott.

MR. SCOTT: Cold in the relative sense.

(Bench conference.)

JUDGE LINENBERGER: With respect to brittleness, Mr. Scott, the witnesses have testified on more than one -- even more than two or three occasions -- that brittleness is highly dependent upon the amount of oxidation.

And you have again, apparently, shown no desire to fold into your questions what has been testified to before.

I can't see any point to taking time of the witnesses to answer this question, Mr. Chairman.

MR. SCOTT: Mr. Chairman, may I explain why this is important?

The oxidation that occurs increases with higher temperatures.

Initially, there is insignificant amounts of oxidation ... at the very beginning of the transient -- I'm calling it transient, the loss of coolant accident. The transient and the pressures within the fuel rod.

It might just be that at that relatively cool state of the unoxidized cladding, that the pressures in there could be higher relative to the tensile strength of the cladding than they are towards the end of the accident, where the cladding is at a higher temperature.

(Bench conference.)

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JUDGE LINENBERGER: As I said before, Mr. Scott, the witnesses have discussed many of the characteristics of the cladding, including brittleness.

And your question as posed has not taken advantage of what has been discussed previously, and has not supplied enough parameters to allow a meaningful answer to that question.

So I just have to recommend that we not permit the question.

JUDGE WOLFE: All right. Objection sustained.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q There seems to be some sort of built-in assumption here that the gas gap temperature is going to be at a maximum at the end of the loss of coolant accident.

Now, I don't see that from the data given here.

You've previously testified that the center of the fuel rod initially was at 3,000 degrees; the outer edges of the fuel rod was at 1700 degrees; and that the cladding temperature started out at 650 and went up to possibly a maximum of only 1600.

During that whole scenario, the very maximum temperature would be at the very beginning, where you have got 1700-degree fuel temperature.

7-2

So I don't understand --

MR. COPELAND: We are not here talking about the fuel, Mr. Scott. We're talking --

MR. SCOTT: We're talking about the gap temperature.

MR. COPELAND: No. We're talking about the cladding swelling or rupturing.

That's the whole purpose of the contention, and the question is, what is the temperature of the cladding.

MR. SCOTT: The question is what is the pressure on the cladding, and the pressure on the cladding comes from the temperature of the gap gas.

And under the testimony here so far that could be a maximum at the initialization of the experiment, if you let the gas gap temperature be that of the fuel, which is on one side of the gap, instead of that of the cladding, which is on the other side of the gap.

MR. COPELAND: Well, Your Honor, these witnesses have explained why Mr. Scott's -- why that is not accurate, why they have calculated the gas gap temperature to correlate with the cladding temperature.

I would move at this time to terminate Mr. Scott's cross-examination, unless he can demonstrate to the Board that he has some points that need to be covered that have not been covered by Mr. Doherty's cross-examination.

I would remind the Board that we filed a motion to try to prevent this sort of thing, and the Board in its own wisdom decided that was not a good thing; but I think the Board did leave it open to decide at each point in the proceeding when we had reached the point where further cross-examination by the non-lead party had to demonstrate something that needed to be discussed that had not been discussed by the lead party.

I for one believe that we have gone beyond that point now and it's time to make that determination.

MR. SCOTT: Mr. Chairman, hopefully you can see, I think you can, that I'm on a very relevant point, a very major point, and it's probably the key to their whole testimony here.

Using their own testimony, the facts are in the record, to show what I've just said.

If you don't understand it somehow, I can repeat it, but it's -- scientifically and legally, we've got a good point here.

JUDGE LINENBERGER: So far as the particular question you are asking, Mr. Scott, not only was it discussed yesterday, but the very same question and the reasons for treating the gas temperature the way it was were explained this morning, just since our last recess, to you; and you are, I'm afraid, providing another example of something I alluded to earlier, that your questions show little evidence that you have listened to what has been told to you previously.

To pursue this again and again is unproductive. We're getting cumulative testimony, and I just cannot see any point to sticking with that question again.

It has been explained.

JUDGE WOLFE: All right.

MR. SCOTT: Mr. Chairman, I'd like to get one very clear point here.

Is it understood by the Board that the maximum temperature of the gas, the gap gas, under their scenario would exceed 1600 degrees Fahrenheit, and that under mine it would be 1700 degrees Fahrenheit?

MR. SOHINKI: I don't know where he's reading from, Mr. Chairman.

If he's reading from the testimony, I'd like to be able to refer to the point that he's reading from.

MR. SCOTT: I'm not reading from the testimony. I'm reading from my notes of the witnesses' testimony today, in which they said that the maximum highest clad temperature could be only 1600 degrees, and that the initial fuel temperature was 1700 degrees.

JUDGE WOLFE: All right. The objection is sustained.

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As I said before, if the record indicates facts or testimony or whatever contrary to our ruling, then we've erred and you have your right of appeal.

So we sustain the objection.

Further, it is now 11:43. It's some seven minutes beyond the period of time that you said you would have completed your cross-examination.

MR. SCOTT: I didn't say that.

JUDGE WOLFE: You expected to complete.

In any event, we find that your cross-examination has been non-productive. It's been redundant, and we will terminate your right of cross-examination as to Doherty Contention 39.

You may now proceed on with another contention, another Doherty contention.

MR. SCOTT: Mr. Chairman, I'd like for this record to show there's not been a single asked-and-answered objection sustained to this point.

MR. COPELAND: Well, the record will show what it will show, and that's absolutely false.

BY MR. SCOTT:

Q Going on to Contention 20(a).

Gentlemen, is it true that the amount of fission gas released will increase with the burnup?

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-6

BY WITNESS HOLTZCLAW:

A. We have correlated the fission gas release with temperature and discussed the model that we've used. It does correlate it with temperature. We have --

MR. SCOTT: Mr. Chairman --

BY MR. SCOTT:

Q. Go ahead.

BY WITNESS HOLTZCLAW:

A. -- as indicated in our testimony, we have recognized an enhancement in fission gas release above burnups of 20,000 megawatt days per ton.

MR. SCOTT: Mr. Chairman, I ask that that answer be stricken as non-responsive to the question I asked.

MR. COPELAND: I don't know how he could have answered it any more clearly than he did.

MR. SCOTT: I asked whether or not the amount of fission gas release would increase over time.

MR. COPELAND: Look at page --

MR. SCOTT: Yes or no.

MR. COPELAND: Look at line 23 at page 17 of the witnesses' direct testimony, Mr. Scott.

JUDGE WOLFE: Well, let's get back to the original question and answer. Ms. Bagby, could you read the question and answer.

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MR. COPELAND: Fine, okay. It doesn't make me any difference, Your Honor.

It's in the record in his direct testimony.

JUDGE WOLFE: I want to hear the question and answer.

(Record read.)

JUDGE WOLFE: The response is in part responsive and is in part not responsive, and I don't intend to strike a part and not strike a part.

I will deny the motion to strike. The response is on the record, and if you're not satisfied with it not being responsive in its entirety, ask another question and get all the answer that you want.

BY MR. SCOTT:

Q. In the second part of your previous answer, the part that is supposedly relevant to the question that I asked, the correction factor that you talk about, the Dutt-Baker correction factor, is that a correction factor that relates to the rate of the fission gas release, or is that a factor that determines the total amount of fission gas release?

BY WITNESS HOLTZCLAW:

A. The factor modifies the fission gas release quantity.

Q. By modifying the rate; is that not correct?

BY WITNESS HOLTZCLAW:

A. No.

Q. You are saying that the fission gas release rate is not greater after 20,000 megawatt days than it was before 20,000 megawatt days?

BY WITNESS HOLTZCLAW:

A. That's just what I said. It modifies the quantity above 20,000 megawatt days per metric ton.

Q. When you say "quantity," you mean quantity per burnup, or do you mean quantity independent of burnup?

JUDGE LINENBERGER: Mr. Scott, this is another example of your not listening or not thinking or not caring. I don't know which.

He just told you how it was related to burnup.

Please, Mr. Scott, will you listen, think, try to make a contribution.

You are floundering and ignoring what you are hearing.

MR. SCOTT: I'm not, but maybe you can't know that.

JUDGE LINENBERGER: I don't want to be pushed into an alternative conclusion about how your questions are going.

Go ahead, please.

//

BY MR. SCOTT:

Q. Gentlemen, do you all understand the difference between the magnitude of something as opposed to the rate of change of that something?

BY WITNESS HOLTZCLAW:

A. I believe I do.

Q. Okay.

What is the formula for the Dutt-Baker correction factor?

BY WITNESS HOLTZCLAW:

A. I don't have the formula here.

Q. Tell me what it is.

BY WITNESS HOLTZCLAW:

A. I don't know.

Q. Haven't you used it?

BY WITNESS HOLTZCLAW:

A. I have not used it directly. We have applied it at General Electric in conjunction with our GEGAP model.

It modifies the fission gas release by increasing the release above 20,000 megawatt days per metric ton.

Q. When you say "increases the release," do you mean increasing the rate of release per unit of burnup?

MR. COPELAND: Asked and answered, Your Honor.

JUDGE WOLFE: Sustained.

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Q Has the Dutton-Baker correction factor been changed any since 1973?

Or has the same formula been used ever since that time?

BY WITNESS HOLTZCLAW:

A. I am not aware of any changes to the correction factor.

Q. Okay.

(Pause.)

What experiments do you know of to show that the correction factor shouldn't be modified as a result of present design and fuel rods?

MR. COPELAND: Your Honor, I object to the question.

The witness has explained at some length last night the verification of that model and has explained it directly on Pages 17, Lines 8 through 15.

We had a long discussion about that last night.

It has been asked-and-answered in detail. Discussed in detail I should say.

JUDGE WOLFE: Sustained.

MR. COPELAND: I might add a point, Your Honor, that this Dutton-Baker factor is not something that GE developed, as I understand it.

And, these witnesses are not here to defend

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that factor. All they're here to do is to testify that they have, at the NRC's request, accounted for that in their model; and what the result -- And, are here to testify what the result would be.

MR. SCOTT: Mr. Chairman --

MR. COPELAND: And, that was their testimony last night as well.

MR. SCOTT: -- anytime the witnesses use a subject in their testimony that is oral or written, they then become open to cross-examination on that --

JUDGE WOLFE: Well, I have sustained the objection.

It has been asked-and-answered previously. We don't have to go beyond that.

BY MR. SCOTT:

Q. When was the new NEDO 10506 published?

MR. COPELAND: Asked-and-answered, Your Honor.

MR. SCOTT: I don't think so.

(Bench Conference.)

JUDGE WOLFE: The Board doesn't recollect. You may answer the question.

WITNESS HOLTZCLAW: I believe, the NEDO 10506 document was issued in 1973.

BY MR. SCOTT:

Q. Okay.

Now, in your description of your testimony between Lines -- Pages 8 and 15, it describes how the model was verified.

How could it have accounted for the fuel rods designs that have come out and been used since 1973, if that was published in 1973?

MR. COPELAND: Your Honor, this is exactly where we broke off last night.

And, Judge Linenberger, as I recall, explained at some length to Mr. Scott why fuel rod design was not critical for purposes of this discussion.

It is clear to me that Mr. Scott has forgotten that entire thirty minutes of discussion that we had on his cross-examination.

I would move to terminate any discussion -- further discussion about the models described at Page 17, Lines 8 through 15.

MR. SCOTT: Mr. Chairman, if you're talking about fuel fission gas release from fuel rods, it is obvious, that that is a function of the design of the fuel rods.

MR. COPELAND: This is where we got into Mr. Scott's hypothetical about a three-mile long fuel rod. Now, we went into all of this last night, Your Honor.

MR. SCOTT: It is obvious that there is a difference between seven-tenths of a mil and a 1.2 mil diameter.

(Bench Conference.)

JUDGE WOLFE: Objection sustained. However, the motion to terminate any further cross-examination on these models is denied.

BY MR. SCOTT:

Q. Gentlemen, do either one of you all understand mechanisms. The theory behind the transport of gas in a solid?

BY WITNESS HOLTZCLAW:

A. I am somewhat familiar with that fairly complex area.

Yes.

Q. Do you know of anything that would make the -- everything else being equal, would make the gas diffusion rate, transport rate be faster and larger chunks of material just because the material was larger?

BY WITNESS HOLTZCLAW:

A. I am sorry.

I can't relate your question of my knowledge of gas transport rate and UO_2 fuel.

Q. I only ask you if you knew of anything? Maybe you don't know of anything.

MR. COPELAND: The witness answered his

question, Your Honor, as clearly as he can answer.

Asked-and-answered.

MR. SCOTT: No.

That is not the answer to the question I asked.

It is not even responsive. It's avoiding the question I asked.

JUDGE WOLFE: I'll overrule the objection.

WITNESS HOLTZCLAW: Would you repeat the question.

BY MR. SCOTT:

Q. I asked: Do you know of anything that would cause the transport rate, or the diffusion rate of gas in a solid to be faster just because it is in a bigger solid?

BY WITNESS HOLTZCLAW:

A. I can think of many potential driving forces such as temperature gradients that --

Q. I said with everything else being equal, did I not?

BY WITNESS HOLTZCLAW:

A. I don't know of anything.

Q. Okay.

Now, getting closer to the real world, what do you know that would cause the diffusion rate, transport rate to be faster in a 1.2 centimeter diameter fuel rod than it was in a seven-tenths of a centimenter diameter fuel rod?

MR. COPELAND: I'm going to object to that question, Your Honor.

The witness answered last night that to his knowledge with respect to the answer on Line 13, which Mr. Scott is still obviously trying to hammer away at, was based on the test that had been done with fuel rods that are known to be used and in existence for four power plants today.

And, Mr. Scott kept trying to create a variety of hypotheticals that departed from that; and I objected to that and the Board sustained that objection, stating that all that is fair to deal with is the witnesses knowledge of the fuel rods that have been tested.

I think we're right back on the same track; and I have the same objection.

MR. SCOTT: Mr. Chairman, I have very specifically mentioned the diameters of two types of GE fuel rods. Now, I don't see how anybody can claim that they're not realistic, reasonable, in use . . .

(Bench Conference.)

MR. COPELAND: Well, if he's relating the question then to known fuel rods that were used in the test, then, the witnesses answer is that the model

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depends only on temperature and not fuel rod design.

So, we're just coming full-circle again.

MR. SCOTT: I am certainly allowed to discredit the witness.

He's got to come up with some kind of justification for his statements.

MR. COPELAND: He did, Your Honor.

The justification was that that's what the test data shows.

(Bench Conference.)

JUDGE WOLFE: Well, the Board sustains the objection because the question is not directed to the perspective -- or to the proposed Allens Creek fuel rod design; and that's all we're interested in.

JUDGE LINENBERGER: And, furthermore, the statement at Lines 12 through 15, the basis for the statement on Lines 12 through 15 of Page 17, was discussed in depth previously by the witnesses.

So, there is little point in repeating what is already on the record on that aspect.

Now, enough said.

BY MR. SCOTT:

Q. Gentlemen, what test have you all done, if any, to verify the gas release from the same fuel rods that would be used -- the same type, the same design of fuel

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rods that are going to be used in Allens Creek reactor, if permitted?

BY WITNESS HOLTZCLAW:

A. We've done two things.

First of all, we've taken the data that is the basis of the GEGAP model, compared the ranges of parameters that were utilized in those test fuel trends and convinced ourselves that the parameters that we're using for the Allens Creek fuel fall within the ranges of the parameters -- the design parameters, that were used in the model verification.

We, also, have developed metal irradiations ongoing in a number of reactors, test reactors, of the same exact design as the Allens Creek fuel.

Q. The longer you talk, the more confused I get. Did -- If the model depends only on the temperature, why were you looking in a various range of designs to see if Allens Creek fell within that?

BY WITNESS HOLTZCLAW:

A. The model, as we indicated in our testimony, was correlated on temperature. That is, there was not a design parameter that was important to be included in the model development.

But, in order to insure applicability of the model to a particular design, you compare the parameters used in verifying the model, with its intended application.

Q. What was the diameter of the fuel rod in the VBWR reactor test?

BY WITNESS HOLTZCLAW:

A. I don't have the exact data or ranges of data with me.

They are included in the NEDO document that we referenced in our testimony.

Q. You don't know --

BY WITNESS HOLTZCLAW:

A. For my best recollections of that data, I believe, the pins that were used in fission gas release correlations were as small in diameter as .325 inches and as large in diameter as .7 inches.

Q. You can't figure --

BY WITNESS HOLTZCLAW:

A. Which clear --

Q. Go ahead.

BY WITNESS HOLTZCLAW:

A. Which clearly brackets the diameter of .483 inches for the Allens Creek fuel.

Q. .438.

BY WITNESS HOLTZCLAW:

A. .483 inches.

(Pause.)

Q. How does the fission gas get from the-where it first becomes a gas to-the gap?

How does it get there?

BY WITNESS HOLTZCLAW:

A. The actual transport process is a very complex phenomenon that many experimenters who spent a good deal of resources in understanding phenomenonologically, and it even today is not that well understood.

And, there are a lot of phenomenonological models that have been developed to describe the process.

In order to best model complex situations such as this, a semi-empirical approach is taken; such as, test irradiations, and then correlations are developed. And, this is the approach that we've taken with the fission gas release model portion of the GEGAP code and it is the approach taken by most of the experimenters that work in this area today.

Q. Well, are you saying that the -- I can't even pronounce it, the models anyway, don't agree with the experimental data and you just go with the experimental data?

BY WITNESS HOLTZCLAW:

A. No. I didn't say that at all.

I said the models are developed based on the experimental data.

Q Well, do you know of any models that determine gas release without determining -- without it being based upon the transport theory of the gas through the solid?

BY WITNESS HOLTZCLAW:

A I know of no first principles-type models utilized to predict fission gas release.

Q Do you know whether or not the models assume that the fuel is crystalline or not?

MR. COPELAND: Can I ask where this line of questioning is going, Your Honor.

These witnesses are here to testify to one thing and to one thing only. And, that is: In accordance with the request of the NRC, they have applied the Dutton-Baker Correction Factor to their code and have demonstrated that after applying that correction factor they still meet the 220 degree limit on temperature.

And, I don't understand why we are spending this amount of time going off into such irrelevancies such as Mr. Scott is now pursuing.

MR. SCOTT: Mr. Chairman, the contention clearly was not a directive for GE to go off and apply the Dutton Correction Code and see what it said.

The contention says, "Hey, if you use that Code, it may not give you a correct answer."

I mean, we wouldn't have been here on this if we believed that it gave the correct answer when it was used.

So, Applicant's description of the contention is, obviously, wrong.

MR. COPELAND: Well, that's all these witnesses have addressed, Your Honor, is how that applies and what the result is.

MR. SCOTT: Then, they have not addressed the contention.

JUDGE LINENBERGER: The problem we have, Mr. Scott, is, I guess, how are you addressing the contention when you are asking about fission gas diffusion mechanisms within a UO_2 matrix.

MR. SCOTT: Okay.

Can I try to explain that?

If the amount of fission gas released depends upon the amount that gets out of the solid, we discussed it at length yesterday: What did he mean by release. And, it is not the -- And, they said it was not that that was released from the nucleus of one element to another in a fissioning process; but it is ones that actually got out into the gap. Out of the solids. In

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order to do that, in order to get out, it, obviously, has to travel various lengths from its point of creation in the solid, to get out of the solid.

They have admitted here that their model does not take into account the distance that that has to travel. And, the amount of fission gas released, obviously, is going to depend upon the distance it has to travel to get released.

And, so, I am impeaching their model that way.

MR. SOHINKI: I think the record will reflect, Mr. Chairman, that he is not summarizing the testimony correctly.

JUDGE LINENBERGER: That is the problem I'm having, Mr. Sohinki, is there is not a proper characterization of the testimony; and --

MR. SCOTT: Where is it incorrect?

JUDGE LINENBERGER: -- again, Mr. Scott, you're failing to avail yourself of what is being given to you by these witnesses.

And, furthermore, not in any sense are you -- is your line of questioning leading to anything that will discredit what they have said about the experimental verification of fission gas release and its affect on cladding.

So, I just have trouble finding any merit to

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this line of questioning.

MR. SCOTT: Mr. Chairman, I would be very glad either on or off the record, to have anybody explain --

JUDGE WOLFE: Why should anyone explain anything to you, Mr. Scott. You heard the testimony. Now, the record will speak for itself.

You're motion was what, Mr. Copeland?

MR. COPELAND: To terminate any further discussion along this line.

We spent, you know, last night and all day this morning on this one point. You know, trying to go into the question of why a fuel rod design was not a factor --

MR. SCOTT: And all the answer we've ever gotten is that they say it is not. That is not an answer.

MR. COPELAND: Well, there's two answers to that.

That is their testimony, and they've explained why it is not, Mr. Scott.

And, secondly, these gentlemen did not develop that factor. They have just applied it to the GE model; and I think we're wasting a lot of time trying to get them to explain how somebody else --

JUDGE WOLFE: All right --

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MR. SCOTT: Well, it just means they could not possibly verify the model --

JUDGE WOLFE: We'll sustain the objection. And, you will proceed to a different line of questioning, Mr. Scott.

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BY MR. SCOTT:

Q You have mentioned dominant gases that are produced as a result of fission: Krypton, Xenon and Iodine and a number of various isotopes of each.

Do you know the rate of diffusion for any of those gases through a solid?

MR. COPELAND: I'm going to object, Your Honor. We must be right back on the same point because he has asked that same question about four different ways now.

MR. SCOTT: It's not the same question at all.

MR. COPELAND: What is the point of this line of cross-examination then, Mr. Scott, if you please?

MR. SCOTT: I'm trying to find out how much these gentlemen know about the model that they've supposedly verified.

MR. COPELAND: Well, that makes my point, Your Honor.

JUDGE WOLFE: Sustained.

MR. SCOTT: They don't know anything ...

MR. COPELAND: Could we ask what is left of Mr. Scott's cross-examination that needs to be developed that was not done by Mr. Doherty?

MR. SCOTT: I've hardly gotten into it.

MR. COPELAND: Well, specifically what points? Your Honor, I think it's time to inquire into that. It seems to me that he has had one point that he spent last night on and all of this morning.

I think it's --

JUDGE WOLFE: Let me ask you this question. How much cross-examination do you have on Doherty Contention 20(a)?

MR. SCOTT: A correct answer is: "I don't know."

I can estimate --

JUDGE WOLFE: Approximately.

MR. SCOTT: A couple or three hours.

MR. COPELAND: Well, I think with that representation, Your Honor, it's very important for the Board to know what points he intends to develop and whether the Board considers it to be worthy of their time to pursue those points, or whether they're satisfied with the record as it stands.

I think that's clearly within the Board's discretion.

MR. SCOTT: It will take me as long to explain it, as it would just to go ahead and do it.

(Bench conference.)

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JUDGE WOLFE: Mr. Copeland, we've indicated before that we're not about to make advance rulings -- these sort of advance rulings.

We expect timely objections, prompt objections, and just as promptly will rule on whether cross-examination is objectionable or not.

I think that's the only way to go about it. And that's the way we're going to go about it.

So proceed. Raise your objections. We'll rule on it.

And when the time comes that it becomes readily apparent that the objections are cascading -- sustained objections are cascading, we'll terminate the cross-examination.

So you're forewarned, Mr. Scott. Next question.

BY MR. SCOTT:

Q. Okay, gentlemen, on Page 15 of your testimony at Lines 8 and 9, it says: " ... a small fraction [of the fission gas] is released to the gap between the fuel pellets and the cladding."

What is a "small fraction"?

BY WITNESS HOLTZCLAW:

A. Lines 8 and 9 were put into our testimony to try and illustrate the process --

Q. Gentlemen, can you please answer my question?

BY WITNESS HOLTZCLAW:

A. I'm still answering, sir.

To illustrate the process that we call fission gas release, typically -- and I can only give relative numbers here -- but typically the percentage would be dependent, as we have indicated, on a number of parameters: temperatures -- specifically temperature of the fuel.

You could characterize, I guess, the amount -- the total amount that's released to the gap to be something in the range of 15 to 25 percent of that generated.

Q. Doesn't the amount released depend upon the time you wait, from the time it was created within the solid?

MR. COPELAND: I'm going to object, Your Honor. He's going right back to the line of cross-examination that has been cut off.

MR. SCOTT: I don't see how that's the case.

MR. COPELAND: You're talking again about the amount of gas in the solids and that was ... you know, the very thing that my last objection was on, that terminated the line of cross-examination.

MR. SCOTT: Line 8 says, "trapped within the fuel pellets."

I'm trying to find out if it's ever trapped forever.

JUDGE LINENBERGER: Well, the witnesses have made it clear that they are not knowledgeable about the mechanism of transport of fission gases out of the fuel pellet.

And your persistence at getting at that mechanism, Mr. Scott, is wasted time on your part.

Now, that is certainly not to say -- very logically, there are other lines of questions relating to whether fission gas release has been overestimated or underestimated and what's the evidence for it.

If you had listened to the testimony, however -- read the testimony and listened to the previous cross-examination, you will structure your line of questions in such a way that will take advantage of this.

That you have not been doing. But continued questioning, Mr. Chairman, as far as I'm concerned, on how fission gas gets out of the pellet should be out of bounds in this cross-examination.

MR. SCOTT: Mr. Chairman --

JUDGE WOLFE: Objection sustained.

BY MR. SCOTT:

Q. Gentlemen, do you know the explicit accounting that is done to relate the fission gas release as a function of temperature, mentioned on Line 14?

BY WITNESS HOLTZCLAW:

A. I don't understand your question.

Q. It says: "The fission gas release model used by General Electric explicitly accounts for the temperature dependence of fission gas release."

It's explicit i it's written down, is that not true?

BY WITNESS HOLTZCLAW:

A. Yes, it is a temperature-dependent model. And --

Q. And it's written down, right?

BY WITNESS HOLTZCLAW:

A. And it is written.

Can I finish my answer, please? It is defined very clearly in the report that we've indicated. It is a regional threshold release model that allows various percentages of gas to be released at specific fuel temperatures.

And for a fuel temperature below -- I believe the number is 3000° Fahrenheit, four percent of the gas that's generated is released.

For areas of fuel at temperatures greater than 3000, I believe all of the gas that's generated is released.

The model breaks the fuel down into radial rings and calculates the temperature of each ring, and then calculates the gas release for each ring and sums that up, and then does a summation of the whole fuel rod.

Q What happens to the gas that's released from one ring? Does it just go into the next ring?

MR. COPELAND: Your Honor, I believe that the last ruling by the Board was that we were terminating any discussion of the mechanism by which the gas gets into the gap from the fuel pellet.

MR. SCOTT: He just answered ... I'm just following up on his answer.

(Bench conference.)

JUDGE WOLFE: This line of questioning has gotten -- or this question has gotten into the area that we said you were precluded from asking additional questions on, Mr. Scott.

MR. SCOTT: I'm trying --

JUDGE WOLFE: There are other fruitful areas. The answer of any witness cannot open up a prior Board ruling. We said you were precluded, and you are.

BY MR. SCOTT:

Q Once again, gentlemen, explicitly what is the formula that describes the temperature dependence of fission gas release -- the formula?

MR. COPELAND: That has been asked and answered, Your Honor. The witness said he did not have the formula --

MR. SCOTT: There has obviously never been a formula put into the record --

MR. COPELAND: He said he didn't have it with him, and he couldn't recall it off the top of his head.

MR. SCOTT: He never said he couldn't recall it off the top of his head.

That's a good hint for him --

WITNESS HOLTZCLAW: I just gave -- There is no formula to work down.

I gave you the model. It's a threshold model, and I gave you the temperature dependence.

BY MR. SCOTT:

Q That's only the two parts then, above or below 3000?

BY WITNESS HOLTZCLAW:

A. That's correct.

Q. Okay.

Now --

JUDGE WOLFE: There was an objection.

MR. COPELAND: I withdraw it, Your Honor.

JUDGE WOLFE: And the witness is advised --

MR. COPELAND: I think he -- I held up my hand to stop him from answering; and I think he misunderstood me and thought that I wanted him to go ahead and answer the question.

JUDGE WOLFE: Well --

MR. COPELAND: It was not his fault; it was mine, Your Honor.

JUDGE WOLFE: All right.

BY MR. SCOTT:

Q. You've earlier testified that the fuel has a maximum temperature at its maximum location, namely, the center, of 3000° Fahrenheit. Is that not correct?

MR. COPELAND: Asked and answered, Your Honor.

MR. SCOTT: I haven't asked if that question is correct before.

(Bench conference.)

JUDGE WOLFE: Sustained.

BY MR. SCOTT:

Q. Now, with the given that it's 3000°, wouldn't

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that mean then that the fission gas release would only need half your model, namely, the part that's related to temperatures less than 3000°?

BY WITNESS HOLTZCLAW:

A. I'm sorry. I don't understand your question.

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BY MR. SCOTT:

Q Okay.

You've earlier stated that the maximum temperature of the fuel rod was 3000° --

JUDGE WOLFE: Wasn't that the question you just asked, and I sustained an objection to it?

MR. SCOTT: You sustained me asking that.

Now, I'm giving the basis to ask another question.

JUDGE WOLFE: Well, then you knew it really had been asked before.

Where did you get the 3000 figure?

MR. SCOTT: Three thousand is in the record. But in Centigrade or Fahrenheit, that's what I'm not certain about.

Three thousand is in the record --

JUDGE CHEATUM: He also answered that.

JUDGE WOLFE: All right, go ahead. Never mind.

MR. SCOTT: Okay.

BY MR. SCOTT:

Q If the maximum temperature is 3000° and the maximum -- and the release rate is four percent for all temperatures less than 3000, then isn't it true to say that you don't need that portion of the explicit accounting?

BY WITNESS HOLTZCLAW:

A. I think we indicated that the maximum temperature at the center line is in the area of 3300 to 3400 degrees Fahrenheit.

Q. Three thousand --

BY WITNESS HOLTZCLAW:

A. We've also used in other discussions today some approximations in responding to questions that didn't require such an accurate description of the center line fuel temperature.

The maximum value, I think the testimony will bear this out, at the center line of the pellet is between thirty-three and thirty-four hundred for peak operating conditions of 13.4 kilowatts per foot.

Therefore, for the area of fuel towards the center of the pellet that is about 3000° F, you would need the capability to account for fission gas release at those temperatures.

Q. Okay, that clarifies that.

Do you know what times are involved in the releases in the experimentation that has come up with your two-part formula here of four percent if it's less than 3000° and all if it's greater than 3000°?

BY WITNESS HOLTZCLAW:

A. Could you simplify your question? You're confusing the model with the data.

Q. Whether it's data or model, the one that says four percent will be released up to 3000° and all of it after that point, that has got to be based on data; is that not correct?

BY WITNESS HOLTZCLAW:

A. That's correct.

Q. What time frames were used in that data determination?

MR. COPELAND: I'm going to object. What do you mean "what time frames," Mr. Scott?

MR. SCOTT: How long after the fissioning took place was the amount of fission gas release determined?

WITNESS HOLTZCLAW: The data is not correlated in terms of a transient model; that is, a time-dependent model. So I can't answer that question.

BY MR. SCOTT:

Q. I don't understand your answer. What do you mean it's not a time-dependent model? What's not a time-dependent model?

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BY WITNESS HOLTZCLAW:

A. The fission gas release model is not time dependent.

Q. Okay.

But I wasn't asking you about -- Are you describing the model that says -- You're saying the model is this thing that four percent will be if it's under 3000°? Is that the model we've been talking about?

BY WITNESS HOLTZCLAW:

A. It sure is.

Q. I thought that was a small part of the much bigger model. That's part of my confusion.

Now --

JUDGE LINENBERGER: Mr. Scott, help me here. This "much bigger model" that you're talking about, what does it address?

MR. SCOTT: It would supposedly address the total amount of fission gas released to the gap, accounting for all of the factors that are --

JUDGE LINENBERGER: And where was that one developed, Mr. Scott, that model that you're describing? I'm missing something about your line of questioning and your objective and your goals and how it relates to the contention.

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MR. SCOTT: I think they were described as phenomenologic ... or something like that ... while ago.

JUDGE LINENBERGER: Oh, you're talking about the model that the witnesses have been discussing?

MR. SCOTT: The witnesses a while ago described -- they said a number of complex phenomenologic models to describe the --

JUDGE LINENBERGER: Okay, I --

MR. SCOTT: I'm not pronouncing the word right.

Phenomenologic ... I don't know what the correct pronunciation is.

JUDGE LINENBERGER: I don't either.

But can you pull us in here and show us what you're trying to accomplish and how it relates to the contention.

MR. SCOTT: I'm trying to find out what was the data basis to come up with a statement in the model that four percent of the gas would be released if the temperature was over 3000°.

JUDGE LINENBERGER: Have you asked that very question, since that's your goal?

MR. SCOTT: That's what I've been trying to ask. That's what I was trying to ask the last time. I asked the question, and I got the answer that somehow this is not time-dependent, so he didn't know.

I guess that's the end of it if his answer is, "Hey, I don't know" --

JUDGE LINENBERGER: Just ask that question of the witness, Mr. Scott.

You're taking history completely out of context here and turning it around. Now, go ahead and ask that question and see where it gets you.

BY MR. SCOTT.

Q. Gentlemen, where is the experimental data? What's the basis for stating four percent would be released, if it was greater than 3000°, irrespective of the time frame between fissioning and the length of time that it was at that temperature?

BY WITNESS HOLTZCLAW:

A. That takes us back to Page 17, Lines 8 through 15, that cover the data base. That was used to verify the fission gas release model in the GEGAP code in NEDO-10506.

Q. So, I take it, your answer then is -- that time in terms of burnup time ... would be between the 300 and 73,000? Is that your answer?

BY WITNESS HOLTZCLAW:

A. I don't know what you're talking about on time.

Q Seconds, hours, days.

BY WITNESS HOLTZCLAW:

A I don't see how it relates to the model. I just don't understand your question, sir.

Q Are you saying the amount of gases that escapes is totally independent of time?

MR. COPELAND: Asked and answered.

MR. SCOTT: If it's not, what's the time frames that this data is based upon?

(Bench conference.)

JUDGE WOLFE: Sustained.

BY MR. SCOTT:

Q Gentlemen, what happens to the size of the uranium dioxide as it accumulates fission gases within it?

MR. COPELAND: Objection to the relevance to this contention, Your Honor. Also, I believe it's falling back within that area where the Board terminated cross-examination.

MR. SCOTT: Your Honor, obviously the gap size depends upon the size of the fuel. And there just might be some relationship between the size of the fuel and the amount of fission gas it had inside it.

JUDGE LINENBERGER: The gap size also depends on the size of the cladding. And if it swelled a little, it might keep pace with the size of the fuel.

So --

MR. SCOTT: True. I'm just going into parts of it at a time.

JUDGE LINENBERGER: Okay. Define things so that the witnesses can have --

MR. SCOTT: I'm talking about only the fuel. I'm not talking about cladding at this point.

(Bench conference.)

JUDGE LINENBERGER: I think, Mr. Chairman, this really has been discussed. But not knowing what it is that Mr. Scott is trying to get at, and recognizing his complete refusal to tell us what he's trying to get at, I guess we're almost forced here to see where it's going. But --

MR. SCOTT: I'm not refusing anything.

JUDGE WOLFE: Well, we'll overrule the objection and will hear the answer.

WITNESS HOLTZCLAW: Could you repeat the question again?

BY MR. SCOTT:

Q What is the effect, if any, on the size of a piece of uranium dioxide fuel pellet on the amount of fission gas inside the fuel pellet?

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BY WITNESS HOLTZCLAW:

A. There is a phenomenon that we referred to in our testimony on Page 16 called irradiation swelling. The irradiation swelling is one means, other than thermal expansion, by which the pellet increases with size during its lifetime.

Irradiation swelling is due to the build-up of fission products within the matrix of both gaseous and solid fission products, which then cause the pellet to increase.

JUDGE WOLFE: It's now 12:45. What's the pleasure of the parties? Shall we recess now? Proceed?

How much more examination do you have, by estimate, on this contention, Mr. Scott?

MR. SCOTT: Probably no more than a few minutes.

JUDGE WOLFE: Can you be completed by one o'clock?

MR. SCOTT: Most likely.

JUDGE WOLFE: Shall we proceed to one and then recess for lunch?

MR. COPELAND: Yes, sir. I'd like to make sure that we do get finished with these witnesses today and get them off the stand.

JUDGE WOLFE: All right.

BY MR. SCOTT:

Q I'm still trying to find where you talk about fuel swelling on that page that you mentioned.

BY WITNESS HOLTZCLAW:

A Line 23, Page 16. It's one of the characteristics that must be considered in addressing gap size.

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Q. Okay. I don't know how to distinguish between a chunk of fuel that's sitting out here that's been bombarded, as opposed to a chunk of fuel that's having fissions take place within it, based on the term fuel irradiation swelling.

Can't fuel be irradiated and not have any new particles added to it?

BY WITNESS HOLTZCLAW:

A. I'm sorry. I don't follow your line of question.

Q. Stick a piece of uranium out here and I'd shoot neutrons through it; would that not be irradiating it, even if none of the neutrons stayed within the fuel?

BY WITNESS HOLTZCLAW:

A. The irradiation swelling that we're referring to herein is uranium dioxide fuel pellets that are undergoing fissioning reactions within the fuel matrix.

Those fissioning reactions result in the creation of additional neutrons which go to sustaining a chain reaction, as well as building up fission products.

Q. Do you know why the swelling takes place? Do you think it's the building up of the products as opposed to the fact that neutrons pass through?

BY WITNESS HOLTZCLAW:

A. As I just stated, the irradiation swelling is due to the creation of fission products due to the

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fission reaction.

Q Okay. Are you able to separate out in that determination whether or not part of the swelling is caused just by temperature increase that takes place whenever you have fissioning?

BY WITNESS HOLTZCLAW:

A. Another facet of the impact on gap size is a phenomena called thermal expansion, which is mentioned on line 22, page 16, of our testimony; and which, also, is considered in our modeling.

Q Okay. Fuel relocation, is that a swelling phenomenon, also?

BY WITNESS HOLTZCLAW:

A. Fuel relocation is a phenomena associated with the fact that the fuel pellet on heatup cracks into sizable chunks, and then can relocate within the fuel cladding tube.

Q In other words, chunks can fall off and get closer to the cladding?

BY WITNESS HOLTZCLAW:

A. Yes, they can, and that's why it's accommodated in the model.

Q Okay. What kind of temperature does it take within the cladding to cause this -- I mean, within the fuel to cause this cracking, shattering?

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BY WITNESS HOLTZCLAW:

A. I'm not sure of any specific temperature bounds, but it's a phenomena that occurs in all operating fuel.

Q. Okay. Is it -- Well, I'm trying to get an idea of the magnitude.

Is it such that essentially anytime you take in a new nicely centered fuel rod and stick it in the reactor, and you heat it up, operate it a few days, that it's going to -- if you cool it down and look at the fuel within the fuel rod after a few days of operation at a rated power, that it wouldn't look like a pellet anymore, but it would look like a bunch of fractured pieces?

BY WITNESS HOLTZCLAW:

A. One way to view it as a bunch of -- as a group of pie-shaped wedges where there are cracks in the center of the uranium dioxide pellet.

However, there is also a phenomena, for lack of a better term, reverse relocation, which would tend to relax the pellet back to its original configuration.

Q. Does it go back to its original size fully after it's cracked and relocated, or is it always going to be larger than it was before?

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BY WITNESS HOLTZCLAW:

A. I don't think I can make a blanket statement in answer to that question.

JUDGE LINENBERGER: Mr. Scott, again, please identify that part of the contention that this line of questioning is attempting to verify or justify or whatever.

We're having trouble here seeing where you are going and why.

MR. SCOTT: I'm talking about the gap size.

JUDGE LINENBERGER: Which part of the contention are you -- Which allegation in the contention are you supporting with this line of questioning, please?

MR. SCOTT: Well, basically, we're supporting the vast uncertainties in everything that they're doing.

JUDGE LINENBERGER: Which part of the contention are you supporting by unfolding these uncertainties?

MR. SCOTT: The conductance is going to vary the function of the gap size. A lot of fission gas release is going to be --

JUDGE LINENBERGER: Have you asked the witnesses whether the conductance does vary as a function of gap size and heard an answer which you can find fault with in any way?

You know, you could go directly to the question, if that's your objective, to conductance versus gap size and, you know, could save a lot of time with respect to pellet cracking or whatever.

MR. SCOTT: I don't know how to respond to that.

JUDGE LINENBERGER: Well, we may not know how to allow you much more time, either.

Well, I guess my comments are wasted. Go ahead with whatever your next question is. I don't know.

BY MR. SCOTT:

Q Gentlemen, doesn't the cladding temperature increase as the gap size decreases, everything else being equal, in operating the Allens Creek BWR?

MR. COPELAND: Objection to relevance.

MR. SCOTT: We're here to determine whether or not the cladding temperature is likely to be in excess of that that would cause melting.

MR. COPELAND: How does that relate to this contention, which talks about the Dutt-Baker correction factor?

MR. SCOTT: What do you mean, the Dutt-Baker correction factor? Who is talking about that?

MR. COPELAND: That's this contention.

MR. SCOTT: This contention is that the peak cladding temperature may be in excess of 2,200 degrees Fahrenheit. That's the contention.

MR. COPELAND: I'll withdraw my objection. Let's go on, Your Honor.

WITNESS HOLTZCLAW: You asked if the cladding temperature increases?

BY MR. SCOTT:

Q. With the gap size decreasing, everything else being equal?

BY WITNESS HOLTZCLAW:

A. The inside cladding temperature would increase, because there would be better gap conductants.

Well, there would be less resistance to heat transfer with the smaller gap.

The outside cladding surface temperature would remain the same.

The cladding volume temperature would go up slightly because of the increase of temperature on the inner surface.

Q. How could the outside cladding temperature remain the same, if everything else was the same, except the fact that more temperature was passing from the interface into the interface of the cladding?

BY WITNESS HOLTZCLAW:

A. Because the resistance to heat transfer on the exterior surface of the clad is unaffected by the change of gap size.

Q Well, I'm not talking about the heat transfer rate at the outer interface, but I'm talking about the temperature of the outer interface.

MR. COPELAND: Do you have a question, Mr. Scott?

BY MR. SCOTT:

Q Before the temperature gets to the outer interface, would the temperature rise?

MR. COPELAND He's answered that question just now.

JUDGE WOLFE: There's an objection.

MR. SCOTT: Well, I have nothing to say. That's not an objection.

MR. COPELAND: I am objecting. It's been answered.

JUDGE WOLFE: It's been answered, Mr. Copeland said.

MR. SCOTT: Well, it hasn't been answered. I don't know how he can say that -- what I can say about that.

This issue has not even come up until just now. If you haven't heard an answer in the last 15 seconds, you haven't heard it.

MR. COPELAND: Well, I'll withdraw it.

He obviously couldn't understand the answer he got, so.... I'll withdraw the objection.

BY MR. SCOTT:

Q. Maybe the other gentleman can say something.

BY WITNESS WILLIAMS:

A. If you are transferring the same amount of heat and the moderator temperature is the same, the external heat transfer coefficient is the same, the clad temperature has to be the same, the external clad temperature.

Q. Even though you are applying more temperature to that interface from the inside of the cladding?

BY WITNESS WILLIAMS:

A. That's what I said.

Q. Are you saying, if I applied to a window in a house dim sunlight through the window in one case, as opposed to a blowtorch in the other case, the temperature on the other side of the glass would stay the same?

BY WITNESS HOLTZCLAW:

A. That's not the same. That analogy is not the same.

Q. What's different?

BY WITNESS WILLIAMS:

A. You are transferring different amounts of heat.

Q. Huh?

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BY WITNESS WILLIAMS:

A. You are transferring different amounts of heat.

Q. I haven't talked about magnitudes. You said there would be no change.

BY WITNESS HOLTZCLAW:

A. We said there would be no change in the cladding external surface temperature.

We did tell you that the cladding volume temperature would go up, as well as the cladding inside surface temperature.

Q. I understand that, and I don't understand how it's possible for the volume temperature to go up and one side for the temperature to go up and the other side to stay exactly the same, if all the other conditions remain the same.

MR. COPELAND: Well, the witnesses have explained it.

If Mr. Scott can't understand it, Your Honor, that's just too bad.

MR. SCOTT: Well, it's not bad. It's just --

JUDGE LINENBERGER: Yes, I think for you it is bad, Mr. Scott, because there's no point to badgering these witnesses about something that they have explained and are not going to change their answer on.

The simple physics of the matter doesn't even require them to change their answer, whatever else might come into play.

Again, I have to inquire, Mr. Scott, how it is you are supporting -- either supporting the contention or finding difficulty with the testimony?

MR. SCOTT: Well, the problem with the testimony is that it doesn't say anything.

JUDGE WOLFE: Well then, you are spending an awful lot of time on cross-examination of nothing, Mr. Scott.

MR. COPELAND: I ask that that comment be stricken from the record.

JUDGE WOLFE: No, I think this is reflective of --

MR. COPELAND: You're right. I agree. I withdraw my request.

MR. SOHINKI: Mr. Chairman, in light of Mr. Scott's last comment, I don't see why the Board shouldn't either terminate cross-examination or place a limitation on it.

I've had two witnesses sitting here for two days. It's quite apparent by now that the witness with regard to cold slug won't even get on, let alone the witness that's here to address this issue has been sitting here for two days and was scheduled to get on the witness stand yesterday.

The cross-examination has been totally unproductive. If Mr. Scott didn't think the testimony said anything that hurt his case, then he shouldn't have begun the cross-examination in the first place, and our witnesses would have had an opportunity to testify.

MR. SCOTT: Mr. Chairman.

JUDGE WOLFE: How much more time do you have on cross-examination?

It's now 1:05.

MR. SCOTT: Five minutes or so, I think. I think I'm about finished.

JUDGE WOLFE: All right.

BY MR. SCOTT:

Q I am still trying to find where in your testimony it says how hot the cladding is going to get.

JUDGE LINENBERGER: What is the question?

BY MR. SCOTT:

Q How hot is the cladding going to get?

JUDGE LINENBERGER: Mr. Scott, I -- Mr. Witnesses, I don't want to hear an answer until Mr. Scott refines and restates the question to specify the circumstances under which he's looking for an answer.

MR. SCOTT: Okay.

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BY MR. SCOTT:

Q. The circumstances are that we've got the Allens Creek reactor operating.

It's operated for 45,000 megawatt days per metric ton.

It's --

JUDGE LINENBERGER: Mr. Scott, keep some realism in this.

You already know what the testimony is on the end of life burnup for Allens Creek fuel.

MR. SCOTT: And it says that they may go up to that kind of length of time.

JUDGE LINENBERGER: Continue.

BY MR. SCOTT:

Q. Now, under this condition where this thing is operated full power for three or four years, and this one rod has stayed in there all that time, and we have a worst case loss of coolant accident, what is the cladding temperature going to rise up to?

BY WITNESS WILLIAMS:

A. We answered this question yesterday in relation to one of Mr. Doherty's comments.

If you'll look at page 18 of our testimony, lines 14 and 15, it says, "The peak clad temperature is significantly below the 2200 limit."

Q I still haven't seen an answer.

MR. COPELAND: The question was asked and answered yesterday.

BY MR. SCOTT:

Q Can you go ahead and give me the answer?

MR. COPELAND: I have an objection, asked and answered.

MR. SCOTT: You had earlier said you weren't going to object.

JUDGE WOLFE: Well, he has.

Sustained.

BY MR. SCOTT:

Q What gap does that determination assume was going to exist at the end of that 45,000 megawatt days per ton?

BY WITNESS HOLTZCLAW:

A. At the end of life we would not expect a gap to be in existence, but that the cladding and the fuel would be at intimate contact.

Q Okay. Where's the fission gases going to go?

BY WITNESS HOLTZCLAW:

A. It will have migrated to the colder plenum region of the fuel rod, which is designed into the rod specifically to accommodate internal pressures due to fission gas release.

Q. What pressures are those fission gases going to be within that small volume of the plenum?

BY WITNESS WILLIAMS:

A. Again, I think we answered that earlier.

In the worst case, we would be looking at something in the region of between two and three hundred PSI, I think, were the numbers that we compilated.

Q. What's the volume of that plenum?

BY WITNESS WILLIAMS:

A. I don't know offhand.

Q. Approximately?

BY WITNESS WILLIAMS:

A. It's about 12 inches long, and whatever the internal diameter of the fuel is, 419.

Q. Okay. Do you realize how many molds of fuel, fission gas, you're going to have squeezed into that plenum, if it's all going into that plenum and none of it is in the gap?

BY WITNESS HOLTZCLAW:

A. As the testimony indicates, a good deal of the fission gas will still be contained within the matrix of the fuel.

The plenum has been sized to accommodate end-of-life fission gas releases and with end-of-life pressures that would not lead to distortions or rupture of the fuel rod.

Q Do we know that based on operating experience?

BY WITNESS HOLTZCLAW:

A. This, again, gets back to the database used in verifying the fission gas release model that we pointed out on page 17 of our testimony.

Q The fact that it gets back to it, I don't....

Was fuel rods, like Allens Creek, with that same size plenum, h e they been operated for three or four years to see that in fact it would create such pressures that it would bust the rods?

BY WITNESS HOLTZCLAW:

A. The fuel rods that were used in that database have plenums   lenum volumes that cover the volumes of the Allens Creek rods.

I don't have the specific ranges of those parameters, but it's very similar to the range that I've indicated earlier on diameters.

That is, the volume of the plenum in the test rods encompassed the volume of the Allens Creek rod.

Q Hasn't General Electric started putting some sort of a getter in the plenums?

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BY WITNESS HOLTZCLAW:

A. We've been doing that since the mid-1970's or earlier, I believe.

Q. Okay. So if the prior data was based on plenums that didn't have the getters in it, why wouldn't the getter be filling up that plenum volume?

BY WITNESS HOLTZCLAW:

A. The data is correlated in terms of a ratio of fuel volume to plenum volume, where the plenum volume is only that volume that is free for fission gases to be stored.

Q. How much of a safety factor do you maintain that is designed into this plenum, as compared to the pressures that it's going to be asked to hold?

BY WITNESS HOLTZCLAW:

A. The design analyses aren't performed in a fashion to identify a specific safety factor.

Q. Does that mean you don't know what the safety factor would be?

BY WITNESS HOLTZCLAW:

A. The design analyses are performed utilizing an acceptable model, and the model is qualified with additional data and shown to provide a conservative prediction of data; and that conservatism is judged to be adequate for use in the fuel design models in design.

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The model is further verified -- or the application, I should say, of the model is further verified through very complete test programs of operating fuel and through inspections of irradiated fuel to preclude the chance that the design analysis for some reason is not appropriate in its application.

Q. Well, that all sounds pretty good, except that so far you haven't been able to give me any details of any of this.

You know, you say, "Well, we checked it out and it's all good"; and, therefore, I should go home and be happy.

I was asking for numbers, data.

What, for example, if you're wrong --

JUDGE WOLFE: I will strike all prior comment.

If you want something more from the witness, ask for it.

I don't want these commentaries on the record.

BY MR. SCOTT:

Q. What if instead of four percent fission gas release, you had six percent? Would the plenum still hold it?

BY WITNESS HOLTZCLAW:

A. I can't address speculative questions like that.

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Q Sure, you can.

MR. COPELAND: The witness has answered the question.

MR. SCOTT: His answer was, "I can't answer it," and that's --

MR. COPELAND: And you just told me he could. Now what are we supposed to do about that, Mr. Scott?

MR. SCOTT: Well, if he can answer it -- If the only reason he's not answering it is he thinks it's speculative -- if he can't answer it because he doesn't have the knowledge, then that should be on the record and not be confused as to why he's not answering it.

That's the problem with letting those kinds of answers be left untouched.

JUDGE WOLFE: The answer will stand.

Now, if you want to ask another question as to perhaps why he thinks it's speculative, that's up to you; but that's his answer.

I will allow one or two more questions for you to plumb that response of the witness.

BY MR. SCOTT:

Q Why is it speculative that we couldn't have six percent release instead of four percent under some fuel rod that's in the Allens Creek reactor?

BY WITNESS HOLTZCLAW:

A. I'm not arguing that portion of it.

I can't happen what would happen with a six percent release, because it's outside my experience in this area.

MR. SCOTT: No further questions.

JUDGE WOLFE: All right.

It is now 1:17. What would the parties like to do, have a short recess, continue or --

MR. COPELAND: I think it really depends -- well, we're ready to keep going, Your Honor.

My main objective is to try to get these gentlemen dismissed today.

I certainly would hope we would get Mr. Meyer dismissed today.

I think if there's any possibility of doing that, we ought to proceed ahead, since we're only going to be here until 3:30 today.

JUDGE WOLFE: Any objection?

MR. SCOTT: Yes, I'd like to go eat dinner.

JUDGE WOLFE: Well, it's not 6:00 o'clock yet.

MR. SCOTT: In Arkansas, dinner is at noon.

JUDGE WOLFE: Oh.

MR. SOHINKI: Perhaps we could inquire,

Mr. Chairman, how much cross-examination Mr. Doherty and Mr. Scott plan of Mr. Meyer, so that we might see whether it's conceivable that he may be finished today?

JUDGE WOLFE: Mr. Doherty?

MR. DOHERTY: No, I don't think it's conceivable that I will finish Mr. Meyer in the time we have remaining.

JUDGE WOLFE: In other words, even between now and 3:30?

MR. DOHERTY: Oh, yes, that's absolutely right.

I also think we have redirect and Board questions on the panel, which is going to make it even more impossible.

MR. COPELAND: Well, that raises --

MR. DOHERTY: I also think that we should get a little break. I'm hungry.

JUDGE WOLFE: To get back to -- Also, have you finished your cross-examination of these witnesses now on all contentions?

MR. SCOTT: Yes. Yes, I wasn't going to cross except on the two.

JUDGE WOLFE: Only on the two. All right.

So you are finished with these two witnesses.

MR. COPELAND: I think it would help, Your Honor, if we could just get some indication on how long the Board thinks they might take, in judging how long a break to take.

JUDGE WOLFE: Board questions will be, I presume, about half an hour.

MR. SOHINKI: Mr. Chairman, it doesn't seem like it matters whether we take a break or not, then, because if they are not going to finish with Mr. Meyer -- In light of the fact that we're taking a week break between now and the next hearings, and Mr. Meyer, according to our proposed schedule, won't be here until the second week of that two-week period, it doesn't really seem logical to even start with him today.

I might add again --

JUDGE WOLFE: Is Mr. Meyer to testify on -- oh, yes, on the interconnection.

MR. COPELAND: That's a different Mr. Meyer.

MR. SOHINKI: I'm referring to fuel failure.

Our proposed schedule which will be submitted to the Board would call for him to be testifying on Monday, June 8th.

JUDGE WOLFE: Well, in any event -- all right.

MR. SOHINKI: All I'm saying is I'm just totally dismayed that we couldn't even get Mr. Meyer on the stand today.

He's been here for three days.

The cross-examination has been totally unproductive,

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and we've flown him and Mr. Brooks down here. They've sat here through this.

Now, I may be required by my job to be subjected to this type of cross-examination, but witnesses aren't.

MR. DOHERTY: Mr. Chairman, I object to Counsel's gratuitous characterization of our cross-examination.

MR. SOHINKI: Gentlemen, the Board itself has on several occasions termed the cross-examination non-productive.

MR. DOHERTY: That does not give you the right to come out and just parade it up and down.

JUDGE WOLFE: The Board will not hear any more of these sorts of arguments.

We are not persuaded one way or the other by what is said. We are persuaded by performance or lack of performance.

We have drawn our own conclusions on that.

MR. SCOTT: Mr. Chairman?

JUDGE WOLFE: Yes.

MR. SCOTT: I would like to suggest and propose that we start letting Intervenors have some real say in schedules, as opposed to just kind of proposing them --

JUDGE WOLFE: Well, I've asked you to get together to talk with Applicant and Staff.

Apparently, there has been very little, if

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any, agreement on scheduling.

Where there is little or no agreement on scheduling, the Board is open to hearing argument; but I must say, inasmuch as it is Applicant -- and I've said this before.

It is Applicant that has the burden of proof and has the number of witnesses that it has. Inasmuch as Staff has the number of witnesses that it has, then they have the -- the weight is on their side as to how they are going to schedule.

If there is any real problem, the Board is always here, but right off the top, I would say whatever Applicant and Staff comes up with, absent some real good substantial argument by the Intervenors, we'll go along with the proposed schedule that is come up with by Applicant and Staff.

Now do you have something else to say?

MR. SCOTT: Yes.

JUDGE WOLFE: Say it.

MR. SCOTT: In that regard, I -- and I assume other Intervenors are in the same shape -- we have no objection to anybody's proposed schedule, because we know they are meaningless.

What the schedule is going to be, when someone gets through, the next person will continue.

On the other hand, if we keep getting posed with these rush-rush, pressure-pressure, three or four people a day schedules, then I don't want to hear the other side complaining about it.

The thing is I don't mind -- you know, they can schedule anything they want. If they don't want to work with us, I don't want them to complain.

MR. DOHERTY: I think yesterday, too, I really did point out that it was very, very unwise, but we really didn't have any option to push into it, very unwise to schedule Contention 3 and 20 and 39 all in one morning; that any reflection on how much work had been done by this Intervenor on Contention 3 would have shown that that just was going to take more timing.

I don't want the Board to have the impression that that was reasonable to expect to cover all that yesterday.

JUDGE WOLFE: We didn't.

MR. COPELAND: How about a 45-minute lunch break?

MR. SCOTT: An hour.

MR. COPELAND: Your Honor, I think we need to make absolutely certain we finish this panel so they don't have to be brought back here.

JUDGE WOLFE: All right.

MR. COPELAND: We do have --

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JUDGE WOLFE: It's now 1:20.

We'll recess until --

MR. DOHERTY: Mr. Chairman, I did want to point out one more thing.

JUDGE WOLFE: Yes.

MR. DOHERTY: The parties are not in total -- spread out. We do communicate, and the one thing we did decide this morning was we should get right in and get the panel going and not talk about scheduling until they were finished; and I wish we had stuck with that and just gone right ahead.

JUDGE WOLFE: All right. We will recess until 2:00 o'clock.

(Whereupon, at 1:25 p.m., the hearing was recessed, to reconvene at 2:00 p.m., the same day.)

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AFTERNOON SESSION

2:00 p.m.

JUDGE WOLFE: Just before the recess, Mr. Scott advised that he had completed his cross-examination upon Doherty Contention 39 and Contention 20(a), and for whatever reason, advised that he elected not to cross-examine on Doherty Contention 3.

Therefore, we will proceed now with re-direct.

Mr. Copeland.

MR. COPELAND: Yes, Your Honor, I do have one question of Dr. Williams.

REDIRECT EXAMINATION

BY MR. COPELAND:

Q Dr. Williams, do you recall being asked several questions about an article in "Nuclear Safety" magazine that were authored primarily by a gentleman by the name of McDonald?

BY WITNESS WILLIAMS:

A Yes, I do.

Q All right.

Are you familiar with Mr. McDonald? Do you know who he is?

BY WITNESS WILLIAMS:

A Yes, I am.

Q Are you aware of any research -- Well, let me back up.

This "Nuclear Safety" article is cited at a variety of places in Mr. Scott's testimony, but I believe it is the one in Volume 20, No. 5 of the "Nuclear Safety" magazine.

Are you aware of any research done by Mr. McDonald that is in any way -- additional research related to that article?

BY WITNESS WILLIAMS:

A. Yes. Mr. McDonald has carried out some additional research, which was not included in the "Nuclear Safety" article.

Q Could you point to where you found that information?

BY WITNESS WILLIAMS:

A. Mr. McDonald presented this information at the Reactor Safety Research Information meeting in October of 1980.

Q And was that research recorded in a paper of any sort?

BY WITNESS WILLIAMS:

A. Yes, Mr. McDonald presented a paper at that meeting.

Q Do you have that paper with you?

BY WITNESS WILLIAMS:

A. I do.

Q. Would you read the title of that paper?

BY WITNESS WILLIAMS:

A. "Response of Preirradiated Fuel Rod Bundle During Reactivity-Initiated Accident Test 1-4."

Q. All right, sir.

Could you advise us as to the conclusion which he reached in that paper?

BY WITNESS WILLIAMS:

A. I'll read the last paragraph. Now, I'm reading from a copy of the paper.

"Light water reactor control systems are presently designed, such that if a reactivity-initiated accident does occur, the resulting peak fuel enthalpy will be below 110 calories per gram. The PBF results indicate that there is no safety problem with respect to loss of coolable geometry, fuel failure propagation or molten fuel coolant interaction as a result of an RIA in a commercial power plant."

MR. COPELAND: Thank you. I have no more questions, Your Honor.

JUDGE WOLFE: Judge Linenberger, Board questions.

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MR. DOHERTY: Mr. Chairman, there is a correction ... if I may indulge ... just in case anyone gets thrown off. It's Volume 21, No. 5.

I think he said "20, No. 5," is that right, counsel?

MR. COPELAND: No, I said "21."

MR. DOHERTY: It sounded like "20" over here, and I wanted the Board to be sure --

JUDGE WOLFE: All right.

MR. COPELAND: It's the one cited in Mr. Scott's testimony.

There's no conflict that I know of.

BOARD EXAMINATION

BY JUDGE LINENBERGER:

Q Gentlemen, with respect to Page 6 of your testimony, the sentence corresponding to Lines 16 through 18, talks about certain tests that were performed in a research reactor -- a Japanese Nuclear Safety Research Reactor -- and confirmation from these tests of earlier SPERT/TREAT results.

And the sentence concludes concerning those SPERT/TREAT results ... " ... as they indicated no detectable pressure pulses or fuel fragmentation between 380 cal/gram."

Now, in the first place, were these tests performed with individual fuel rods or a small number of fuel rods in an in-pile loop or capsule of some sort?

BY WITNESS WILLIAMS:

A. I believe they were individual rods in some sort of in-pile loop.

Q. All right, sir.

The absence of a detectable pressure pulse then leads to what conclusion?

BY WITNESS WILLIAMS:

A. It leads to the conclusion that for energy depositions up to 380 calories per gram, that there is no adverse consequences as a result of the event ... as cited by Mr. Doherty in his contention.

I believe one of the specific things that Mr. Doherty addresses in his contention are the pressure pulses.

I believe it's Item (b) of the contention, which states pressure pulses due to fuel conducting the cooling water.

I would conclude from the Japanese results that there is no problem with pressure pulses at energy depositions up to 380 calories per gram.

Therefore, the sort of energy depositions that we're talking about for the Allens Creek plant is certainly no problem.

Q. Okay. Now, let me explain my problem.

Rightly or wrongly, I assumed that that statement concerning no indication of detectable pressure pulses on Page 6 referred to the fact that -- as you said -- individual fuel pins did not rupture and release fission gas into the test loop, so that the absence of a pressure pulse would be indicative of the lack of any significant rupture.

Now, is that a --

BY WITNESS WILLIAMS:

A. That's partially correct, in that I would imagine that a number of these rods would have failed at these sorts of energy depositions.

And the resultant pressure pulse of these rods failing was very, very small -- as they say, was not detectable.

Q. Well, these fuel rods -- Were these fuel rods water cooled or cooled in some other way; or do you know?

BY WITNESS WILLIAMS:

A. It's very similar to the SPERT loop. They're suspended in a capsule that contains water.

Q. So they are water-cooled?

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BY WITNESS WILLIAMS:

A. Yes.

Q. And, again, with respect to the same sentence, " ... indicated no ... fuel fragmentation below 380 cal/gram."

What would have been the evidence of fuel fragmentation had it occurred, or let me turn the question around -- what observations were made to substantiate the conclusion that there was no fuel fragmentation?

BY WITNESS WILLIAMS:

A. Actually -- after they take the tests, when they take the rod out and they examine the capsule and the rod itself, they see that the rod had -- that there was no fuel fragmentation ... fragments left in the capsule. The rod hasn't expelled fuel into the coolant.

Q. Now, in the case of a system, such as proposed for Allens Creek, if you had a rod drop event, such as that discussed in the early part of your testimony, I would presume that associated with the reactivity increase effect of the rod dropout, that within the core pressure vessel, pressure would increase at least during the early part of the excursion.

Is that a proper conclusion on my part, or can you discuss what -- during the early part of the excursion following a rod drop event, what would happen to pressure?

BY WITNESS HOLTZCLAW:

A. During the early part of the excursion, I would expect that the pressure would go up very slightly, based on the information that we've seen in test results.

That would be very localized, but it would be a very insignificant pressure rise locally around the bundles that -- where there would be perforations in the rods.

Q. So any pressure transient in the Allens Creek facility would bear no relationship to the kind of pressure transient you're talking about with respect to these fuel pin tests on Page 6. Is that correct?

BY WITNESS HOLTZCLAW:

A. The pressure transients that I would expect would be very mild, in relation to the potential damaging pressure transients associated with higher reactivity excursions.

I haven't reviewed all of the pressure transient information from the Japanese data, but I would expect, since there were no detectable pressure pulses, that it would be very similar to the SPERT data

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pressure transients, which were very mild pressures for low reactivity insertions.

Q Now, going to Part (b) of Mr. Doherty's Contention 3, which addresses pressure pulses from fuel in contact with the water after it escapes from the fuel rod, that kind of pressure -- a pressure pulse resulting from that kind of mechanism ... can you characterize how you think that would affect the fuel or core assembly, or the course of the excursion, please?

BY WITNESS HOLTZCLAW:

A Yes.

The kind of pressure transient associated from fuel coolant interactions is associated with very high energy depositions, wherein the fuel is elevated in temperature up to -- and potentially past the melting temperature.

And it's then expelled, either as a molten material or with very finely grained, very hot particles that then can cause a very violent interaction with the coolant.

And for that reason the safety design limit was created in the first place to preclude that kind of a situation, because those very violent fuel/coolant interactions then evolve into very sizable pressure transients, which could harm the internals to the vessel and potentially affect the pressure boundary.

That kind of interaction obviously would not be expected in a rod drawback because of the very low energy deposition.

If there were perforations in the cladding, the fuel is not at the highly elevated temperatures; that is, into the melting region and even approaching vaporization kind of temperature, to provide the driving force for that kind of a fuel/coolant interaction.

Q. On Page 3 at Line 18 -- 18 through 20 -- it's probably a minor point, but that sentence states that the reactivity increase in a rod drop accident is terminated by a combination of the effects that you spell out there.

Superficially, I would have thought that the reactivity increase was terminated when the rod had dropped as far as it could go, and that the thing that is terminated by these effects you talk about here is not reactivity, but the effects of a reactivity increase.

Now, have I oversimplified this picture?

BY WITNESS HOLTZCLAW:

A. I believe that there are inherent neutronics involved with the reaction, whereby it is self-limiting because once there is energy deposition, so that there is a temperature effect, there will be an effect on the neutronics because of the effects on the cross-sections of the material that's involved.

Q. Understood. But the point I was getting at is that it seems to me once the rod has dropped as far as it can drop and can go no farther, at that very instant of time, you have all the reactivity increase you're going to get.

What happens after is a consequence of that, as I view it. And so I'm asking you, literally, is this a correct statement, that the reactivity increase --

BY WITNESS HOLTZCLAW:

A. You're correct. You're not putting in any more -- There's no means of putting in any more reactivity after the rod has dropped completely out.

Q. This was not to fault your testimony, but only to make sure that we're understanding it correctly.

BY WITNESS HOLTZCLAW:

A. Yes.

Q. In places such as at the bottom of Page 6 and the top of Page 7, you have used the term "enthalpy," and you have also used the term, "energy deposition."

Now, to what extent are those terms not synonymous, or for what reasons?

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BY WITNESS HOLTZCLAW:

A. The energy deposition is the actual energy deposited in the fuel due to the reactivity increase. The enthalpy is a direct function of the physical conditions of the fuel; that is, the temperature of the fuel.

In trying to address the differences relative to the way we model the phenomena, the two are synonymous, if you don't allow any of the energy to escape from the system; that is, all of the energy deposited remains within the fuel system.

The two are not synonymous if allowance is made for some of that energy to escape from the system; that is, from the fuel itself.

And calculations have been performed to try and define how much of that energy does escape. And estimates on the order of ten, and some as high as 20 percent, indicate that some of the energy in the terms of heat energy, escapes from the fuel pellet to the cladding.

Because of the short times involved and because of the large effect of time constants, usually that energy goes no further than that during the time domains of interest.

Q. Are you saying here in this particular circumstance, this is a radiated heat transfer rather than a conductive?

BY WITNESS HOLTZCLAW:

A. Actually, it would be all modes of available heat transfer.

But I would suspect that a good deal of that would be radiated, because of the resistance to conductance -- to direct heat conduction are fairly substantial over these kinds of time domains.

Q. On Page 7 the answer beginning at Line 19 discusses a reassessment or re-evaluation of the limit on radial average peak fuel enthalpy given in Reg Guide 1.77.

I think the answer to my question may have come out in some of your earlier discussion, but I'd like to have you review it again.

What was the motivating consideration that indicated it would be wise to re-evaluate this limit?

BY WITNESS HOLTZCLAW:

A. I think the prime mover was the results from the test programs carried out in Idaho by EG&G, Incorporated. And in that program, there was concern with regards to coolability, relative to the 280 calorie per gram limit.

I should point out, however, that there were --

in private communications with some of the people in Idaho ... trying to best understand what they really meant by that 230 calorie per gram value that they were suggesting, that they were only considering the effects of the prompt neut s during the course of the excursion.

And they were also providing for the transfer of some of that energy out of the rod, and so they were allowing some of the heat to be transferred from the fuel pellet to the cladding.

And they made the suggestion that based on coolable geometr considerations, that they would recommend a lowering of that limit.

I should again point out too that it was with regards to an enthalpy value and not to the total energy deposition.

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Q By the way, you indicate that both NRC and EG&G has suggested a different enthalpy limit.

What is EG&G's role here? Are they part of a consortia of operating contractors at Idaho?

BY WITNESS HOLTZCLAW:

A I believe they have a contractual relationship with the Department of Energy, and I believe -- I'm not positive, but I believe these tests were performed under contract with the government.

Q Well, I guess what I'm asking here, if you know, was EG&G merely responding to a recommendation that came somewhere else in the NRC National Laboratory System, or did someone within the EG&G organization originate the consideration that this ought to be looked at?

BY WITNESS HOLTZCLAW:

A I'm sorry, that the problem ought to be looked at, or the --

Q That the problem ought to be looked at.

BY WITNESS HOLTZCLAW:

A I don't know the basis for -- I don't know the reason why the test program was started.

I don't know the basis for that.

Q All right. Let's leave that one alone.

Now, when you talk about in that same sentence, the same part of your testimony, insuring a coolable

2-2

geometry, is that as opposed to a -- coolable geometry as opposed to a geometry that is non-coolable for what reason?

BY WITNESS HOLTZCLAW:

A Okay, a good question.

The term coolable geometry takes on, I think, a number of different meanings, depending on the accident scenario, as you've really indicated in your question, depending on the accident scenario in question.

I think it is the terminology originated in loss of coolant accidents where you wanted to make sure that the resultant degraded bundle structure would not be in such a geometry that would not allow emergency core cooling system coolant to insure that it's a safe shutdown in the plant following an accident.

With regard to reactivity in this unit accident, I think the terminology is a little bit looser and has been utilized to question any geometry changes in the assembly following a potential accident, because we have seen through emergency core cooling tests of simulated fuel bundles that you can get very drastic distortions of the bundle.

In fact, with flow blockages on the order of up to 40 percent; and still have an assembly that's very amenable to cooling by any number of emergency core

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cooling systems that are available.

I think the terminology in this respect has been slightly misused in that there were cases in the EG&G test program where there were geometry distortions; but that would not necessarily entail a resultant assembly that would not be amenable to cooling by any number of cooling systems.

Q. So are you saying, then, that in the context used here, the term "coolable geometry" is or is not a go/no-go situation with respect to things like the requirements of Appendix K?

BY WITNESS HOLTZCLAW:

A. I would say it's not a go/no-go situation. It's really with regards to assembly distortions, say, from design.

Q. On page 8, the answer beginning at line 7 refers to what is called Rod 568 of the SPERT tests, and the sentence at lines 11 and 12 indicates, "There was no prompt fuel dispersal...nor any indication of resulting large pressure pulses."

With respect to -- What does the term "prompt fuel dispersal" mean?

BY WITNESS HOLTZCLAW:

A. That's the rapid expulsion of small fuel fragments, which could then become involved in the fuel coolant with the so-called fuel coolant interaction.

Q. And is the evidence for that lack of a prompt fuel dispersal, the lack of a large pressure pulse?

BY WITNESS HOLTZCLAW:

A. Actually, it's two things, sir. It's both the lack of a large pressure pulse, and the post-radiation inspection of the capsule wherein the rod was contained.

Although there may have been sizable chunks of fuel pellets, there was not the finely-grained fuel at very highly elevated temperatures that interacted with any coolant.

Q. In various parts of this testimony there's been a discussion of energy deposition limits, and at the top of page 9, for example, there is the statement at line 4, "Numerous test results indicate that the 280 calorie per gram limit on total energy deposition is conservative."

Now, I guess that should be comforting, but what would be more comforting would be to know what kinds of things about either the design or the operational mode or whatever, what sort of Allens Creek-specific things will assure that that limit is not exceeded?

BY WITNESS HOLTZCLAW:

A. There are two things, I think, that will actually assure that the energy deposition would be on the order of the 135 calories per gram, as we've quoted.

One of those is the design of the control system, which limits the rod worth; and the second is the operation of that control system, which actually performs the same function and insures the relatively uniform distribution of rod worths within the core, which physically, then, precludes the physical possibility of a rod-drop accident resulting in severe energy deposition, because from the physics involved, if the rod were, sir, kept low enough, there is no way that the excursion, even if it were to occur, would deposit energy that would result in any deleterious effect.

Q Well, let's hypothesize that in the continuing reassessment of matters such as this that is likely to go on for some time, I would think, that a few years from now something turns up experimentally or theoretically that would indicate that the 280 calorie per gram total energy deposition limit really isn't so conservative.

In fact, it really ought to be prudent consideration to say it ought to be reduced -- I don't know how far -- significantly.

What I'm getting at is if this realization surfaces well into the construction and assembly of the Allens Creek reactor, assuming it is going to be constructed and assembled, what leeway is there once the design is

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set to accommodate to any changes of these sorts of considerations about what energy deposition limits ought to be?

BY WITNESS HOLTZCLAW:

A. We've reviewed that internally at GE just in light of the suggestions that have come out of the EG&G test program.

I can tell you what our thoughts have been with regards to the suggestions on changing that limit, and it's not very severe, because we would calculate being well below that limit now anyway.

I don't think we would have a significant concern of any changes in that limit down to where we are currently calculating the results of the rod-drop accident.

If in fact there were some very severe problem that has been overlooked in the industry for all these years with regards to reactivity-initiated accidents, which I find fairly unlikely, but which for purposes of our hypothetical discussion here, if they were to lower the limit to something like 135 calories per gram, then I would think that there were two things that I would be reacting to personally.

One, I would not allow certain control patterns to be utilized in the operation of the plant.

As we've seen in the topical report that we have discussed in our testimony, we would obviously make some recommendations on plant operation with regard to control rods being out of service; and so we would make some changes in that regard, and that would evolve into technical specification changes.

I have a hard time hypothesizing too much further than that, although I think that there would be other things that could be done, even of a more stringent nature, such as hard wiring certain control patterns in the control room of the reactor, precluding the changing of a pattern during the course of operation and thereby limiting the rod worths to specific values that would meet whatever limit may be put into place.

Q Okay. Now, I've heard you say nothing that touches on derating of plant operations in any way.

Is this intentional on your part to say nothing on it?

BY WITNESS HOLTZCLAW:

A. Yes, because I don't think that would be a feasible alternative, because I think we've pointed out in many cases the limiting rod-drop accident can occur at zero power conditions.

So power derating would be effective only on one range of the rod-drop accident. It might not address that cold condition case.

Q. At the top of page 12 you refer to both the plenum gas and the fuel gas.

I really don't quite understand why they aren't rather intimately mixed.

BY WITNESS WILLIAMS:

A. Essentially, they are, but for the purposes of the analysis, they are treated separately.

Q. They are treated separately, okay.

At page 13, the first full answer there beginning at line 8 discusses tests on prototypical BWR fuel bundles tested under simulated LOCA conditions.

Were these fuel bundles in a neutron field? Were they heated by fission energy?

BY WITNESS WILLIAMS:

A. No, they were electrically heated.

Q. Electrically heated, okay.

Were they actual fuel bundles or were they fuel bundle mock-ups with heater elements replacing fuel pins?

BY WITNESS WILLIAMS:

A. They were actual fuel rod cladding with internal electrical heaters.

Q. But the cladding was --

BY WITNESS WILLIAMS:

A. Yes, the cladding was --

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Q -- typical?

BY WITNESS WILLIAMS:

A -- was typical, yes.

Q And here you are using the word "coolability," I gather in the LOCA sense, and not the sense we were talking about earlier?

BY WITNESS WILLIAMS:

A Yes.

Q At the bottom of page 27, starting at line 25 -- page 17, I beg your pardon, starting at line 25, you indicated that the Dutt-Baker correction factor used for BWR's, in essence, was an outgrowth of a similar correction factor developed for the Liquid Metal Fast Breeder System.

I can't help but be curious why the LMFBR program would develop a need for this correction factor before the BWR field would be interested in it.

BY WITNESS HOLTZCLAW:

A Well, I believe it has to do with the fact that the consideration of fission gas release at elevated exposures, that type of data was more readily available from LMFBR research due to the higher target exposures that that fuel type would have relative to LWR fuel type.

If you look at the two research areas on a -- if you're viewing both research areas, there's probably

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a larger grouping of data available in that prog am at the elevated exposures.

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JUDGE LINENBERGER: Thank you, gentlemen. That's all I have.

JUDGE WOLFE: Mr. Sohinki, cross on Board questions?

MR. SOHINKI: I think I just have a couple of questions.

RECROSS-EXAMINATION

BY MR. SOHINKI:

Q. Gentlemen, Dr. Linenberger was discussing pressure pulses with you.

Now, I take it that the way you would tell in a test that's done in a capsule whether there was significant damage from a pressure pulse, would be if there were damage to the test capsule.

Is that right?

BY WITNESS HOLTZCLAW:

A. Yes. And, in addition, these capsules are instrumented with a pressure measuring device, such as a pressure transistor of something of that nature; and the pressure traces are monitored during the course of the tests and the readout on such an instrument is available post-test.

Q. And, I take it that if a pressure pulse were created in a test that were sufficient to damage the test capsule that you might infer from that that level of pressure pulse might damage the reactor internals in an actual operating mode in a commercial reactor?

BY WITNESS HOLTZCLAW:

A. That's correct.

Q. Do you know of any test in the SPERT series or the TREAT series, or Power-Burst series in which there was this damage to the capsule from the pressure pulse?

BY WITNESS HOLTZCLAW:

A. I don't recall the capsule damage, per se. And, it is just because I don't recall the details of some of the more extreme energy deposition tests.

However, based on the summary provided in the McDonald paper, there are indications of some significant pressure levels having been attained in test with the very high energy depositions.

Q. And, do you have opinion as to how high a pressure pulse would be in terms of either megapasquills or either PSI in order to cause damage to the reactor internal?

BY WITNESS HOLTZCLAW:

A. We would have to conclude that it would be -- that it would require a significant overpressurization to cause such damage. And, I don't have a specific value in mind.

However, as an indicator, we would assume that our pressure integrity or the pressure system capability of, say, the reactor pressure vessel was fairly substantial, on the order of some 600 PSI above system operating pressure.

That's a little bit misleading, however. Because that pressure is a static-type of pressure and the pressures that we are talking about here are, obviously, very dynamic and are very rapid. And, in vessels such as reactor pressure vessels have strafe capabilities well in excess of their static pressure capability.

It happens to be a parameter or a property of such a vessel that it is very hard to analyze and exactly pinpoint. However, it is well in excess of this static pressure capability.

Based on the static pressure alone, we would assume that pressure pulses in as high as the static overpressurization test pressure of the vessel would not do harm to the system.

Q Would it be your opinion, that in order to achieve a condition where there was damage to a reactor internals from a pressure pulse, that the water in the reactor would have to have come in contact with molten fuel; or would fuel fragments which are not molten be sufficient to cause that type of damage.

BY WITNESS HOLTZCLAW:

A. Based on the test information, I would conclude that it would require a fuel coolant interaction to achieve such a pressure pulse, which would mean interaction with molten fuel.

MR. SOHINKI: Thank you.

I have no further questions.

JUDGE WOLFE: Mr. Doherty?

RECROSS-EXAMINATION

BY MR. DOHERTY:

Q. Mr. Holtzclaw, do you have that -- Well, Judge Linenberger asked a couple of questions with regard to -- which you answered by discussing the Power-Burst facility tests.

Do you have that Nuclear Safety document still with you --

BY WITNESS HOLTZCLAW:

A. Yes. I do.

Q. -- that's been up and down a couple of times?

Now, in line with the problem of Coolable Geometry.

Do you see the chart on Page 592 there? Test RA1-1?

BY WITNESS HOLTZCLAW:

A. Uh-huh [Affirmative.]

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Q. Would it be fair to characterize that test as one where two pairs of fuel rods differed in burnup that were subjected to the same radial average peak fuel enthalpy?

BY WITNESS HOLTZCLAW:

A. On this table there are -- Test RA1-1 was a test involving four fuel rods each surrounded in their individual flow-shrouds.

Two of these rods had burnups of 4,600 megawatt days per ton.

Two of these rods were fresh rods with zero burnup.

Q. Now, would it be fair to say, I'm repeating myself, I know it is a long question, that the radial average peak fuel enthalpy was the same for all four of the rods?

BY WITNESS HOLTZCLAW:

A. The radial average peak fuel enthalpy as indicated in the chart was the same for all four rods --

Q. All right --

BY WITNESS HOLTZCLAW:

A. Two hundred -- I'm sorry.

Q. Go ahead.

BY WITNESS HOLTZCLAW:

A. 285 calories per gram.

Q. All right.

Do the rods with the fuel burnup, suffer or experience greater flow blockage than the rods without burnup?

BY WITNESS HOLTZCLAW:

A. According to the comments on this chart, that is the case.

It should be noted, however, that these rods had their own individual flow shrouds and, as such, are not representative of the field assembly, such as an assembly that might be inserted into the Allens Creek plant. That is, the BWR fuel assemblies do not have an individual flow shroud around each rod.

That's why we discussed later -- Well, that's why we tend to lend more credence to the more recent work done by McDonald, et al, in Idaho, as being more representative since the bundle geometry is closer to that which would be expected in the BWR assembly.

Q. Now, on Page 6, Line 16, there was a -- Excuse me, Line 18, there was a line with regard to the NSRR Tests.

Is it your testimony that 350 tests showed that there were no detectable pressure pulses or fuel fragmentation below 380 calories per gram?

BY WITNESS HOLTZCLAW:

A. Yes.

MR. DOHERTY: Okay. That's all of my questions. Thank you, gentlemen.

JUDGE WOLFE: Mr. Scott?

MR. SCOTT: No recross.

JUDGE WOLFE: Mr. Copeland, redirect?

MR. COPELAND: No, sir.

JUDGE WOLFE: All right.

Are the witnesses to be permanently excused ?

MR. COPELAND: Mr. Williams will be recalled during the hearing s in June.

JUDGE WOLFE: All right.

MR. COPELAND: But, Mr. Holtzclaw is to be permanently excused.

JUDGE WOLFE: All right.

You're excused then.

(Whereupon, the witnesses were excused. Mr. Holtzclaw was excused permanently. Mr. Williams was excused, subject to testifying further in June.)

MR. COPELAND: Mr. Chairman, while we have some time, I would like to discuss the matter of scheduling further here.

JUDGE WOLFE: All right.

What are we referring to now?

MR. COPELAND: Well, I have to apologize.

I believe it was Mr. Culp sent out a letter to the Board, and I don't have a copy with me.

But, I can tell you the substance of that letter, because I remember it very well.

JUDGE WOLFE: Was that the May 1, letter?

MR. COPELAND: Yes, sir. That sounds right. Basically, it was a letter that we sent asking the Board to go ahead and set or establish two weeks of hearings in July. And, suggested the weeks of July 13 through 17, and July 20 through 24.

We had promised that on the 18th, which was this Monday, we would provide the Board with a list of the contentions which we were ready to go to hearing on.

We've had some difficulty in coming up with the exact number of contentions. And, I think Mr. Sohinki can explain those reasons better than I.

But, we have discussed it and we both feel very strongly that we can represent to the Board that we will be ready to go to trial on a sufficient number of issues to justify going ahead and blocking out those two weeks.

JUDGE WOLFE: Now, may I have those two

periods now. July what?

MR. COPELAND: It is the week of July 13 through 17; and July 20 through 24.

JUDGE WOLFE: And, this would call for, in each instance, pre-filings by what date?

MR. COPELAND: By June 26.

JUDGE WOLFE: June 26.

MR. COPELAND: And, I might add, Your Honor, that we believe that we are very close to being able, and may indeed by able, to hear all the remaining issues during July that are in the case.

JUDGE WOLFE: Well, now there are still outstanding issues that have to be ruled on --

MR. COPELAND: Yes, sir, I --

JUDGE WOLFE: -- on Motions for Summary Disposition.

MR. COPELAND: Yes, sir. I understand that. I am referring only to the remaining issues that have not been ruled on for Summary Disposition; and have not already been accounted for in the schedule.

JUDGE WOLFE: And, this would also exclude what, hopefully, will be tried during the two weeks of June; June 1 through June 12th.

MR. COPELAND: Yes, sir.

JUDGE WOLFE: Now, can you give me some

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approximation, either you or Mr. Sohinki, of how many issues or contentions would be heard July 13th through what?

JUDGE LINENBERGER: 13th through 24th.

JUDGE WOLFE: Right. To the 24th.

MR. SOHINKI: Well, let me make a few comments. As the Board may or may not be aware, the Office of Nuclear Reactor Regulations has been in the process of reassessing their priorities with regard to their review of different facilities, operating license facilities and construction permit facilities.

As the Board may also be aware, the TMI near-term lessons learned requirements with regard to construction permits have just been approved. And, the Staff is now reviewing the Allens Creek facility and have a dedicated review team looking at the Allens Creek facility from the point of view of the TMI requirements.

We need, as the Board knows, to issue an SER supplement with regard to TMI requirements. And, also, there are approximately, and I am not sure exactly, about ten contentions that have to do with the TMI related issues.

We expect, and have every hope, of being able to, in the next two or three weeks, be able to generate testimony as well as substantially complete work on SER input with regard to those issues.

So, that it is quite possible that we may be able to go to hearing with regard to TMI issues during that July period.

JUDGE WOLFE: Now, it is only with the TMI ten issues that are already --

MR. SOHINKI: In the case.

JUDGE WOLFE: -- in the case.

All right.

Yes.

MR. SOHINKI: Right.

As well as, several issues that are non-TMI issues.

So, I guess what I'm saying is: I'm not sure exactly about the number of issues that we will be totally prepared on.

I can represent to the Board that we will be prepared on a sufficient number of issues to justify setting aside those two weeks of hearings.

And, I will be able to let the Board know within the next couple of weeks exactly what issues we would be prepared to go to hearing on, if the Board chose to set a schedule for those issues.

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JUDGE WOLFE: Thank you, Mr. Copeland.

MR. COPELAND: I can't add anything to that.

We feel that we're ready to go to hearing on every contention that is left in the case because we are a little bit ahead of the Staff obviously.

We've already submitted our TMI amendment. We are now ready.

We're ready to clear the decks, and I think the pacing item is the Staff and how quickly they can go; but I feel very strongly that we ought to go ahead and block out hearing time in July, because it's clear to me that that will be productive time.

JUDGE WOLFE: All right. You were going to give me the prefiling date for the July 20th, or would the prefiling date of June 26th be --

MR. COPELAND: That's for both weeks.

JUDGE WOLFE: For both weeks.

MR. COPELAND: Yes.

JUDGE WOLFE: All right.

MR. SOHINKI: Your Honor, I might add that since we're going to be back here the weeks of June 1st and June 8th, we could tell the Board during those weeks, give the Board an exact list of issues for the July hearings.

I wouldn't think there would be any problem with that.

JUDGE WOLFE: All right. Messrs. Doherty and Soctt, any input here?

MR. DOHERTY: No, I don't think I have any input on that.

JUDGE WOLFE: All right.

MR. SCOTT: My major input is, number one, I'm planning on going to New York for vacation in that general timeframe. Maybe before; maybe I can get back by then, but it is still unclear.

Also, a much bigger problem is when one has time to prepare. We're into hearings up until June the 12th and prefiled testimony is June the 26th.

That's just not much time to prepare.

JUDGE WOLFE: For what?

MR. SCOTT: Direct testimony.

MR. COPELAND: Do you have witnesses --

JUDGE WOLFE: Could you advise what direct testimony you are present on behalf of TexPirg?

MR. SCOTT: It's not at all clear yet. It might be just about anything.

JUDGE WOLFE: Well, we're going to have to have more than that generalized statement.

You should know by now whether you're going to have any written direct testimony.

MR. SCOTT: We can present testimony on any contention that is under consideration.

JUDGE WOLFE: I'm not saying you can't, but I'm saying you should by this time know whether or not you are going to.

You were advised by this letter of May 1st from Applicant that we were going to discuss the proposed July scheduling.

So you should be pretty well certain. If you're not, why, that's no answer.

MR. SCOTT: Well, part of it depends on whether or not we can get someone else --

JUDGE WOLFE: Well, that's always been the case, and you just have to let us know. We're here today.

If you can't tell us you're going to have a hundred witnesses or you're going to have ten or you're not going to have any -- As far as we can tell, you're not going to have any, because I don't know that the situation has improved whereby you would be able to get any witnesses.

Therefore, I'm just going to assume without more that you're not going to have any direct testimony, unless you can specifically advise me right now that you're going to have five, ten, twenty witnesses.

MR. SCOTT: I can't tell you how many.

JUDGE WOLFE: All right. Anything more?

MR. DOHERTY: Mr. Chairman.

JUDGE WOLFE: Yes.

MR. DOHERTY: Yes, there is one thing more.

I haven't looked at the status of this in a good while, but I did file a motion which was denied without prejudice, I think, was the status of it, which puts the ball in my court with regard to Demetrios Spasdicos of the NRC Staff as a possible witness.

So we're talking about contentions we're not certain of, although there's a couple that involve control systems.

JUDGE WOLFE: Yes. Well, I would hope that Mr. Sohinki is well aware of the Board's order on that.

The Staff is to keep us notified on that area of -- whatever area it was -- that we were to be kept advised as to whether -- what the status of matters in issue were; and upon that notification, it was reserved to Mr. Doherty to once again renew his motion.

I would think that you would keep in mind when determining what contentions should be heard, should keep in mind that particular outstanding motion, or still surviving motion, as to whether you presently want to go forward with that or not, because under whatever the circumstances might be, we may have to make that effort to secure Mr. Spasdicos' presence at the hearing.

So keep that in mind. Thank you, Mr. Doherty.

Keep that in mind, Mr. Sohinki.

MR. SOHINKI: Yes, sir, we will.

JUDGE WOLFE: Anything else?

MR. COPELAND: No, sir.

MR. SCOTT: When was we going to learn which contentions it might be in the July timeframe?

JUDGE WOLFE: Well, we haven't gotten to that yet.

MR. SCOTT: That's why it's kind of hard to answer who your witnesses are going to be. Which ones will we need witnesses for?

MR. COPELAND: I don't understand your comment, Mr. Scott.

MR. SCOTT: How can you decide which contentions to have witnesses for in that timeframe, if you don't know what the contentions are?

JUDGE WOLFE: Are you ever going to have any witnesses?

MR. SCOTT: I hope to have witnesses for every one of them.

MR. COPELAND: But you don't have any now, right?

MR. SCOTT: Right.

JUDGE WOLFE: I am accepting that as a statement that you have no witnesses, because by this time you should have reviewed your contentions.

No matter whether Contention 59 is coming up or Contention 12, even if you don't know those numbers, you should have reviewed the case, determined those contentions as to which you wanted to present direct testimony, and let us know what those numbers were.

You don't even have any numbers, so it wouldn't make any difference if we told you the number of the contention, because you just haven't decided whether you're having any witnesses.

Therefore, we just accept that at this point that you are not having any witnesses.

All right.

MR. SOHINKI: Mr. Chairman, I have one additional matter regarding scheduling.

Since there are two Staff witnesses and one of the Applicant's witnesses that were scheduled for this week that haven't made it to the stand, and Mr. --

JUDGE WOLFE: I would assume in this schedule you're sending out, that you said you were going to send out, that number one would be the carryover witnesses, including Mr. Moon or whoever is taking his place, testifying on two Board questions, that this carryover would be taken care of.

MR. COPELAND: Well, I intend to take care of them in that carryover, but the first part of that schedule is pretty tightly fixed with the witness availability.

So I wouldn't expect we would pick up on Monday, for example, with the LPCI cold slug witnesses, for example.

JUDGE WOLFE: In other words, your witnesses, if they are your witnesses, Behren and Nehamias, are pretty well socked in.

MR. COPELAND: Yes, sir. For example, Mr. --

JUDGE WOLFE: Locked in, I guess, is the word.

(Laughter.)

MR. COPELAND: We have Mr. Meyers scheduled on the 8th of June, and I would suggest that we just pick up his testimony on the fuel swelling on that same day so he doesn't have to make two trips down here again.

MR. SOHINKI: That's the only reason I raised the issue, Mr. Chairman, so that we weren't under the impression necessarily that we would begin on Monday --

JUDGE WOLFE: With the carryover.

MR. SOHINKI: -- with the carryover.

JUDGE WOLFE: All right. That's no problem, but get that letter out as soon as you can.

MR. SOHINKI: We will.

JUDGE WOLFE: No problem, and as you all

know, for that June 1 through June 12 hearing we have the Bates College Auditorium.

Now, with regards to the proposed July 13 through -- weekdays -- through July 24th, the Board has conferred and that presents no problem to it.

However, we have not secured hearing room facilities. That may or may not present a problem.

MR. COPELAND: I can't imagine that it would, Your Honor.

I would imagine that somewhere in Houston we could find a place.

JUDGE WOLFE: And I would imagine that during the steamy weather of the summer that not too many people will be coming here to confer.

In any event, that time is satisfactory, as well as certainly the time for prefiling written direct testimony of June 26th.

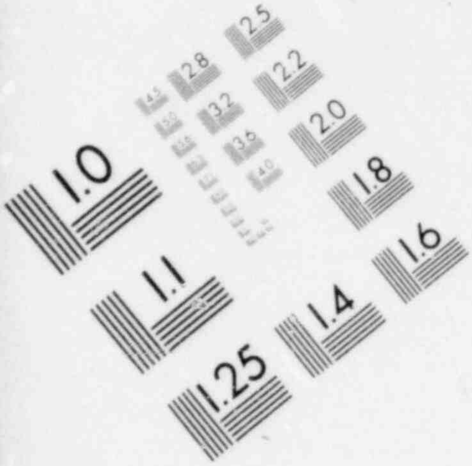
MR. COPELAND: Yes, sir.

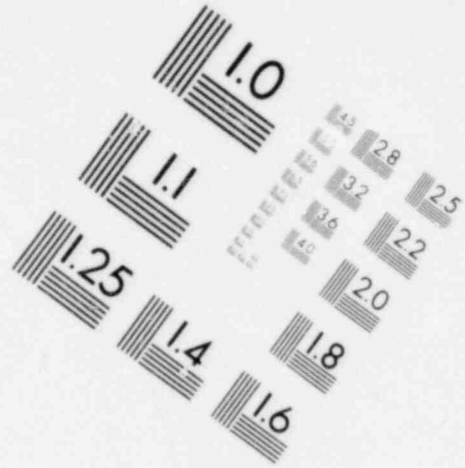
JUDGE WOLFE: All right, and when may we anticipate a letter setting out the contentions and witnesses for that session?

MR. SOHINKI: Is this for the July session?

JUDGE WOLFE: Yes. Yes.

MR. COPELAND: I've just got to defer to Steve. I'm sorry.





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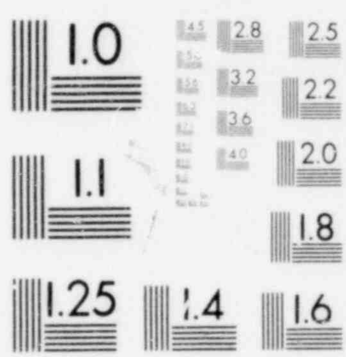

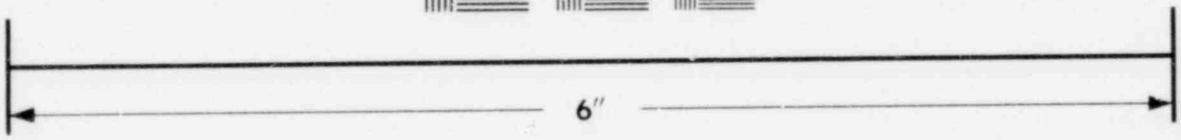

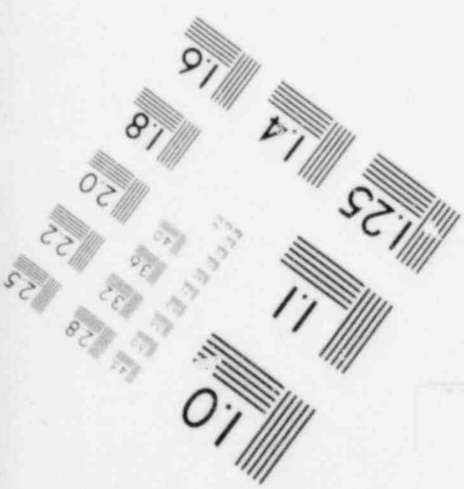

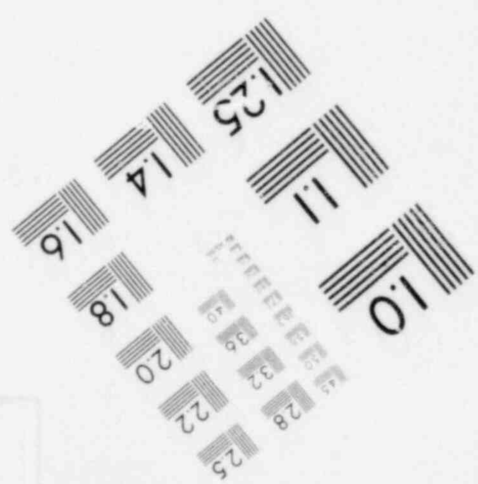

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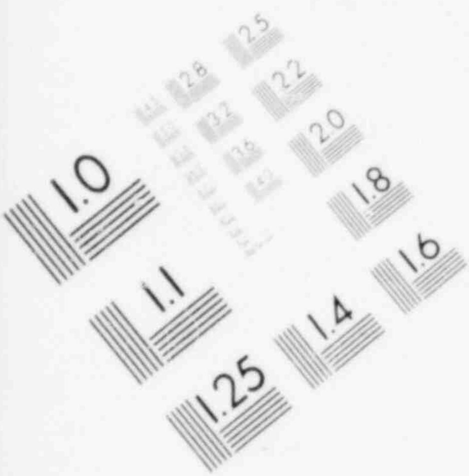

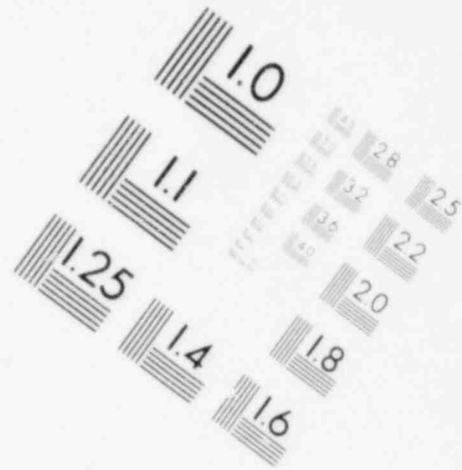

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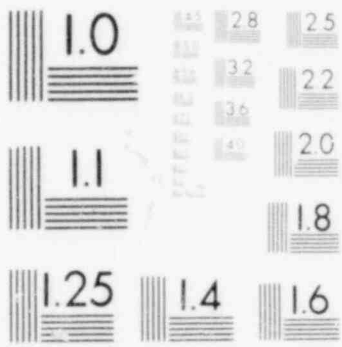

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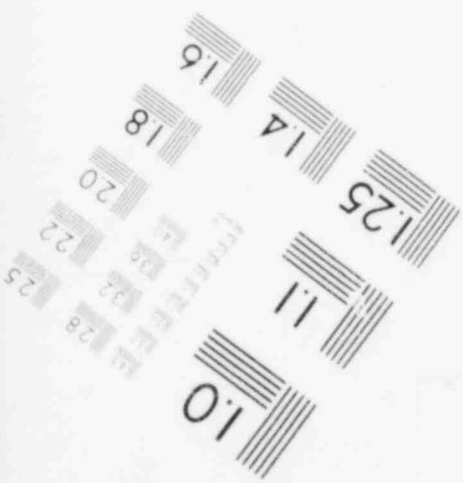

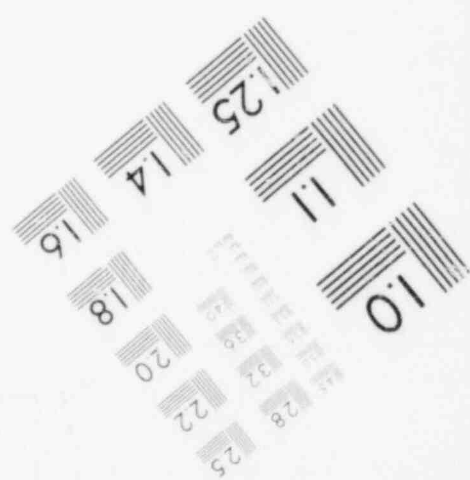

MR. SOHINKI: I've just been in contact with Mr. Black back in Bethesda, and what he told me was that the decision with regard to how many issues will be ready depends heavily on that TMI review, and that will be sort of locked in within the next week or two.

I'm not sure I can give the Board an exact date, but....

JUDGE WOLFE: Well, yes. At the same time, though, I would like to, obviously, give all parties sufficient lead time so that even though they are not presenting any witnesses, direct testimony, and don't have to meet that June 26th date, they do have enough time to review the testimony and prepare cross-examination.

MR. SOHINKI: I appreciate that, and I wouldn't think there would be any problem letting the Board and the parties know on the first day of the next session --

JUDGE WOLFE: The first day of the next session would be June 1.

MR. SOHINKI: -- which is a week from Monday.

JUDGE WOLFE: All right. That sounds reasonable.

Are there any other matters to be considered or raised?

MR. SCOTT: We haven't discussed the schedule for June 1 through June 12th yet.

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MR. COPELAND: I thought we had.

MR. SCOTT: We've got your proposal. That's all I know about it.

JUDGE WOLFE: Well, as I had indicated -- thought I had indicated -- that's the proposed schedule beginning June 1.

MR. COPELAND: I don't understand what there is to discuss, Your Honor.

It says the proposed schedule or order of presentation.

The Board has made it clear that we've got the burden of scheduling our people.

We have Mr. Marrack in on a Wednesday, which is the day he says he always like to be available to testify.

I talked to Mr. Scott about where to fit him in on the schedule, and I thought we had an understanding on that.

So I don't really understand what the problem is.

MR. DOHERTY: Yes. We do have a slot set for Mr. Scott, it was admitted in the early discussion -- as my witness.

We have a date. He's set up after Dr. Meyer.

So that part of the problem is solved. So anything further from Mr. Scott is in relation to his representing TexPirg.

MR. SCOTT: The problem here is -- and this is the third or fourth set of hearings where the same thing has occurred -- is that Applicant has scheduled three, four and five witnesses in one day and then complains bitterly when he doesn't get through them.

I don't --

JUDGE WOLFE: Well, that's the nature of the adversary, to complain. I don't pay too much attention to whoever complains.

(Laughter.)

JUDGE WOLFE: I've been a trial attorney myself, and you always try to get the best possible ruling in your favor; and the way to do it is to complain.

MR. SCOTT: On the other hand --

JUDGE WOLFE: On the other hand, defense counsel, or plaintiff's counsel -- whichever is the adversary -- would take just the contrary view for his own or her own personal viewpoint.

I'm sure the judge didn't pay any attention to either one of us. So you may be sure I'm not paying much attention to either one of you either.

(Laughter.)

JUDGE WOLFE: On this, because, granted -- and it's proved up in our last two weeks, we just simply have not met the schedule. So we're not going to meet the schedule.

So Applicant or Staff is going to complain bitterly that we didn't finish what we had scheduled to finish.

And on the opposite side of the fence we're being pushed too hard. And I don't pay any attention to it because nothing is constant on this proposed schedule.

It's a schedule, and we'll try to get at it; and we'll hold some evening hours and try to expedite this, not because of this proposed schedule --

MR. SCOTT: That's what bothers me --

JUDGE WOLFE: Not because of this proposed schedule, but because the Board itself is concerned that we still have a long way to go.

And the Board appreciates the proposed schedule; it doesn't feel that it's bound by it. But it lives by its own clock.

And the sooner the parties know that we live by our own clock and are concerned about proceeding, the

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better off all parties will be, because on the one hand, people are trying to advance the clock -- our clock and other people are trying to slow it down.

And you just can't do it. Somebody else can't do it. The `ard can.

So ... you know, this is a fact of life. You had better live with it. I have lived with it for years. You had better live with it, too.

All right.

MR. SCOTT: I don't know what fact you're talking about --

JUDGE WOLFE: Mr. Doherty, you clue Mr. Scott in --

All right. I don't see any problem here at all.

Just as soon as you can, get that schedule out so all parties will have enough time to be here.

All right. We'll recess until 9:00 a.m. on June 1.

(Whereupon, at 3:25 p.m. the hearing was recessed, to reconvene on Monday, June 1, 1981, at 9:00 a.m.)

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This is to certify that the attached proceedings before the

NUCLEAR REGULATORY COMMISSION

in the matter of: HOUSTON LIGHTING & POWER COMPANY

DATE of proceedings: May 22, 1981

DOCKET Number: 50-466 CP

PLACE of proceedings: Houston, Texas

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

MARY L. BAGBY

Official Reporter (Typed)

Mary L. Bagby

Official Reporter (Signature)