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NUCLEAR REGULATORY COMMISSION

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Docket Number:	50-247-LR and 50-286-LR
ASLBP Number:	07-858-03-LR-BD01
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UNITED STATES OF AMERICA

U.S. NUCLEAR REGULATORY COMMISSION

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BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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In the Matter of:	: Docket No.
ENTERGY NUCLEAR OPERATIONS, INC.	: 50-247-LR
(Indian Point Nuclear Generating	: 50-286-LR
Station, Units 2 and 3)	: ASLBP No.
	: 07-858-03-LR-BD01

Thursday, November 19, 2015

Doubletree Tarrytown

Westchester Ballroom

455 South Broadway

Tarrytown, New York

BEFORE:

LAWRENCE G. MCDADE, Chairman

MICHAEL F. KENNEDY, Administrative Judge

RICHARD E. WARDWELL, Administrative Judge

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(8:33 a.m.)

CHAIRMAN McDADE: Please be seated. The hearing will come to order. Before we get started with testimony, are there any administrative matters to be taken up by the staff?

MR. HARRIS: No, Your Honor. This is Brian Harris for the staff.

CHAIRMAN McDADE: Entergy?

MR. KUYLER: No, Your Honor.

CHAIRMAN McDADE: New York?

MR. SIPOS: Not at this time, Your Honor.

CHAIRMAN McDADE: Riverkeeper?

MS. BRANCATO: No, Your Honor. Thank you.

CHAIRMAN McDADE: Okay. Let's continue with the taking of testimony with regard to Contention 26.

Judge Kennedy.

JUDGE KENNEDY: Yeah, this is Judge Kennedy. I have just a couple follow-up questions on Contention 26 first to Dr. Hopenfeld.

DR. HOPENFELD: Yes, sir.

JUDGE KENNEDY: Microphones at the ready?

DR. HOPENFELD: Can you hear me okay?

JUDGE KENNEDY: Thank you.

DR. HOPENFELD: Can you hear me, sir?

JUDGE KENNEDY: I can hear you. Thank you.

DR. HOPENFELD: Okay.

JUDGE KENNEDY: In your pre-filed testimony, you assert that Entergy relied improperly on CUF values of record.

What do you mean by "CUF values of record"?

DR. HOPENFELD: Okay. What I meant to basically the term came from the LAR. That's the term they used in those tables, but what I mean -- what it means -- what I think what it means is the CUF that was calculated during the design stage. That's the CUF that the CLB is based on.

JUDGE KENNEDY: And why is that improperly relied on?

DR. HOPENFELD: Because as we heard the testimony yesterday, and I was trying to inject my --- interject on here, is that -- the original plants were designed, the --- when you calculated --- you assume a certain number of changes. And in most of the cases, not in all cases, some place the assumption about the transients were not conservative, but I believe in most case it was conservative.

But in addition to the number of changes that you assume, you also calculate the stresses, but you use the ASME code. And we have had a lot of confusions --- confusing statements from Entergy about the subject, but in -- the code has margins, has allowances. It does not have an allowance for stress concentration. It is you that you provide the stress concentration.

Now, if you were designing the plant 40 or 50 years ago, and you go into one of the Pen books or Peterson or something, got thousands and thousands of different stress concentrations for different geometries, because it's a very common engineering parameter that you have to use in any design.

Just to get you a feel for what I'm talking about, in my younger days, I remember, they used to have razor blades that had three holes in them. Now, these razor blades used to break all the time. The reason was because there's a lot of stress concentration in those holes. So, what they did, they did away with the holes and they had a slot in there and they put a stop to the breaking. That's where the stress concentration is a notch.

Every weld has one, because there is a difference in the metal composition between the base

weld and what you --- and the welding material. So, stress concentration, an extremely important parameter. Now, when they designed, originally, the stress concentration was used, did not take in effect --- in account effects like corrosion, which affects the surface roughness, but more importantly it causes discontinuities between --- in the geometry.

You see the wall thinning. You sometimes have a very abrupt change in wall thickness. So, that wasn't taken in account and that's unsteady, but another thing that's more important, and that's what I test or discuss was the stress concentration depends on ductility. And ductility, as we all agree, I hope, is affected by embrittlement, by neutron flux. So, that affected embrittlement, all the stress concentration wasn't there. It wasn't taken in account.

So, you look at that, see, -- and there's an uncertainty there, but I am not applying for life extension and I'm going back. It is their responsibility to come up with the upper limits, with a conservative assumption. Every weld is an uncertainty, that must be a conservative assumption. That's their job. That's what I'm talking about.

There is no accounting in that CUF for

stress concentration that is being affected by irradiation. Sure, irradiation does --- has improved the uses, but I'm talking about the stress concentration. The stress concentration is the site for stress -- for crack initiation. The cracks initiate at corners. They don't -- really, crack initiation at the stress concentration points. That's what you have to in account of. What Entergy just said, well, they don't even mention it, but they keep saying that they are conservative. We are conservative whatever we do. They are not conserving anywhere.

CHAIRMAN McDADE: Okay. Dr. Hopenfeld, I just want to make sure I understand what you're saying.

Although we cannot review the design basis of the plant, what you're suggesting is that the geometry of the plant is significantly different today 40 years into its operation than it was at the time of the original design.

So, even if the CUF locations were appropriate at the time of design, they're not necessarily appropriate today given the inherent changes that would occur over time in the plant.

DR. HOPENFELD: You verbalized my thoughts

very well. I couldn't say it better. That's exactly -- but also in this specific occasion I'm talking about embrittlement.

Because if you are to -- usually the stress concentration factors are experimental values, but there are some -- there were some attention in the literature that people try to come up with some kind of correlation to see if you can calculate on an empirical basis what it is, because at certain point stress concentration goes to infinity. It depends on the ratings and depends how --- at the corner it goes to infinity.

So, the point is that the effect of embrittlement, the effect of ductility on that stress concentration or that CLB CUF, whatever, is not reflected in those calculations. You don't have to do anything, but do not say conservatively, because this is untrue that I am conservative. They are not conservative. This is one example.

I gave you yesterday about the Fen. The Fen is based on a --- I don't want to get into that now. Hopefully we'll get later.

CHAIRMAN McDADE: So, it's your view that with regard to, for example, Commitments 43 and 49, that although they recalculated the CUF, that they

didn't redetermine the appropriate limiting locations. And that, therefore, the analysis is ineffectual in determining whether or not the intended use will be maintained for the next 20-year period.

DR. HOPENFELD: Yes, they're recalculated properly. They went through the raindrop procedure, you know, the pagoda thing. That's how to count the maximum/minimum stresses and you take the difference and you multiply by a stress concentration, but that stress concentration they have multiplied -- they made changes to it.

There's one place and I remember in my testimony, there was one weld where I couldn't tell the difference, but there was a huge reduction in their screening process or their reevaluation process where they refuse the original CUF by I think an order of magnitude and say, well, it came from some California plant. I don't remember the detail of that, but I did discuss it in my testimony.

They changed the CUF by an order of magnitude. Adjusted it lower because of the stress concentration. When I looked at the stress concentration, I couldn't tell because the drawing was so kind of murky.

CHAIRMAN McDADE: The drawing was what?

DR. HOPENFELD: You see, the stress concentration depends on the geometry -- or in the weld, in especially would depend on the radius at the corner and they change that. They made changes because they said it was too conservative. Originally they said it was too conservative. I was trying to find out how much --- I couldn't tell from the drawings that they have provided.

But nevertheless, my concern wasn't that much even with the geometry in this particular case, it is where is the effect of embrittlement on the ductility on the concentration factor.

JUDGE KENNEDY: Okay. Dr. Hopenfeld, I think I'm still a bit --- I guess I want to make sure I understand the point you made. I heard two specific points. One is that the applicant had used improper non-conservative transients in calculating the CUF values, and that the stress concentration factors should have been applied to the CUF value calculations, and that those values were improperly applied. Is that what you just testified to?

DR. HOPENFELD: The second one is correct. The first one I like to amplify a little bit, because I don't --- all I was saying, and maybe I --- I was saying that --- I was kind of too general, I think.

I think when those plants were originally designed, you assume number of transients. And in that -- along that thought I said originally most of their chances were good, except there are some cases that were underestimated, there were more transients, but I don't know which plants they were, but I know that was the case. But in most cases they were conservative with respect to the number of transients.

So, in that respect when I talk about the transient in the particular case -- in the case of IPEC, transients -- number of transients or the -- it's not really the number, it's the intensity of the transient. So, there has to be --- for 20 years they didn't have any data for it on the pressurizer surge line. So, I don't know how they got it. We've been trying to find out.

In that sense, to answer your question, in that sense the number of transients is not --- maybe they did the right thing, but I don't know what it is.

I do know that for 20 years there's no data on the thermal loads on those certain components. And I haven't seen anywhere in there describing what they have done.

And that's an uncertainty because when you calculate a CUF, when you calculate the final CUF, the

past transients are reflected in there, but how do you do something when you don't know what the number of transients or what the transients were? You don't have data for it.

JUDGE KENNEDY: Is that the particular transient you're referring to when you -- or particular component you are referring to when you said improper non-conservative transients? Is that the one we should focus on?

DR. HOPENFELD: That was -- I believe there was connection of the stratification, because originally -- I'm going back to this issue of stratification.

Originally when Westinghouse designed, they wrongly so even though there was data, they wrongly assumed that there will be no stratification.

And in the mid-'80s, suddenly the component started falling apart. Some components, not all, because of stratification or there were the surge line. I don't know this particular case. Mostly welds.

And at that point they started getting data, but for 20 years, they didn't have any. So, you ask yourself, what did they do here? And I think they discussed it, but I don't know what they did, but I am

not like the NRC staff. I'd like to verify it and I have no opportunity to verify it.

JUDGE KENNEDY: But that --

DR. HOPENFELD: So, I have to go trust what they say, and I don't -- do not.

JUDGE KENNEDY: Dr. Hopenfeld, I didn't mean to interrupt you, but yesterday we took the testimony on this stratification issue and how it was accounted for in the CUF calculation.

Do you remember that testimony from Mr. Gray yesterday?

DR. HOPENFELD: No.

JUDGE KENNEDY: Okay.

DR. HOPENFELD: He was talking about different part. He was talking about the moving front. There is a problem, but that -- I didn't want to -- that is not the one I really focusing. There are two aspects.

You see, he was talking about -- he was talking about the moving front when you -- during the heat-up where the pressurizer forces the fluid towards the primary pipe.

That's what he was talking about, which is -- is the moving front back and forth that cause fatigue, but I was talking about the instability of

the two layers.

When you have stratification, you have an unstable situation, because two different fluids of two different densities come in contact. There are all kind of instabilities that you can define there.

One of the most common ones, I think, is called the Helmholtz instability, which is affected --- which describes --- that really takes into account the different density and the sheer between the plants.

Now, Entergy said that we are not going to have thermal striping because there is -- because there's a standing wave theory that says that we are not going to have it.

Now, originally they say they are talking about standing wave theory. Then they are talking about the Reynolds number theory.

I, again, I've been working on this -- we were one of the first ones to identify this problem. So, I worked on this problem 40 years ago, but -- and I had some -- I admitted certain problems in this area.

For the last few years I haven't been working, but I have been following the literature. And believe me, I have never heard of a pressure wave

theory or Reynolds number theory.

Reynolds, you can't just say Reynolds number, you have to be a Reynolds number, it has to be based on something. Has to base -- at least based to be on some kind of a geometry.

They just say a Reynolds number theory, pressure wave -- this is voodoo engineering at best. And that's what they say that's conservative. That's what --

MS. SUTTON: Your Honor, this is Kathryn Sutton for the applicant. We object to these ad hominem attacks on the expert's references to voodoo and whatnot.

We just ask that Your Honors direct the witness to please curb those sort of ad hominem attacks on our experts. It's -- the hearing is very professional. We just ask that we maintain that sense of decorum.

CHAIRMAN McDADE: Okay. I don't think that when Mr. Bush commented on Ronald Reagan's economics as voodoo economics, he viewed it as an ad hominem attack on President Reagan. At that point, Governor Reagan.

I didn't view what Dr. Hopenfeld said as an ad hominem attack. I took it merely as an

indication that he thought that this was not based in sound engineering judgment and it's taken in that regard.

Dr. Hopenfeld.

DR. HOPENFELD: True. I sincerely apologize. I lost my cool. I shouldn't, and I apologize to you, ma'am. I shouldn't have said that.

MR. SUTTON: Thank you. Thank you, Doctor.

DR. HOPENFELD: I didn't meant to, but I -- there are certain points you -- I don't know how to describe, because we are trying to get the problem, we are trying to understand something and we get distracted by saying -- well, when I bring the issue and Dr. Lahey bring an issue they say, well, it's already accounted somewhere.

You can deal with something, but I brought the issue of the Fen saying, well, this is accounted somewhere else. And the same thing with the oxygen. So, we don't have --

JUDGE KENNEDY: Dr. Hopenfeld --

DR. HOPENFELD: -- time to get to the details. I'm sorry.

JUDGE KENNEDY: Can we get back to the, I guess, what was the --

DR. HOPENFELD: I'm sorry.

JUDGE KENNEDY: -- stratification problem and which particular component are you concerned about?

DR. HOPENFELD: Okay. The stratification problem is whether you have types of fluctuation that penetrates all the way to the surface.

What happens there, you have very large fluctuations of the order between one to ten hertz that could be very severe. And what they do is affect the cracked surface.

Now, we don't understand the exact phenomena. I believe that what it affects is really affects the initiation time with respect to fatigue. It doesn't really have an effect on the crack propagation. We are not into Section 11 or anything. We are into the initial initiation process.

JUDGE KENNEDY: I guess the question was, Dr. Hopenfeld, which particular plant component would this --

DR. HOPENFELD: The surge line.

JUDGE KENNEDY: The pressurizer surge line? Is that what you said?

DR. HOPENFELD: Yes.

JUDGE KENNEDY: Okay. And so, is that the

improper non-conservative transient of concern is the --

DR. HOPENFELD: Yes.

JUDGE KENNEDY: And is that also the component that you felt there was 20 years of missing data that should have been ---

DR. HOPENFELD: Yes.

JUDGE KENNEDY: -- accounted for?

DR. HOPENFELD: Yeah, that's what they said -- stated, yes.

JUDGE KENNEDY: Thank you. And then the stress corrosion or stress concentration factors, you feel those should be applied differently than you believe they've been applied in calculating the CUF value?

DR. HOPENFELD: Right. The stress concentration factor is --- comes at a different place. The one I really would be more concerned is indication of the tube-to-tubesheet welds. There are 20,000. Not each concentration the same. That's why I asked yesterday how do you do it? And the answer was there's a procedure in the ASME.

And I'm not that familiar with the procedure, but I'm sure there is, but that's just not an answer, really. I would have to see what they've

done, but I have no access to their computer codes and I don't really know what they have done.

JUDGE KENNEDY: Dr. Hopenfeld, let me try it a different way. You brought up the stress concentration factors.

Are they applicable to metal fatigue?

DR. HOPENFELD: Are they applicable to fatigue? I don't understand the question.

JUDGE KENNEDY: Are these not metals?

DR. HOPENFELD: Could you please repeat the --

JUDGE KENNEDY: I guess I'm, you know, this contention is about component metal fatigue.

DR. HOPENFELD: Right.

JUDGE KENNEDY: And we've been discussing for almost a day now a Cumulative Usage Factor. And I tried to start my question discussing any concerns you had bout those calculations, the CUF of record, as you termed them.

DR. HOPENFELD: Well, yes.

JUDGE KENNEDY: And so, you brought up the transients, which I think we now understand.

DR. HOPENFELD: Yes. Yes.

JUDGE KENNEDY: And I'm not sure I quite grasp the stress concentration factor and how it

applies to the CUF of record calculation.

DR. HOPENFELD: Can I explain to you? What you do, you have a whole bunch of transients. You look at the whole data of loads versus time. Then you go to some technique, I said raindrop technique, there are others, and you pick up the maximums and they group them together.

When you take the maximum, the peak, that's all the -- mostly that's what they're talking about. I don't really have a problem, but I'm sure that they know how to do it and I'm sure they're doing an excellent job.

My problem is, is after you take the plus -- the peak and subtracted the minimum, then you multiply that by a concentration factor. That -- the result that you get is related to the fatigue life of the component, yes. It affects the fatigue.

JUDGE KENNEDY: So, you're suggesting that there's a stress concentration factor term that needs to be applied or has been applied to the cumulative usage factor calculation.

Is that what you just said?

DR. HOPENFELD: Yes.

JUDGE KENNEDY: Okay. Thank you. Let's turn to Entergy. I think there's two questions at

least on the table. One is the lack of data, the 20-year data for the pressurizer surge line and how that was handled in the CUF of record calculation.

Mr. Gray.

MR. GRAY: This is Mark Gray for Entergy. The transient development for the surge line and pressurizer nozzles is documented in our two WCAPs.

The WCAP for Unit 2 is WCAP 17199, which is Entergy 681. And the Unit 3 WCAP is 17200, which I don't readily have, but I can find that -- 682, okay. So, Entergy 682.

Section 3 of each of those WCAPs describes in detail the transient development for those nozzles. Within that description there are, for Unit 3 in particular, there is a discussion of how we handled the data for the past operation. To summarize, the way that is developed is in general you'll have a subset of the data for the plant operations.

For Unit 2 we had a good amount of data -- well, let me stop for a second. The reason there is such a thing as past and future is because there was a recommendation in the '90s due to the pressurizer in-surge/out-surge issue that Westinghouse studied within the Owners Group for the plants to change their mode of operation to mitigate these transients.

So, the time that the plant incorporated those changes is where we expected to see a difference in the transients that resulted from the operations. We had data for both that past and present for Unit 2.

For Unit 3, that data was -- we had the data for the present, but for the past, you know, we were lacking data. So, what was done and is described in the calculation notes, as well as in the WCAP, is a study of the plant operations.

Coupled with looking at data, we also employed operator interviews asking the operators in the history of the plant how they've changed their heat-up and cool-down operations.

I should say that the significant transients happened during heat-up and cool-down of the plant when the Delta-T between the pressurizer and the hot leg is high and the stratification is maximized.

So, a combination of operator interviews, studying the heat-up and cool-down procedures, seeing what effects there would be was one part of that investigation.

The other part of the investigation was using actually the results of the Owners Group program where all of the Westinghouse plants at the time were

studied for their susceptibility to in-surge and out-surge transients. And all the plants were characterized according to a dimensionalist parameter, which is -- and this is described in WCAP 13588, which I know is in our exhibits, but, again, I don't have the exhibit number.

That parameter was used to compare Indian Point Unit 3's surge line and pressurizer layout to those other plants and to look for similarity in plants for which we did have data. And of course to nobody's surprise, the most similar plant to Indian Point, Unit 3, with respect to that, was Indian Point Unit 2.

So, the data from Indian Point Unit 2 for the past operation, as well as other plants, was all considered and an evaluation was done to determine a conservative estimation of the past transients for the surge line and pressurizer.

JUDGE KENNEDY: Okay. Thank you, Mr. Gray. You used the term "heat-up" and "cool-down." When do these -- when does that occur?

Is that something daily? Weekly? Monthly? Annually?

MR. GRAY: No, it's -- at the least, it's every refueling outage. Sometimes they'll cool down

and heat up for a different -- and Mr. Azevedo might have a better estimate of --

MR. AZEVEDO: Yeah. This is Nelson Azevedo for Entergy. It's once every two years. Maybe once every few cycles we'll also cool down for some other reason like, you know, equipment failure, something like that, but normally just once every two years.

JUDGE KENNEDY: And so, over 20 years of operation heat-up and cool-down would occur on -- what's a number -- estimated number of heat-ups and cool-downs over the 20 years of missing data?

MR. AZEVEDO: Well, we can look up the data. I don't have it here in front of me, but, you know, I'm not implying that all over those 20-year periods -- over that 20-year period when we cool down 10 times, you know.

Back then we were in a different cycle length. So, the number was higher, but probably by a factor of two or so.

JUDGE KENNEDY: All right. Thank you. Dr. Hopenfeld, any particular concern over how the analysis was handled? And did you review those WCAPs?

DR. HOPENFELD: I read those three years ago when we started with this. I read them -- that's

when I got the information that they did not have the transients and they developed some kind of models.

There wasn't sufficient detail in that -- those documents to see how conservative -- or if conservatives they were, but that I couldn't tell and that was my problem.

And I think if I read it today, I probably couldn't tell either. So, I am very much -- maybe NRC has, because they say that all these models are conservative, but I couldn't tell. I don't know how you can tell when you don't have data, that something is conservative.

JUDGE KENNEDY: All right. Thank you, Dr. Hopenfeld. Stress concentration factors and their impacts on metal fatigue or CUF calculations?

MR. AZEVEDO: Yeah, Your Honor. This is Nelson Azevedo for Entergy. First, let me comment that I think it's implied that the stress concentrations change over time. They don't change over time. They're a function of the geometry of the plant. So, unless you modify the component, the stress concentrations stay the same.

Also, the ASME code when you do fatigue analysis, you use what the code calls "peak stresses." And peak stresses -- excuse me -- are already the

intensified stresses.

"Stress intensification factor" is really not the right term, because ASME Section 3 requires we use -- excuse me -- stress intensity is not really stresses, but the end result is the same, but the stresses that we use are already peak stresses which have already been identified. They're not intensified. They're not intensified after we paired the peaks and the valleys. They're intensified prior to that and we use those peak stresses to pair them, you know, to peaks and to valleys.

So, the stress concentration effects have been incorporated and they're clearly specified in the ASME code how to calculate them.

JUDGE KENNEDY: And did I hear you say the stress concentration factors aren't influenced by corrosion or embrittlement or radiation?

MR. AZEVEDO: Well, again, they're certainly not influenced by embrittlement or corrosion, because there's no corrosion going on in the primary side.

MR. STROSNIDER: Your Honor, this is Jack Strosnider from Entergy. I'd like to add to Mr. Azevedo's comments that the notion about changes in geometry over time it should be recognized that under

Section 11 of the ASME code, these systems are inspected periodically. In particular, the welds are looked at with -- using ultrasonic methods.

So, if there were any change which, you know, as was pointed out is not expected, they would be -- that would be identified through these inspections. It would have to be put in the corrective action program and evaluated.

One other thing which I think was in Dr. Hopenfeld's testimony and may have mentioned earlier was the notion of flow-assisted corrosion. And I just want to point out that that mechanism is not applicable to the primary system components that we're talking about. So, that would not be something that would change the geometry.

JUDGE KENNEDY: Thank you. Dr. Hopenfeld, any final thoughts on stress concentration factors and how --

DR. HOPENFELD: Yes.

JUDGE KENNEDY: -- Entergy is applying them?

DR. HOPENFELD: I have several, but I don't want to take too much time. But one that I would like to choose is that the stress concentration I was talking about is affected by ductility.

And if the ductility doesn't change, if the irradiation doesn't affect ductility, then there's no effect on it. But from what I heard yesterday, it does affect ductility. And from what I read about it, it does affect ductility.

The original stress concentration for which these peaks are multiplied by do not have embrittlement effect in it.

JUDGE KENNEDY: Are you suggesting that the ASME code prescribed method is incorrect for this calculation?

DR. HOPENFELD: No, the ASME code is correct. What I am suggesting the number that you have, decay or whatever the number, ASME code will tell you go to the Pearson chart or something or handbook and pick up what the concentration factor is for this particular geometry. But it doesn't tell you that if that geometry is subjected to embrittlement over time, how to handle that, or at least I'm not familiar with.

So, I think it's true the geometry on the primary side doesn't change, except in one case I do have a problem with the whole LAR, but I don't want to take too much into it.

If you notice that in the original LAR --

I don't have time to address it. So, maybe if I have time, I'll come back to it. I'm sorry. It would take me too long to explain.

It relates -- I'll focus my attention now on the effect of radiation on the stress concentration. I don't know how that was accounted for.

JUDGE KENNEDY: Well, maybe just to clear the air, Mr. Azevedo, if we focused just on embrittlement and the stress concentration factors --

MR. AZEVEDO: This is Nelson Azevedo for Entergy. Again, Your Honor, stress concentrations are geometrical, impacted by the geometry of the component, not the embrittlement of the component. That impacts the material properties, not the stress concentrations.

CHAIRMAN McDADE: Okay. Mr. Azevedo, I just didn't hear what you said. It's affected by the geometry, not by -- I just didn't --

MR. AZEVEDO: It's not affected by the embrittlement.

JUDGE KENNEDY: So, this ductility question that Dr. Hopenfeld is raising, you don't -- do you feel it's significant in relation to stress concentration factors?

MR. AZEVEDO: No, I don't feel it impacts the stress concentration factor at all. As we discussed over the last couple days, what it does impact is the ability of the material to resist crack propagation, but that's not what we're talking about.

We're talking about CUFs and crack initiation and irradiation has no impact on stress concentration. So, it's a geometry issue.

JUDGE KENNEDY: All right. Thank you. Dr. Hopenfeld, I have one final question. At least it will start as one final question.

On Page 6 of your report, Exhibit RIV or Riverkeeper 144, you state that the Fen is an experimental factor and the underlying premise is that the user would not extrapolate the Fen to conditions other than those in its derivation.

Are you suggesting that you believe that Entergy did so? And where in your testimony do you support that statement?

DR. HOPENFELD: Let me explain. I'd like to see the statement, but from what you read -- I don't have it in front of me.

JUDGE KENNEDY: Would you like us to -- would it help if we put it up on the screen? Mr. Welkie, could we try 144? Riverkeeper.

(Pause.)

JUDGE KENNEDY: Page 6, I hope.

DR. HOPENFELD: Where would you like me to look?

JUDGE KENNEDY: Well, I'm looking myself.

MR. SIPOS: I believe we're on Page 8. I believe we're on Page 8 of the pdf, Your Honor.

JUDGE KENNEDY: Right. Thank you. Yes. Document Page 6, which I think is pdf Page 8. Thank you. Okay. Scroll down just a little bit.

Right. The last sentence under Section 1.1, since the Fen is an experimental factor, the underlying principle of using the above equation is that the user would not extrapolate the Fen to conditions other than those that existed in its derivation.

And I guess I -- that seems like a hanging statement. I filled it in by suggesting are you challenging the application of this by Entergy? Has it been applied outside -- that you believe it's been applied outside the range of applicability?

DR. HOPENFELD: Yes.

JUDGE KENNEDY: And how do you support -- what do you point to to support that statement?

DR. HOPENFELD: One of several.

Obviously one we discussed was the oxygen. The oxygen was -- I don't want to rehash that now, because there are others. The other one is stress corrosion cracking.

You see, when these tests -- and if I read the rebuttal to my report, it doesn't seem like they understand. It doesn't appear as to how these tests were run, because they, in their testimony, said that you can take the Fen as it was in this equation and directly apply it.

Dr. Chopra, who had developed this equation, discussed this issue for full two days before the ACRS in 2006. And he made it very, very clear that it's up to the user to any -- make adjustment for its environment, and I made that point in my report.

In reply, Entergy said that it's my imagination, that Dr. Chopra never was there. I gave you the reference. It's in the record, but -- and I can give you the pages where he said that.

Now, to reply to your question, which I didn't, the specific one was oxygen, but the one that really concerned me especially for the tube-to-tubesheet welds is the stress corrosion aspect of it.

You see, stress corrosion is different

than metal fatigue and only in one respect for the same material. Stress corrosion you have uniform, steady-state --

JUDGE KENNEDY: Dr. Hopenfeld, let's back up just a second. I -- again, I -- maybe it's the way I'm asking the question.

What this statement seems to imply is this test, these tests that generated the Fen factors had a range of conditions under which the tests were run. And I read that last sentence and I may be reading it incorrectly, which is why I ask the question, as a challenge to someone applying those factors outside the applicable range of conditions under which they were developed, I don't see that as having any bearing on stress concentration factors.

Maybe oxygen content, I'm not sure, but this implies to me that there is an extrapolation of the Fen to conditions that are inconsistent with its derivation.

Could you please respond to that particular question as what -- well, first of all, what did you mean by this?

DR. HOPENFELD: Well, I started trying -- started explaining going into the stress concentration -- stress corrosion cracking. There is

no stress corrosion cracking in these tests. There was no steady-state component during these tests. It was only cycle components.

So, there is only fatigue, but there is a synergy, as Dr. Lahey said, between fatigue and stress corrosion cracking. Where is that synergy? In two places.

One, in the initiation. And I would like to -- because, again, when we talk about crack initiation, crack propagation, we're talking about two different things. So, if you wish to see what I'm talking about, I'm talking about the crack initiation and propagation by the short cracks.

They are talking about Section 11 cracks. I'm talking about the short cracks the way are described by Dr. -- or by Argonne in this report. And we can go to the definition of what the crack means, but there were no -- there was no stress corrosion component during these tests.

So, you cannot apply these Fen directly to a situation where the stress corrosion occurring simultaneously, because their synergetic effect, their mechanism of the synergy is as follows.

When you have steady-state tensile force superimposed on the oscillating force, oscillating

stress, what you do, you're affecting the distraction of the outside layer at the tip of the crack.

So, the crack propagation usually would be much faster, and that's what data shows that you have a faster propagation of the crack, how it -- how the CUFen would be affected, because the fatigue like, that's what we're talking about.

JUDGE KENNEDY: Doctor.

DR. HOPENFELD: Yes.

JUDGE KENNEDY: I hate to keep interrupting you, Dr. Hopenfeld, but I think that -- if I look at this equation, it appears to be adjusting laboratory data in air for laboratory data in water conditions. Maybe water conditions that are applicable for a pressurized water reactor.

What part of that do I not understand?

DR. HOPENFELD: What I think you don't understand is it's not only the water condition, it's the condition how the specimen was stressed. There was no uniform stress at the time when the cycle stresses were applied.

JUDGE KENNEDY: And how is that captured in the conditions other than those that existed in its derivation?

DR. HOPENFELD: It's not -- it's not --

it's up to the user to make adjustments for that. There's no stress corrosion --

JUDGE KENNEDY: Where in this document does it say you need to do that?

DR. HOPENFELD: In the testimony -- in the testimony of Dr. Chopra before ACRS, he discussed the things that they did and the things they didn't do it. And the members of the ACRS a whole bunch of questions like you do right now. And the answer was, well, we haven't done this, it's up to the user to adjust it. It's up to the user to take care of it. We hadn't looked at fluence. It's up to the user, and they keep on going.

And we haven't covered everything. There's a full two-day discussion of this, which is -- which to some degree if you read the report, some of it is in here, but I --

JUDGE KENNEDY: Let's --

DR. HOPENFELD: What I'm telling you is that loads, there was no stress concentration -- stress corrosion cracking.

Let's put it differently. Suppose you took a sample. They use brand new samples, perfectly clean -- due to stress -- a sample that already had -- that was already had some stress corrosion cracking.

The result is not going to be the same.

JUDGE KENNEDY: Let me --- I heard a lot in your discussion there, and I heard you pointing us to another document that you would suggest draws into question the Fen calculation.

Is that what you just said? I'm having trouble following you, to be honest with you.

DR. HOPENFELD: It draws into the question of the Fen. It's a new concept, really. It hasn't been around for many years. So, it's a perfect -- it's an excellent concept. I have no problem with that.

JUDGE KENNEDY: So, you ---

DR. HOPENFELD: I'm just saying I have a problem when you use --- put blindfolds and use it everywhere. You have to see under what condition it was obtained and ask yourself, is it applicable to what I'm doing? And I don't see that this is being done.

I brought stress corrosion cracking as one. Oxygen is two. I'm sure there are others that are constant.

JUDGE KENNEDY: Is there a particular exhibit in your pre-filed testimony that you'd like to point us to, to address your concern? It doesn't

appear to be this document, I guess, is my point.

DR. HOPENFELD: Well --

JUDGE KENNEDY: So, I'll give you an opportunity to point us towards your most applicable reference.

DR. HOPENFELD: Well, in my exhibit, I did discuss the effect of stress corrosion cracking. And I -- in a reference report by -- I guess by Argonne, and it will take me time to look for it, I did discuss the synergy between stress corrosion cracking, metal fatigue. And I reference the work of Argonne where they got a very, very detailed analysis showing there's definitely synergy between stress corrosion cracking and metal fatigue.

And they came up with equations and they said, we can handle it. There's information in the -- we can handle it. It's difficult to handle for welds, but for the very base metal it's okay, but the problem is with the welds. We don't have enough data.

And welds usually are subjected to large residual stresses. So, that's what the stress is.

JUDGE KENNEDY: Dr. Hopenfeld, are you testifying that those subsequent references would lead us to adjust the Fen parameters to account for other mechanisms, aging mechanisms?

I'm trying to put -- this started with an Fen discussion, and we're off into synergistic effects.

DR. HOPENFELD: Here is what I suggested. I think it's an excellent question. Here is what I suggest.

If you're asking me how to do it, I don't know how to do it, because I don't have the data although there is information -- there is some data in the literature as to the synergy recreating how fast the crack propagate with or without stress corrosion cracking, and how fast it will initiate or not initiate.

I don't know if I provided the reference. There's just too much material here, but there is an effect. Now, how to take in account that effect?

I don't know, but I am sure a fraction mechanic expert will come up with an answer and say, well, look, if you want to be conservative, do this, take this extreme. But if you don't want to be conservative, that's what they doing.

I'm talking about conservatism. Their effect is finite. I don't know how to calculate it, but if you -- you cannot say in the same breath that you are conservative without taking into account.

That's all I'm saying.

JUDGE KENNEDY: I understand, Dr. Hopenfeld. And as you're aware, we took quite a bit of testimony over the last few days both on Contention 25 and 26 about synergistic effects.

I guess I'll just go back, circle one more time to this Fen calculation. Do you have a particular concern about how Entergy has applied the adjustments for an environmental-assisted fatigue calculation? And in particular, the application of the Fen parameter.

DR. HOPENFELD: Yes, because they did not account for the irradiation effect.

JUDGE KENNEDY: So, we're back -- are we back to synergistic effects?

DR. HOPENFELD: It's not -- we're using the word "synergistically" interchangeably. The way I look "synergistically," and maybe not exactly the same as Dr. Lahey, I look synergistically as one thing happening, another thing happen. They work simultaneously.

And when they work simultaneously, the result is different than separately. That's what "synergistically" mean.

In the case of embrittlement and fatigue,

as far as I'm -- embrittlement, like the other thing, just affects the material property. It's a different property. It's not that it works together. It's just the property is different. So, I -- in that case, the synergy word doesn't mean much to me.

JUDGE WARDWELL: But let me take a crack at what I -- I want to make sure you are or are not saying.

Do you believe that the Fen should include -- the selection of the Fen should include some aspect associated with stress corrosion cracking and oxygen content? Is that your position?

DR. HOPENFELD: All right. Let me answer to -- yes. In the case of oxygen content, it's already included in there. They told you use a number if you don't have the actual measurements of oxygen near the surface. It's not at the surface, but near the surface or near the component.

If you don't know what it is, then use a conservative value. And Argonne gave you 0.4 -- maybe it's more. If you have justification, use something else, but don't use 0.05.

Even Westinghouse in their analysis acknowledge that oxygen gets in there during the heat-up period.

Now, how does it get out? I'm not going -- there are millions of -- oxygen is being reduced during --- in the core all the time.

JUDGE WARDWELL: So, you're saying that oxygen is already included in the Fen, but it's not included sufficiently, is your position.

DR. HOPENFELD: No, I -- the Fen includes the oxygen. There's an oxygen term. What do they call it? Reduced oxygen with a star on it. So, you have to put -- ask yourself what oxygen --

JUDGE WARDWELL: Okay. So, the Fen does include the oxygen.

DR. HOPENFELD: Oh, sure.

JUDGE WARDWELL: And but you are -- are you objecting to the value that the applicant has used --

DR. HOPENFELD: Yes.

JUDGE WARDWELL: -- for oxygen in the Fen?

DR. HOPENFELD: Absolutely.

JUDGE WARDWELL: Okay. Thank you. Now, what about stress corrosion cracking?

DR. HOPENFELD: I'm sorry?

JUDGE WARDWELL: And what about stress corrosion cracking?

DR. HOPENFELD: Stress corrosion is not

there, and I think --

JUDGE WARDWELL: And you believe it should be a component --

DR. HOPENFELD: Yes, but I don't --

JUDGE WARDWELL: -- in the calculation of the Fen.

DR. HOPENFELD: -- know how to do it. I wouldn't know how to do it. But if I was -- if somebody said, hey, you are getting on this plane, think of it this way. Stress corrosion is not only unique to -- it occurs on planes, too.

If I get on a plane and the guy said we got -- these wings are stress corroded, but they're also going to fatigue during the turbulence, then so I add, did you take into account the stress corrosion and said, no, I am not going to get on that plane.

So, the answer to your question, sir, yes, I would include it. I don't know how, but, again, if you take an expert person, and I can name you some expert, Dr. James for one, he will come up with a number how you can adjust or put a safety factor into this.

JUDGE WARDWELL: And is that in your testimony in regards to a suggested method to include stress corrosion cracking into the selection of the

Fen value?

DR. HOPENFELD: I didn't feel it was my position to -- in writing this report to make suggestion as to what to do. I didn't put myself in that. I just said it's not adequate.

JUDGE WARDWELL: Do you have a cite to anyone else -- is this your professional opinion, or are there others in the industry to which you have cited backing up your professional opinion in regards to whether or not stress corrosion cracking should be included as part of the selection of Fen?

DR. HOPENFELD: There are plenty of -- there is -- in the paper I cited -- indicated an effect of synergy before. Now, they didn't say specifically --

JUDGE WARDWELL: Excuse me, Dr. Hopenfeld. I'm not talking about synergism. I'm now asking just what you were trying to focus in on. The selection of the Fen value, you believe, should include stress corrosion cracking.

I'm asking you, do you have a cite to anyone else who also -- who shares that opinion of you and your testimony? And if so, where do you cite that?

DR. HOPENFELD: I do not have anybody

addressing the Fen should be corrected by stress corrosion crack. It's up to the user to do that. The stress -- the code doesn't tell you, you know, how to do this. It's up to the user to make the adjustments.

But I don't think that --- I haven't seen anywhere in dispute that -- I mean, the whole concept of Fen is not that old. It's fairly new. So, I haven't seen any discussion in literature that say, hey, these people should have adjusted the Fen.

I am telling you that that Fen was not the effect of stress corrosion cracking. The effect of pre-conditioning the specimen with crack was not involved here.

JUDGE WARDWELL: Thank you. Let me turn to Entergy, either Mr. Gray or Azevedo or whoever else. Let's start more generically.

Is there any mechanism by which you would -- is there any mechanism in the current guidance that allows you to change or add or supplement different parameters in the calculation of the Fen?

MR. AZEVEDO: You mean to account for stress corrosion cracking?

JUDGE WARDWELL: Or any -- I was doing it more generically to start with, but, yes, my next question was going to be for stress corrosion

cracking. So, fine. Use that as an example.

MR. AZEVEDO: Well, let me just start out by saying that the stress corrosion cracking is handled by a separate program. We have a separate program to handle stress corrosion cracking specific of LI-600. Those are the materials susceptible to stress corrosion cracking. That's a separate program.

JUDGE WARDWELL: Separate AMP?

MR. AZEVEDO: It's a separate -- yeah, that's correct. We have inspections specifically for that. So, that's addressed in a separate program.

To the extent --- well, stress corrosion cracking is driven by a susceptible material, a conducive environment, in the presence of stress.

To the extent that the environment impacts the CUF, that's exactly what the Fen is for to account for the impact of the environment on the crack initiation. In this case, the CUF. So, we would claim that that's already -- that's specifically what the Fen is doing.

JUDGE WARDWELL: Okay. Thank you.

MR. AZEVEDO: But, again, stress corrosion cracking is a separate program, a separate issue and handled separately from the CUFen.

JUDGE WARDWELL: Yesterday we talked about

the oxygen content and that you're using an order of magnitude greater than what you are actually experienced at the plant; is that correct?

MR. AZEVEDO: That's correct.

JUDGE WARDWELL: And do you have anything else to add to it just so those comments are here in the transcript and saves us from flipping back to find out where you said it before yesterday?

MR. AZEVEDO: I'm not sure there's anything else I can say other than that we feel that the numbers that we're using are extremely bounding and that's already accounted for.

JUDGE WARDWELL: And when we were talking about that number, that number does relate to the one used for the ultimate calculation of the Fen; is that correct?

MR. AZEVEDO: That's correct.

JUDGE WARDWELL: Thank you.

MR. DOLANSKY: This is Bob Dolansky with Entergy. I just would like to add I believe the numbers that Mr. Azevedo gave yesterday were actually in our testimony or in a cite.

Is that right, Nelson, the numbers you read from yesterday?

MR. AZEVEDO: Yes, it's one of the Entergy

exhibits.

JUDGE WARDWELL: Thank you.

JUDGE KENNEDY: With that, I have no further questions on Contention 26.

JUDGE WARDWELL: I think I'd like to clear up a couple, if I dare.

CHAIRMAN McDADE: Please.

JUDGE WARDWELL: This is for Mr. Azevedo or whoever else in Entergy. Dr. Hopenfeld did mention something about the importance of this fatigue for welds.

Do you put any more emphasis on welds as opposed to any other component in regards to the fatigue analysis?

MR. AZEVEDO: All the locations, all the, you know, nozzle corners, for example, welds, anywhere where there's a change in geometry or change in the materials, the ASME code specifically addresses that and tells you how to calculate the stress indices and the peak stresses which are used for fatigue analysis.

So, I'd say welds are not handled any different than any other component that requires to be, you know, accounted for, for change in geometry.

JUDGE WARDWELL: And those environmental conditions that you apply to other components are also

applied to the welds like the oxygen content, et cetera.

MR. AZEVEDO: Yes, all the CUFs are amplified by the Fen. That's correct.

JUDGE WARDWELL: Dr. Hopenfeld also mentioned something about the fact that transient data wasn't available from the early operations of the plants.

Could you comment on that whether it is or isn't, and then how have you adapted for that in regards to the tracking of CUFs during operations and that will be extended into the period of extended operation?

MR. COX: This is Alan Cox. Let me start, and Mr. Azevedo can continue, but I believe you're referring to the lack of the details about pressurizer heat-ups and cool-downs.

I just want to say that the number of pressurizer plant heat-ups and cool-downs is known. That is not lost.

What was not available was the specific temperature information related to each of those heat-ups and cool-downs as far as how many cycles occurred.

JUDGE WARDWELL: Say again what was missing. I missed a couple words right in there that

are crucial.

MR. COX: The detailed temperatures related to the -- the local temperatures that -- at the pipe when the heat-ups and cool-downs occurred.

JUDGE WARDWELL: Aren't those critical, though, or are they not? And how did you handle that lack of data?

MR. AZEVEDO: Well, yeah, this is exactly what Mr. Gray was discussing a few minutes ago. Maybe he can reiterate what he said before.

MR. GRAY: Hi. Yes. Mark Gray for Entergy. We --

JUDGE WARDWELL: Are you suggesting I wasn't paying attention, Mr. Azevedo?

MR. AZEVEDO: No, Your Honor. I did not mean that.

(Laughter.)

JUDGE WARDWELL: I probably wasn't.

MR. GRAY: Yeah, let me explain a little bit about the difference in the heat-up and cool-down events versus the actual sub-events and maybe that will clear that up a little bit.

During a given heat-up you can have sub-events, sub-cycles, transients that occur in the pressurizer lower head due to in-surges and out-

surges. So, the data for the number of heat-ups and cool-downs for the plant was available. What we didn't have was detailed temperature information for those in-surges and out-surges.

And so, the study that we did both with respect to the sensitivity of the Indian Point Unit 3 layout to in-surges and out-surges, the similar operating procedures to other plants including Indian Point 2, that study was all used to determine an applicable set of transients for that path. And that's what was documented in the WCAP and the supporting calculations.

JUDGE WARDWELL: Thank you. I do recall that testimony. I appreciate that.

Dr. Hopenfeld, two different times you mentioned, I believe, the tube-to-tubesheet welds. And I wasn't -- because you mentioned it twice, I was wondering why that sticks in your mind as something of importance.

And if so, to what degree is it important in regards to the CUF and CUFen calculations?

DR. HOPENFELD: It's extremely important. And I could spend half an hour, but I could spend a week to talk about it, but I don't want to take the week and I don't want to -- you wouldn't be interested

in a week of work.

The reason it's important -

JUDGE WARDWELL: I think that's a safe assumption.

DR. HOPENFELD: Okay. The reason it's important is because -- and the reason it's important to say -- to know what the CUF is, and if we can go off to some material, maybe designated proprietary, because I would like to mention a number for that --

JUDGE WARDWELL: I'd like you to avoid that at all possible. I don't think I need it in-depth enough to see that number.

DR. HOPENFELD: Okay. If you don't need it, okay.

JUDGE WARDWELL: Make up a suggested number. Don't --

DR. HOPENFELD: Okay. Suggested --

JUDGE WARDWELL: Or a range of numbers.

DR. HOPENFELD: More than one. It's three.

JUDGE WARDWELL: More than one?

DR. HOPENFELD: Yes.

JUDGE WARDWELL: Fine.

DR. HOPENFELD: Three.

JUDGE WARDWELL: And what's this number

for? Number of what?

DR. HOPENFELD: It's the CUF. The CUFen --

JUDGE WARDWELL: The CUF more than one --

DR. HOPENFELD: -- for the weld.

JUDGE WARDWELL: -- for what?

DR. HOPENFELD: For the welds, I mean, the CUFen for the welds between the tube-to-tubesheet welds. The tube-to-tubesheet welds. The CUFen for the tube-to-tubesheet welds.

JUDGE WARDWELL: If it becomes greater than one, then what?

DR. HOPENFELD: If it's greater than one, then what happens? First of all, I have to backup. The analysis -- well, due to a steam line break, okay, because it's greater than one, there's a high probability, I would say probably a hundred percent probability, that those -- if it's really more than one, that those welds will fail.

Now, we don't know how they're going to fail. They'll fail -- usually when these things fail, it means there is a crack. Okay. So, I have 20,000 cracked welds and I don't know to what degree they crack.

JUDGE WARDWELL: Are there actually

20,000, or was that just --

DR. HOPENFELD: Don't take the number literally.

JUDGE WARDWELL: Okay. I want to make sure what --

DR. HOPENFELD: I'm going back in my memory and I've been away from these numbers for some time. There are 10,000 tubes, roughly. Maybe I know Entergy will say it's 11,000. So, whatever. 10,000. They are welded on both sides of the plenum. So, it might be 20,000.

So, you have 20,000 welds and they are -- they have exhausted their useful design usage factor. They are damaged. They are not something brand new that came in a box from Amazon. They have exhausted their usefulness. So, now what happens? What happens? Well, you have a steam line break.

Here the steam line break depends where the break is, but usually for analysis purposes we usually assume that the break occurs between the containment and the relief valve and the safety valve, not farther that you can isolate it. So, you can't isolate that.

So, when you have a steam line break like that, you impose 2,000 pounds on the primary side

because now you open to the atmosphere.

After you scram the reactor, the pressure in the steam generator goes down. So, you impose that pressure and now you have a leak, a direct path for the primary fluid to go directly to the -- to bypass the containment and go directly to outside.

If the operator doesn't operate, doesn't do things properly, you deplete the water and you uncover the core. So, what you have to do, you have to keep the core cool. You have to keep adding water. But at the time, you will not lower the level, too. You will stop the leak. The only way to do it to stop the leak when the leak is large, is to minimize the levels on both sides.

JUDGE WARDWELL: Is it your position that the sensitivity of the plant's integrity is -- has a higher degree of potential impact associated with any potential failure of the tube-to-tubesheet welds than other components that are also tracked for fatigue?

DR. HOPENFELD: This, in my mind, is very critical --

JUDGE WARDWELL: You think that's the most critical component.

DR. HOPENFELD: In my mind it is, because of the numbers they came up with.

JUDGE WARDWELL: Okay. Thank you.

DR. HOPENFELD: If they came up with small numbers, I wouldn't worry about it.

JUDGE WARDWELL: I'm not worried about it. I'm just -- the welds are your most critical --

DR. HOPENFELD: That --- in this case, yes.

JUDGE WARDWELL: Entergy, would you like to comment on that position of Dr. Hopenfeld?

MR. AZEVEDO: This is Nelson Azevedo for Entergy. First of all, the CUFens for the tube-to-tubesheet welds are all below one. So, they're, I believe, 0.3 and 0.8. We were just looking at them on one of the exhibits.

JUDGE WARDWELL: We don't need the number, but that's fine. Below one is fine.

MR. AZEVEDO: I apologize. So, they're less than one. So, the idea that they have -- we have cracks, I'm not sure how to respond to that, because we feel that we don't have cracks. The CUFs are within the allowables.

JUDGE WARDWELL: Do you believe that the plant safety is any more sensitive to failures of those than they are of any other particular components or other components within the plant that are tracked

for fatigue?

MR. AZEVEDO: No, I don't feel that that's the case. They're part of the reactor coolant pressure boundary just like many other components.

JUDGE WARDWELL: Thank you. Dr. Hopenfeld also mentioned something about pressure wave theory and Reynolds number theory.

Do you know what he was talking about in regards to that? And how have you handled or not handled that particular application of those theories to your fatigue analysis, if at all?

And if you don't know what he was talking about, that's fine, too. And I'll try to have him clarify.

MR. GRAY: This is Mark Gray for Entergy. I believe that that was in reference to the loadings that were used for the surge line analysis. The --

JUDGE WARDWELL: Excuse me. Is that what you were referring to, Dr. Hopenfeld?

DR. HOPENFELD: That's correct.

JUDGE WARDWELL: Thank you. Continue.

MR. GRAY: The surge line transients were developed consistent with a Westinghouse Owners Group program where stratification of the line is considered.

The transients consider two effects of the stratification. One effect is the overall bending moment that occurs from the stratification in the line, which is different than if you assume the line to be at a uniform temperature. Those bending loads are included in the analyses of the nozzles.

The other aspect of the stratification on the nozzle at the hot leg, which is, you know, two -- in this evaluation, I should say, two locations that are controlling or evaluated. The hot leg nozzle, which is -- enters the hot leg on a horizontal from a horizontal aspect on the surge line, and then the nozzle on the bottom head of the pressurizer, which is vertical. So, the stratification occurs in the nozzle when, and only when, the reactor coolant pump is not running.

When the reactor coolant pump is running, stratification can occur in the line, but not in the nozzle, because of the turbulence caused by the reactor coolant pump in the loop.

So, when the -- when the nozzle is stratified, that only occurs when the reactor coolant pump is off. And this has all been discussed in WCAP 12639, which I Can find that exhibit number for you. WCAP 12639 is the documentation of the Owners Group

studies of surge line stratification.

When the stratification occurs in the hot leg nozzle, there is an out-surge that has to come from the pressurizer to create that hot layer on the top. And then the cold layer is fed by the hot leg water.

Since the surge line is an open line, there's no valves in it or anything. You get this communication between the hot and the cold.

When the temperature difference is very high, the stratification is more severe as far as its effect on the stresses. So, when you evaluate the nozzle, you evaluate the nozzle for the fact that this stratification comes and goes.

It was analyzed conservatively for those local effects by just assuming that it steps from stratified condition to a non-stratified condition and back.

So, those cycles are considered in the fatigue evaluation of the nozzle, as well as the bending moments coincident with that same thing happening in the line, because you get a range of load which gives you a range of stress from that.

A question that was raised was with respect to when you have the stratification layer,

there has also been observed historically not in surge lines, but in feedwater lines back in the late '70s, a term called "thermal striping." Which what happens is that layer, that interface between hot and cold layers will begin to fluctuate at a very high frequency. This caused, actually, cracking in feedwater nozzles.

Number one, the presence of thermal striping in feedwater nozzles caused them to fail in a rather short period of time, because it's a high-cycle fatigue phenomena.

Those -- because of those failures, there were studies done of feedwater lines and nozzles in particular really to investigate the cause of the cracking which identified this striping phenomenon.

That's also in WCAP 9693, which is also an exhibit. Let me see if I can pull that up.

(Pause.)

MR. KUYLER: Your Honor, that's Entergy Exhibit 217, WCAP 9693.

MR. GRAY: And actually the surge line WCAP is 218. So, anyway, not to get into lots of detail, but you can look in 9693, I think it's in section -- it's a big volume. Section 1073. And I can confirm that. I have notes on that where it

pretty much gives the conclusions of a whole testing program where they had to simulate what was happening in the feedwater lines to determine what it took to get this fluctuating interface at very low flow rates.

And feedwater lines are a little different at this weld. The aux feed water is very cold coming in. So, you get an even higher temperature differential, which gives you a higher Richardson number, which is the dimensionless quantity that's used to determine whether you can have stratification or not.

So, with those high Richardson numbers in the feedwater line, you -- they had to get in conjunction with the high Richardson number and the stratification, a high enough flow in that cold layer coming in so that -- and there were a number of conditions that are summarized in WCAP 9693.

One is you have to have a persistent flow of that cold layer. And it has to be a high enough flow characterized by the Reynolds number that creates this condition where that interface becomes unstable.

So, they describe two different conditions. A stable interface with the low flows, and a -- the wavy interface, is what they call it, for the high flows. That occurs in feedwater lines

because of the conditions under which stratification occurs in that continuous flow.

In surge lines, the characteristics of the stratification transients is discussed in WCAP 12639. We observed at least 15 plants worth of data. You're not going to observe striping in thermal couples on the outside of the pipe. So, you don't see that.

The feedwater testing had to put sensors on the inside in the test loop. So, the -- but the characteristics of the transients when the stratification comes and goes was observed in 12639. It was used to develop the distributions of the cycles of stratification that I described before.

What happens is the stratification is not a sustained situation in the surge line because of this communication back and forth between the hot leg and the pressurizer. So, as a result of that, you don't have that sustained condition.

Number two, a I mentioned before, the only conditions under which the hot leg nozzle is stratified is when the reactor coolant pump is off. When the reactor coolant pump is off, you don't have a source of spray flow, because any appreciable velocity or flow, Reynolds number, again, for that difference to cause a wavy interface.

And number three, WCAP 12639 though it does consider striping because it was in the early days of, you know, the development of surge line stratification, it states very clearly and references studies that thermal striping in the surge line is inconsequential. Insignificant, I think the word is what it uses.

JUDGE WARDWELL: Okay. Thank you. I'm all set.

CHAIRMAN McDADE: That concludes the questions we have directly on Contention 26. I propose to take a 10-minute break before we start considering Contention 38.

Is there anything else that we need to take up?

DR. LAHEY: Your Honor, I'd like to try to clarify for the record something that came up under 26.

CHAIRMAN McDADE: Okay. Hold that for just a second, Dr. Lahey. Ms. Sutton or --

MR. KUYLER: Yes, Your Honor. There were two items that I believe Your Honors had asked our witnesses to look into yesterday, substantive matters on this contention that I believe Mr. Gray has some responses to.

CHAIRMAN McDADE: Okay. Specifically with regard to the methodology used to address thermal coupling?

MR. KUYLER: Yes.

CHAIRMAN McDADE: Is that the first one?

MR. KUYLER: Yes, Your Honor.

CHAIRMAN McDADE: Okay. Mr. Gray.

MR. GRAY: Yes, Your Honor. The question was to where do we have an example in the record showing how we treated the thermal couple data, the sensors from the plant and how those were used for incorporation into the transients and the transient binning that I described.

Entergy 689, which is WCAP 12191, Section 2.6 describes the process used to characterize the system transients based on the Delta-T. The corresponding -- and that's for the charging system, by the way.

The corresponding use of those -- of that information is documented in Entergy 727, which is calculation CN PAFN 0921. In Appendix A.3.1 of that calculation, it describes how that information was applied to the stress model to calculate fatigue.

CHAIRMAN McDADE: Okay. Thank you, Mr. Gray.

MR. GRAY: I would like to also answer another thing that was brought up, if I may.

CHAIRMAN McDADE: Can you give us general life here of what it is before you jump into it?

MR. GRAY: Yes. Dr. Lahey stated that we used elastic plastic analysis from MB 3228 of the code. And we -- and I stated that we did not. I would just like to clarify what may have occurred with that.

CHAIRMAN McDADE: Please.

MR. GRAY: Okay. While MB 3228 of the ASME code allows you to do a plastic analysis, the section of MB 3228 that describes that is 3228.3. This is commonly referred to as elastic plastic analysis where you calculate strains. And from those strains, you use those in your analysis. We did not do that elastic plastic analysis.

What he may have been confused by in our calculations and documentation is the fact that when you do the linear elastic analysis of MB 3200, MB 3228.5, which I mentioned yesterday in my testimony, describes a factor called K-E. It's a penalty that you put on your elastic stress when you exceed certain limits. And so, it allows you to exceed those limits of stress equations when you penalize your usage

factor calculation.

That's called a simplified elastic plastic correction factor in the code. So, you could see the words "elastic plastic" with respect to the Ke penalty factor, but it's not the same as doing a 3228.3 plastic analysis.

CHAIRMAN McDADE: Okay. Thank you. Okay. Dr. Lahey, before you proceed, what I was thinking it might be appropriate to do, there's a couple of references there to Entergy 689 and 727 relating to methodology and I think we're probably going to want you to comment on those methodologies.

And it may be appropriate for us before you begin to, you know, augment your testimony, to take that break to give you the opportunity to take a look at those two exhibits, see whether or not you need additional time to review them before you comment.

I mean, it's -- when we move on from 26, it's not like this is a strong wall, you know, we can come back to it later. A lot of these contentions obviously are interrelated, but I would like to give you the opportunity to at least take a look at those two exhibits and that may be helpful in some questions that we have when you come back.

DR. LAHEY: I'll do that over the break, Your Honor.

CHAIRMAN McDADE: And it may well be, I mean, we're only going to take, you know, we'll break until 10 minutes after 10:00. It may be that you'll need additional time. And if so, just, you know, let us know.

Is there anything else we should take up before the break, Ms. Sutton?

MS. SUTTON: No, nothing further, Your Honor.

CHAIRMAN McDADE: Mr. Kuyler?

MR. KUYLER: Nothing further, Your Honor.

CHAIRMAN McDADE: Brian Harris.

MR. HARRIS: No, Your Honor.

CHAIRMAN McDADE: Okay. We'll stand in recess then to 10:10.

(Whereupon, the proceedings went off the record at 9:55 a.m. and resumed at 10:10 a.m.)

CHAIRMAN McDADE: The hearing will come to order.

MR. SIPOS: Judge McDade, this is John Sipos for the State of New York. Dr. Lahey would like some additional time to review those documents.

CHAIRMAN McDADE: Okay. Should we then

take the additional testimony from Dr. Lahey up after lunch? Would that be appropriate?

DR. LAHEY: That would be fine. I could do them both at the same time after lunch.

CHAIRMAN McDADE: Okay. And we will determine, I mean, there may or may not be significant questions after that, but you indicated that you had certain things that you wanted to clarify.

DR. LAHEY: Yes.

CHAIRMAN McDADE: And that may lead to additional questioning by the Board. But at this point, then, we might as well move on to 38. Before we do, I believe Dr. Duquette is the only potential witness who has not yet been sworn at least looking out at the gallery of witnesses.

Dr. Duquette, would you please rise? Would you raise your right hand? Do you swear that the testimony you will give in this proceeding subject to the penalties of perjury will be the truth, the whole truth and nothing but the truth?

DR. DUQUETTE: I do.

CHAIRMAN McDADE: Okay. Please be seated. and for the record, would you please state your full name?

DR. DUQUETTE: My name is David Duquette.

CHAIRMAN McDADE: Okay. Dr. Duquette, a couple of things that we've mentioned to other witnesses before you were here. It's necessary for us to maintain a transcript.

If a question is asked generally to the intervenor witnesses and you're the one who is going to respond, if you could state your name first to make sure that the court reporter is able to attribute it to you as opposed to Dr. Lahey or Dr. Hopenfeld.

If the question is directly to you, for example, if I ask, Dr. Duquette, would you comment on something, there's no need for you then again to repeat your name, you know, because it will be clear on the record who it is who's testifying.

Also, we just took a break. We'll probably go now until lunch. But if any witness needs a break, you know, before the Board, you know, decides we need a break, they should just simply, you know, let us know and we can accommodate that.

I think those are the only bits of information that I really needed to bring out to you that you wouldn't already be aware of. So, with that, I want to --

MR. BESSETTE: Your Honor, this is Paul Bessette for Entergy. I just want to introduce Martin

O'Neill has joined us as Entergy counsel for this contention.

CHAIRMAN McDADE: Yes, we are very familiar with Mr. O'Neill from Track 1 and from all of the pleadings.

Before we go further, I wanted to talk a little bit about what we intend to do now. We're moving on to Contention 38.

There's a lot of overlap between the various contentions and it is not our intent at this point to revisit issues regarding the adequacy of the AMP for RVIs that were covered, you know, by Judge Wardwell the first two days of this hearing.

And, likewise, we don't intend to revisit issues relating to metal fatigue and CUF values and environmental adjustments and the various WESTEMS issues that were covered by Judge Kennedy. It's not our intent. Although some of those are applicable to Contention 38 and Riverkeeper TC5, the combined contention, we are not going to revisit them.

Likewise, with regard to the license conditions that are a part of Contention 38, we -- there are sort of two aspects to that. One has to do with enforceability, and the other has to do with adequacy in order to provide reasonable assurance.

The first part of that, the enforceability, is primarily a legal contention. So, there's going to be minimal testimony that we're going to be eliciting on that just simply to ensure that we understand how in practice this is going to be carried out by the Agency. So, we're going to be focusing primarily on the adequacy of these individual commitments in order to provide reasonable assurance.

That said with a preface, I want to know, I mean, the parties have submitted detailed questions that they propose the Board to ask. As you know form the first few days of this, many of those questions were not asked by members of the Board. And part of that is a -- the concept of why we're having this hearing and what the Board is hoping to get out of it.

All of the parties to this have submitted detailed presentations and detailed testimony. Many issues are clear and it isn't necessary for the Board to go through those again.

When the parties were preparing their questions, obviously you had no way of knowing what, if anything, the Board understood from the submissions. But, so, in those instances where the Board felt that it didn't need clarification, we simply didn't go forward and ask those particular

questions. I say that as a preface to this.

In the Track 1, we had questions at the end of the hearing from the parties and the question arises as to how to handle that in this Track 2 proceeding. And what we would be looking for or, in any event, even possibly amenable to are not to allow parties to go through all of the questions that they propose that weren't answered, but only questions that were specifically addressed where their own party, one of their own witnesses, said something that you believe is either incorrect or perhaps misleading the way it came across, or that an opposing party's witness testified to that you believe was misleading or incorrect and had not already been addressed. Because in many instances, we've gone back and forth and the differences between the positions of the witnesses were very clear.

So, what we would be looking for is a very small universe. And what we would like counsel to do is after lunch, to be prepared to discuss with us before we begin testimony again, how you want to proceed in that regard whether there are any additional questions that you think need to be asked in order to clarify or complete the record. And then if so, whether it would be more efficient for you to

advise us generally as to those issues you wish us to consider, or alternatively to allow counsel to ask questions.

We did allow counsel to ask questions at the Track 1 hearing. Those questions were short. They were focused. None of the parties took more than 30 minutes. And we certainly would envision if it were sent to the parties, to ask some questions relatively short, relatively focused on those areas that I just addressed.

Are there any questions with regard to what I've just gone through from Entergy?

MR. BESSETTE: No, Your Honor. Thank you.

CHAIRMAN McDADE: From the staff?

MR. HARRIS: No, Your Honor. Thank you.

CHAIRMAN McDADE: New York?

MR. SIPOS: No, not now, Your Honor.

CHAIRMAN McDADE: Riverkeeper?

MS. BRANCATO: No, thank you.

CHAIRMAN McDADE: Okay. Thank you. Okay. Dr. Hiser, some -- and basically, you know, one of our purposes also in addition to clarify sometimes is to summarize, you know, so we have in one place in the record what perhaps in the exhibits and the testimony is spread out over a relatively long period of time.

And nothing that I say is evidence. It's only something that you say is evidence, but sometimes I'll ask a question, I'll sort of summarize and ask you whether or not it accurately reflects the position of the NRC staff so that it's on the record.

And then it is your testimony, you're the one who's swearing to it under oath, because I'm not under oath, and you are in a much better position to speak with confidence about what the NRC's position is than am I.

Okay. That said, is it the position of the NRC staff that license commitments made as part of the license renewal are part of the CLB and are enforceable under the ongoing oversight process established by Part 50, specifically 10 CFR 54.33? Is that something that you feel --

DR. HISER: I would just need to review 54.33, Your Honor.

CHAIRMAN McDADE: Okay. Let's strike the particular citation. Is it the general view without getting into the legal citation, that these license commitments become part of the CLB?

DR. HISER: As incorporated -- in particular as incorporated through a license condition in the UFSAR, they are.

CHAIRMAN McDADE: Okay. Now, most license commitments are captured in the FSAR, the Final Safety Analysis Report. Some are made as license conditions due to high regulatory or safety significance, correct?

DR. HISER: Yes, that's correct.

CHAIRMAN McDADE: Okay. And there are also others that I believe are referred to as regulatory commitments; is that correct?

DR. HISER: Within the context of license renewal, I don't --

CHAIRMAN McDADE: Yes.

DR. HISER: -- believe we use that terminology. We have -- applicants make commitments that are -- would be incorporated in the UFSAR. And those are the only commitments that are -- pertain to license renewal.

CHAIRMAN McDADE: Okay. In this particular instance we've got -- we have commitments 30, 41, 42, 43, 44 and 49. Which category do these commitments fall in?

DR. HISER: Those would be under the license renewal commitment that would be incorporated in the UFSAR that once the license is -- renewed license is issued for the plant, then that would

become a part of the CLB for the plant.

So, each of those commitments would be included within the discussion that we had several questions ago.

CHAIRMAN McDADE: Okay. Now, some of these commitments are ongoing, for example, such as Commitment 30. And others are commitments that are completed and then they can be closed; is that correct?

DR. HISER: Yes, that's correct.

CHAIRMAN McDADE: Okay. Commitment 43 and 49, the technical analysis for IP3, is that complete?

DR. HISER: If I can just review records for a moment?

CHAIRMAN McDADE: Okay. As I understand it, there were two, you know, with regard to IP3. There's a question of it being complete with regard to IP3. there's an indication that Entergy will close the commitment for IP3 prior to the PEO. And I'm just trying to get what the status is as far as the completion of the commitment with regard to IP3.

DR. HISER: If you could repeat the commitment numbers.

CHAIRMAN McDADE: These have to do with Commitments 43 and 49. I believe they're addressed in

the Entergy answer -- testimony -- well --

DR. HISER: That is my understanding. For IP2, those are closed. For IP3, they are still open.

CHAIRMAN McDADE: Okay. And what does that mean in this particular context that Entergy will close the commitments? What still needs to be done in order to close the commitments?

DR. HISER: What is needed -- actually, closure may not be the correct work, but really completion of the action that's specified in the commitment is what would be necessary for the applicant to be able to state that they had fulfilled the commitment. So, whatever action is specified would need to be completed.

CHAIRMAN McDADE: Okay.

JUDGE WARDWELL: While you're looking, may I ask Entergy under your testimony, I think it was Answer 113, Page 69 through 70, you state that the limiting location reviews required by Commitments 43 and 49 have been completed for both IP2 and 3; is that correct?

MR. AZEVEDO: This is Nelson Azevedo for Entergy. That is correct, Your Honor.

JUDGE WARDWELL: So, in your position as far as your position is concerned, what is left to be

done in regards to closing out 43 and 49?

MR. AZEVEDO: So, after we closed it for Unit 2, there's still some calculations that need to be completed. And those have been completed and they've been reviewed. They've been -- it was part of the NRC onsite audit back, I believe, in August. So, but those are complete.

JUDGE WARDWELL: Is there any reason why those particular limiting locations weren't identified as part of your initial application rather than have to be put off as a commitment? Because if we had run our hearings at any reasonable amount of schedule, they would still be outstanding.

MR. AZEVEDO: Well, you know, the only thing I'd say is these calculations are extensive calculations and they took time and we just didn't feel that we needed to complete the Unit 3 portion when we completed the Unit 2 portion.

So, the Unit 3 portion was extended beyond the Unit 2 portion. That's why they were still open, but again they were completed early this year and the commitments are closed.

JUDGE WARDWELL: Okay. Thank you.

MR. DOLANSKY: This is Bob Dolansky for Entergy. Judge McDade, you had mentioned earlier

Commitment 30 you thought was open. I believe Commitment 30 is complete.

CHAIRMAN McDADE: Well, Commitment 30 is ongoing; is it not? It has continuing obligations. It's been accepted by the NRC staff, and the NRC staff has determined that it provides adequate assurance and there are actions that need to be continually done over the course of the period of extended operation in the event the license is granted, correct?

MR. DOLANSKY: You are correct. We closed it.

CHAIRMAN McDADE: Okay. And compliance with Contention 30 then would be monitored, as you indicated earlier, Dr. Hiser, under the FSAR and/or the --

DR. HISER: Actually, I would say that that item is completed. This is the original commitment made in the original application regarding the reactor vessel internals aging management.

With the submission of the AMP by the applicant and the inspection plan, then that effectively completed this commitment. So, we would consider that to be complete.

CHAIRMAN McDADE: But the commitment also includes then doing what is in the AMP that was

submitted. You will monitor compliance. It envisions various actions will be taken over the next 20 years.

DR. HISER: I guess the way that I would interpret the commitment when it says "evaluate and implement the results," I think the development of the AMP, the development of the inspection plan fulfilled the commitment and implementation of the program inspections, analyses, et cetera, is just a part of implementation then of the AMP. So, I think from my personal perspective, I would consider 30 to be completed.

CHAIRMAN McDADE: Okay, but it is now part of the FSAR, correct?

DR. HISER: It is a part of the FSAR that would be identified as being completed. And this happens many times. As we review applications and applicants make commitments, sometimes they're completed before it becomes a part of the FSAR.

MR. COX: Judge McDade, I'd like to clarify that also. This is Alan Cox for Entergy. The commitment was to submit the inspection plan and the program. That was done.

That program has been incorporated into the FSAR supplement. So, in that sense it will be an ongoing commitment. It's now part of the FSAR that's

described there. Any changes to that will be done under 5059. So, in essence, that's how that will be controlled going forward.

MR. TURK: Your Honor, this is Sherwin Turk.

CHAIRMAN McDADE:: Yes, Mr. Turk.

MR. TURK: Just as a point of information if we're looking at the SER supplement Number 2 where there is a list of the commitments and the status as of the time of the --

CHAIRMAN McDADE: Yes.

MR. TURK: -- SER 2 issuance, you'll note that there's a date of December 15 -- or December 12, 2015, for IP3. That's the date that the Unit would -- the original license would expire and that would then be going into the period of time to renewal until a decision is made by the NRC as to whether license renewal should be issued.

There were some recent correspondence from Entergy that it might be worthwhile to note at this point. Entergy, as you know, for Unit 2 sent in a status report before Unit 2 entered the period of time to renewal. And at that time they indicated that the license commitments had been implemented for Unit 2.

There was also recent correspondence

regarding Unit 3. It may be that it's important for the witnesses to explain to you what has happened with regard to Unit 3 so that you understand the status currently.

CHAIRMAN McDADE: Okay. Thank you, Mr. Turk.

Are you prepared to do that, Dr. Hiser, or --

MR. TURK: Or perhaps the Entergy witnesses could address that, Your Honor.

MR. STROSNIDER: this is Jack Strosnider for Entergy and I'm familiar with some of what's been referred to. And I don't know that these are exhibits on the docket, but in the case of Unit 2 as an example what Entergy committed to do, two things.

One was to submit a letter to NRC confirming complete implementation of Unit 2 license renewal commitments required to be implemented prior to entering the period of extended operation. And the date for that to be completed was August 2013.

The second commitment was to modify the Unit 2 updated Final Safety Analysis Report, incorporate Unit 2 materials set forth in Appendix A of the application, and develop a new appendix into the Unit 2 FSAR, as well as updating correspondence

sections of the UFSAR with new or modified information programs and transmit a letter to NRC confirming that that had been completed. The completion date that was established for that was September 28, 2013.

So, essentially this would confirm completion of the commitments that were to be completed before entering the period of extended operation and to put into the updated FSAR those commitments that will be ongoing throughout that period of extended operation, which, as was noted, would put them under the control of 5059.

That's in an August 19, 2013 letter to -- actually, this is to Entergy from the NRC, but I think what was being referred to is that's the general philosophy of how this -- how these commitments are managed in terms of being completed before entering the period and what needs to be continued during the period of operation -- extended operation.

MR. COX: This is Alan Cox again. That's correct and that was a description of what was agreed upon for IP2. Similar actions are being done for IP3 prior to their PEO, which begins in December.

CHAIRMAN McDADE: Okay. Thank you, Mr. Cox. Let me move on to Entergy. Can you explain what peak editing under the WESTEMS system is, and explain

why and how it is done, you know, perhaps specifically addressing with regard to the pressure spray nozzle evaluation for IP2?

MR. GRAY: This is Mark Gray for Entergy. This is a technique that is employed in the analysis. It basically when you do a fatigue analysis whether it be with a computer program or manually, you have to select the maximum and minimum stress states to form your stress cycle pairs as dictated by the ASME code in MB 3222.4(e)(5).

The way that you do that has developed over the years. Different analysts use different techniques. In the computer program that was used, the program does an automated accounting for those peaks and valleys, maxima and minima.

When it does that, there are two different quantities of stress that are -- that have to be employed because of their effect on the elastic plastic penalty factor, as well as the total stresses in the analysis.

So, the program since it's an automated approach, is developed as a tool for the engineer to use. And in that regard, it will select more -- it can potentially select more peaks and valleys than are really needed for the evaluation.

In the practical application of the program when those peaks and valleys are reviewed, the analyst can then, if needed, identify those times that are redundant with others.

Typical example. If the analyst defines his transient for a heat-up, it goes from a stress-free condition to some stress state at the end of the transient. For a cool-down, you do just the opposite.

So, the end of the heat-up, a stress state, is the same as the beginning of the cool-down. Well, the program doesn't know that those are really the same state. It will select them both.

So, the analyst has the option of leaving that conservatism in there and having more fatigue pairs than really required and leaving that conservatism and still have an acceptable answer, or the analyst has the option to do a re-analysis with those results eliminating the redundant stress states. This is what we call peak editing. So, he removed those states, re-analyzes and documents the final result.

CHAIRMAN McDADE: Okay. In your pre-file testimony, Dr. Lahey and Dr. Hopenfeld, you both address the issue of peak editing and had criticisms of it. In light of what Mr. Gray has just said, let

me ask Dr. Lahey first, then Dr. Hopenfeld, Can you explain any continued concerns you have with the use of peak editing?

DR. LAHEY: Your Honor, I don't recall having expressed any concern about peak editing. I understand the process. I think if it's done by experienced analysts, there's nothing wrong with it.

CHAIRMAN McDADE: Okay. Dr. Hopenfeld.

DR. HOPENFELD: I feel the same, except one thing I do not understand, it was mentioned you see the Fen if you look at the data, shows that increases with the strain decreasing and it's a substantial change. So, what it says is really that during transients, the length of the transients, the strain may decrease.

Now, it's not clear how that was accounted or I couldn't tell without really going just from the description was provided. Maybe it was okay, maybe not, but I have no problem.

This is a standard procedure, and I mentioned before the pagoda or the raindrop procedure of how to put these things together and how to identify and count the transients. That aspect of it I'm not worried.

I do -- there is a lot of judgement in

there. And what I do worry about in some of the expression I heard yesterday about that these things are in the code, about the Fen and so forth, that there -- if they rationalize that everything is in the code, it doesn't -- they can come up with any number.

I have no way of -- to determine what their uncertainties were, but the main thing is that I was concerned is, oh, I didn't understand how do they treat the effect of the Fen being increased with strain decreased.

CHAIRMAN McDADE: Okay. Thank you, Dr. Hopenfeld.

JUDGE WARDWELL: Just to make sure I understand this also, Dr. Lahey, do you agree that the term "peak editing" and "user intervention" are the same in this particular -- certainly in regards to Commitment -- I believe it's 44.

DR. LAHEY: It's my understanding, Your Honor, that the US NRC when they refer to user intervention, they're talking specifically about peak editing. When I use that term, it's more general.

It has to do with the injuring judgments and other things the analysts can do to the code.

JUDGE WARDWELL: Okay. Thank you. And, Entergy, is that your understanding also in regards to

that for -- in regards to Commitment 44, the user intervention, if that term is seen as the same as peak editing?

MR. AZEVEDO: This is Nelson Azevedo, for Entergy. That's correct, Your Honor.

JUDGE WARDWELL: Thank you.

CHAIRMAN McDADE: With regard to Commitment 41 for the steam generators, there's an option either to redefine the pressure boundary, or to inspect the tube-to-tubesheet welds.

There was a process for License Amendment 277 that has been completed. And with regard to the other unit, it has not been.

Can you explain briefly the sort of theoretical justification for taking the tube-to-tubesheet welds out of the definition of reactor boundary, pressure boundary, Entergy?

MR. DOLANSKY: This is Bob Dolansky with Entergy. First, just to clarify, that option is in Commitment 42, not 41.

CHAIRMAN McDADE: I'm sorry.

MR. DOLANSKY: So, that's called H star analysis. So, when we talk about the H star analysis, what that does is that takes the -- in very high level -- I'll just give a high-level overview. You have the

tubesheet which is approximately 22 inches thick. And the tubes are inserted into the tubesheet.

They're rolled into the tubesheet, which means they're pressed up against the hole in the tubesheet. So, there's an interference fit. When it's manufactured, a little piece of the tube is left at the bottom of the tubesheet. That piece of tube is then welded to the tubesheet on the primary side. That makes the tube-to-tubesheet weld.

So, what H star does is it takes -- it does an analysis that shows that the -- under all accident-required conditions under current licensing basis loads and so forth, that no matter what happens seismic, you know, LOCA loads, shock loads, whatever you want to call it, that the tubes would not pull out even if that weld were not there.

So, by doing that, they determine how much of that tube you need inside the tubesheet to withstand all the required forces. And that's called your H star distance.

So, at IP2 we got the H star analysis done. And that basically determined using round numbers, approximately 19 inches from the top of the secondary side of the tubesheet, you go down 19 inches, which leaves approximately three inches on the

bottom, but you don't need that to maintain your pressure boundary.

So, we redefined the pressure boundary from the weld at -- on the primary side to approximately three inches up inside the tubesheet.

MR. AZEVEDO: Your Honor, this is Nelson Azevedo. Let me just add a little bit to what Mr. Dolansky just said.

In addition to the structural component to make sure the tube stays in place, the interference fit between the tube and the tubesheet hole also make sure that the leakage, if there is any leakage, is within acceptable limits. So, the interference fit there's two things; leakage, and provide the structural integrity for the tube.

MR. DOLANSKY: Right. And thank you, Nelson. This is Bob Dolansky again with Entergy. So, effectively what we've done is we've said that the bottom three inches of the tube could go away, could totally be gone and we would meet for both leakage and structural, we would meet all requirements under all accident conditions.

CHAIRMAN McDADE: Okay. Now, with regard to Indian Point 2 in September of 2014, there was a license amendment that was granted by the NRC.

What is the current status with regard to Indian Point 3? You had the two options. One was to redefine the boundary. The other was to inspect the tube-to-tubesheet welds.

What's the current status?

MR. DOLANSKY: This is Bob Dolansky with Entergy. Commitment 42 is very, very specific. It was written in a very specific and clear way. So, under Option 1 analysis, IPEC will perform an analytical evaluation of the tube-to-tubesheet welds in order to establish a technical basis for either determining that the tubesheet cladding and welds are not susceptible to PWSCC, or redefining the pressure boundary in which the tube-to-tubesheet weld is no longer included and, therefore, is not required for the reactor coolant pressure boundary function.

So, that second part is what we did for Unit 2. And the last sentence, the redefinition of the reactor coolant pressure boundary must be approved by the NRC is a license amendment request, that's what we did with H star. We basically submitted that as a license amendment request. The staff reviewed it and approved it.

For IP3, our plan -- the plan for IP3 is to do the first part of Option 1, which is to

establish a technical basis for determining that the tubesheet cladding and welds are not susceptible to PWSCC. So, that -- when we do that, that would not require the -- we don't have -- that would not be a license amendment request.

So, we would plan to do -- to determine that the tubesheet cladding welds at IP3 are not susceptible to PWSCC, and that's how we plan to address it for Unit 3.

CHAIRMAN McDADE: Okay, but the license amendment is not in effect for Unit 3 at this time. And the question is, at this time, you're indicating that you are required to and will pursue the technical justification for Option 1.

Where do we have reasonable assurance in the IP3 license renewal application at this time that we will -- that the tubesheet welds will continue to maintain their intended function?

We don't have the license amendment and we don't have the technical analysis completed at this time. So, if we're looking just at the IP3 application for license renewal, where does the reasonable assurance come from?

MR. DOLANSKY: This is Bob Dolansky with Entergy. I believe our steam generator program

provides the reasonable assurance that the steam generators are maintained in a manner that they can perform their required safety function.

CHAIRMAN McDADE: Okay, but we had a situation where as part of the license renewal the staff addressed questions to Entergy. And in response, Entergy suggested that they would do one of two things in order to answer the staff's concern in this regard. That they could either, as you did, apply for a license amendment establishing that this is not part of the pressure boundary and, therefore, does not present a safety issue, or provide the technical, you know, justification with regard to the tube-to-tubesheet welds.

Let me move -- Dr. Hiser, can you be of assistance on this?

DR. HISER: Yeah, I think -- this is Allen Hiser of the staff. I think if we looked at 54.29 where it requires renewed license -- and I'll try to cut out a lot of the words -- renewed license may be issued if the Commission finds that actions have been identified and have been or will be taken with respect to managing the effects of aging with the implementation of this commitment and the implementation of that commitment within the UFSAR

that then is controlled by 50.59 and through NRC inspections -- well, let me backup.

The imposition of the commitment and it being incorporated in the UFSAR is sufficient to provide the staff with reasonable assurance consistent with 54.29.

CHAIRMAN McDADE: And I guess where I'm hung up on, Dr. Hiser, is this: The concept provide technical justification, it sort of assumes that once you do the analysis, you may or may not be able to technically justify it.

If you haven't done the analysis yet, you can assume based on general knowledge that you will be able to do it. But it seems that the Agency was asking for Entergy to provide this technical justification and you haven't yet received that technical justification.

I mean, isn't it conceivable that the technical justification simply can't be provided?

DR. HISER: Well, the commitment has two pieces to it; Option 1, Option 2.

CHAIRMAN McDADE: Yes.

DR. HISER: If the applicant is unable to complete Option 1, whatever NRC approval is necessary, then Option 2 would become operative and they would be

required to do the inspection consistent with the completion date for that commitment.

So, if the analysis is not necessary right now, it would be necessary that they demonstrate that they meet Option 1, or perform the inspections that are covered by Option 2.

CHAIRMAN McDADE: Okay. So, that brings us to the next question. We have the technical, I mean, the -- there are actually multiple options. One was changing, you know, the license amendment which they did for IP3, the technical justification or the inspections. So, let's get down to the inspections themselves and whether or not the inspections are capable of providing the reasonable insurance.

Dr. Duquette, you had issues with regard to the adequacy and the nature of the inspections and can you elaborate on that?

DR. DUQUETTE: Duquette, New York State. Yes, I am very positive about wanting to see a physical inspection of what's going on in the system. Everything I've seen indicates that there aren't any analyses that are available at least at the present time, or anything in the system that would make me feel comfortable with any kind of a paper analysis that would make me feel comfortable that you couldn't

get stress corrosion cracking in the tube-to-tubesheet welds.

And so, I think the Option 2, which is the inspection, is the only one that makes any sense.

CHAIRMAN McDADE: Well, at this point, you know, one of the things that you raises is saying that there was not an adequate inspection technique. Entergy proposed to use and identify EVT1 as the inspection technique that they would use.

What criticisms do you have? Why would you think that EVT1 would not be adequate to accomplish that function?

DR. DUQUETTE: I thought I -- in my testimony, I'd have to go back and review it, but that there was no industry-accepted technique at the present time. I don't think I meant there was no adequate technique to do that inspection.

I think that there are physical methods to do the inspection. Today it's being done in other -- in foreign steam generators, to my understanding. And so, I think there are techniques that could -- that can be used.

I didn't see in anything that was presented to me where Entergy or the NRC had indicated any specific technique, except for a statement that

there are techniques that are available. I agree with that, but I would like to see what technique that they are going to use.

CHAIRMAN McDADE: Okay. Well, I believe in the testimony Entergy indicated that it would be EVT1. Am I correct there?

MR. DOLANSKY: Yes, you are correct. Our plan is to do an EVT1.

CHAIRMAN McDADE: Okay. And are you familiar with that inspection technique, Dr. Duquette?

DR. DUQUETTE: I don't think I am.

CHAIRMAN McDADE: Okay. Mr. Dolansky, Can you briefly explain? I know we had it the other day. We had some detailed discussion of EVT1, but could you just sort of briefly explain the method?

MR. DOLANSKY: Yes. EVT -- this is Bob Dolansky with Entergy. Again, just to start at the same point, in Contention 25 we went in some detail about performing an EVT1 to inspect for stress corrosion cracking.

So, I think it's -- I would say that it's understood through the industry that that's an acceptable method, but an EVT1 is a very detailed, close-up, visual examination. It uses a character card.

When you calibrate the EVT1, you have to do a character card. I believe it's 0.044-inch height with open case letters such as an O or a C or an E, not something with like a P or a Q that has a tail that would make it a little easier to see.

You have to be within a certain distance. Off the top of my head, I don't remember all the details. You have to be within a certain distance and there's a certain scan speed that you have to maintain. And it's -- basically an EVT1 is an accepted approach to look for cracking.

Does that answer the -- I think that's relatively high level. If anybody else remembers or wants to add anything --

CHAIRMAN McDADE: No, I think that should be sufficient. Based on what Mr. Dolansky just said, Dr. Duquette, it's my understanding that the purpose of the inspection is to detect cracking.

Is there any reason to believe that that method would not be sufficient to detect cracking?

DR. DUQUETTE: No, I think it would be -- it would detect cracking. And as I indicated, I think, a few minutes ago, I would feel far more comfortable with a physical inspection, which is what that technique implies and probably would work just

fine.

CHAIRMAN McDADE: Okay. Now, with regard to once -- and I shouldn't say "once," rather if cracking is detected, there is specific actions to be taken, correct?

MR. DOLANSKY: Any cracking that were detected would be put into our corrective action program, absolutely, yes.

DR. DUQUETTE: I'm sorry, I didn't hear the answer.

MR. DOLANSKY: This is Bob Dolansky with Entergy.

DR. DUQUETTE: Duquette, I didn't hear the answer to that.

MR. DOLANSKY: If any cracking were detected, it would be put into the Entergy corrective action program just like we do in Section 11 or vessel internals, you know, New York State 25.

We go out and perform inspections on an EVT1. If we found anything, it would be put into our corrective action program.

CHAIRMAN McDADE: Okay. And that -- and I believe there's reference to SPR-LR Revision 2, which is New York State 161, that the corrective actions would need to be consistent with that; am I

correct?

MR. DOLANSKY: I don't know the SPR. Could we bring that up and I could look at it? I'm not sure what --

CHAIRMAN McDADE: New York 161.

(Pause.)

MR. COX: Your Honor, this is Alan Cox for Entergy.

CHAIRMAN McDADE: Yes.

MR. COX: The Standard Review Plan for license renewal is what you've called up here. And, again, that's the NRC's guide for reviewing license renewal applications.

There are discussions in there about the corrective action program. I'm not sure if that's what you're referring to, but it is the same corrective action program that Mr. Dolansky referred to in saying that the inspection results would be entered into that program and evaluated under that program.

CHAIRMAN McDADE: And I guess my question was that that corrective action program of necessity needs to be consistent with the provisions of SPR-LR Revision 2. And specifically 8.1-6 to 8.1-7.

Dr. Hiser, is that correct?

DR. HISER: Yes, that's correct.

CHAIRMAN McDADE: Okay. Let me go on to something else. Talking about the -- we've got the tube-to-tubesheet welds. We're also talking about the divider plate.

Can you explain very briefly what the divider plate is?

MR. DOLANSKY: This is Bob Dolansky with Entergy. Can we go to the Entergy pre-file testimony? I'll give you the page.

CHAIRMAN McDADE: I believe maybe Answer 130 you discuss it briefly.

MR. DOLANSKY: Yes, sir.

MR. COX: That's Entergy 698 would be the exhibit number.

MR. DOLANSKY: We'll start on Page 81 and then go to Page 84. So, if we can pull up Page 81 --

CHAIRMAN McDADE: Yeah, I'm not looking to have you go through the entire several pages. Just very briefly what is the divider plate?

MR. DOLANSKY: Okay. Basically -- this is Bob Dolansky with Entergy. When reactor coolant comes in from the reactor, it's -- the hottest comes from the reactor, goes through the steam generator at the large U-tube -- through the tubes, which are large U-

tubes.

Comes in what's called the hot leg, the channel head, goes up through the tube. As it's going through the tube, it transfers the heat to the secondary feedwater and then it goes out the cold leg side of the steam generator.

So, hot water comes in the channel head, goes through the tube and comes out on the cold side. There's a divider plate in the middle that just keeps those two sides separate in the channel head.

CHAIRMAN McDADE: Okay. And it's not part of the coolant system pressure boundary, is it?

MR. DOLANSKY: That is correct. And, in fact, at IP3 there's a little thing called a mouse hole. There's actually a hole in the bottom of the divider plate to allow some -- when we shut down and drain, it allows water to communicate between both sides.

CHAIRMAN McDADE: And why -- what is it made out of?

MR. DOLANSKY: It's made out of --

CHAIRMAN McDADE: Is it Alloy 600 or Alloy 690 or --

MR. DOLANSKY: We have it in our testimony. I just have to find it. Give me one

moment, please, Your Honor.

CHAIRMAN McDADE: Well, let me follow. Is it a material that's particularly susceptible to cracking?

MR. DOLANSKY: Yes, it's a material that is susceptible to PWSCC. Yes, Your Honor. Bob Dolansky with Entergy.

CHAIRMAN McDADE: Okay. And what are the implications of cracking in the divider plate?

MR. DOLANSKY: Um --

CHAIRMAN McDADE: You indicated that it's not part of the pressure boundary and there actually is in it, you know, designed a hole.

If there is a crack in the divider plate, what consequence is that to the operation of the reactor -- in the steam generator, rather?

MR. AZEVEDO: Your Honor, this is Nelson Azevedo. Maybe I can start and some of my colleagues can jump in.

It depends if the crack is big enough, it could allow coolant to bypass the tubes themselves. So, the water will come in through the hot leg side and go out the cold leg side without going through the tubes.

So, if you imagine after a design basis

accident, you wouldn't be able to remove heat from the primary side. If the divider plate was gone, then the water just bypassed the tubes. So, you lose that ability.

CHAIRMAN McDADE: Okay. So, although it does not -- it is not part of the pressure boundary, it, nevertheless, plays a significant safety function.

MR. AZEVEDO: It plays a function. I'm not sure if it's a significant safety function. Again, maybe somebody can jump in.

MR. STROSNIDER: This is Jack Strosnider for Entergy. So, I don't have the reference right at hand, but the Electric Power Research Institute actually has evaluated that condition.

They postulated a large thru-wall crack in the divider plate, which would allow this communication between the hot leg -- between the hot side of the channel head and the cold side.

And they looked at that from an accident perspective and concluded that it would not -- that you could still meet all the design basis accident conditions that you could -- that you could manage those appropriately even with a large crack in that component.

CHAIRMAN McDADE: Thank you. Dr.

Hopenfeld.

DR. HOPENFELD: Yes. With regard to the plant, the plate may not play a very -- as EPRI said, it may not play a very important role. It doesn't have an important role in the design basis accident. However, there is a certain sequence of events, especially a station -- after a station -- for a station blackout.

You get into a situation that's called "high and dry." And you get into the severe accident, but I don't want to get in too far. What happens there, we depend on cooling the core by natural circulation.

If that plate is not there, which is not going to be there especially if the hole is very big or the whole thing is gone, so you would have all the coolant bypassing the tubes up and you are not going to be removing the heat from the core. So, there is a concern, but it's during severe accidents.

However, we have spent -- or Westinghouse spent huge amount of money. This is not a trivial case even though it's a severe accident, and we have spent huge amount of studying on this. And all those studies are -- rely on 1/7th scale tests that were done at Westinghouse somewhere in the '70s.

There have been I don't know how many studies and reviews over that. So, all the information we have is based on those studies where the plate was there.

Now, they remove the plate. So, what you have done something to the plate. Basically what I mean, it's being removed because it's not functioning anymore. Now, you've done something that you affect the consequence of what's going to happen during severe accidents.

Now, I don't know what the legalities are. But if I remember correctly, there are some things -- if you do something to the plant that affects the severe accident, you have to explain it. Now, what EPRI has done, it just didn't carry it far enough.

What they have done is okay for normal operation, just small break LOCAs, but it's not correct, due to a -- or a situation where you get into the natural circulation.

Mr. Strosnider knows exactly what I'm talking about, because we discussed EPRI over the years.

MR. STROSNIDER: Your Honor.

CHAIRMAN McDADE: Just before you --

MR. STROSNIDER: I'm sorry.

CHAIRMAN McDADE: Dr. Lahey.

DR. LAHEY: Richard Lahey, New York. I also reviewed the EPRI report and --

JUDGE WARDWELL: Excuse me. Is this the 2014 report I saw references to in this commitment testimony -- or really it was a statement of position by Entergy.

DR. LAHEY: I have to look back at --

MR. O'NEILL: Your Honor, this is Mr. O'Neill for Entergy. Before we delve any further into the details of the EPRI report, I think the witnesses are referring to the October 2014 EPRI report that's New York State exhibit NYSR0544A through D. I just want to remind the Board and the parties that that is a proprietary document.

JUDGE WARDWELL: And, Mr. Strosnider, is that your belief, the report you were referring to?

MR. STROSNIDER: Jack Strosnider for Entergy. Yes, I do believe that is the report.

DR. LAHEY: So, since it's proprietary, does that mean I can't discuss it or --

CHAIRMAN McDADE: Right now, I mean, as far as the details go. Discuss what your concerns are.

DR. LAHEY: All right. My concerns are

always focused on the safety significance. They did an analysis of a thru crack and came up with a flow area, which was relatively small in terms of flow bypass from one side to the other through the plate.

However, when they looked at the accident, the largest load that you could put on it, it appeared that what they did is took the high pressure on one side and atmospheric pressure on the other, which is what you would get instantaneously with a loss of coolant accident, and then concluded it could withstand that.

It was not at all clear that they did it as an impulsive load. In fact, it appears they did it as a static load. And from my previous testimony, you know, there's a huge difference between hitting something with a sledgehammer and pushing your hand against it with the same force.

So, it's not at all clear to me that they can't break out the welds and blow out the plate completely. It's a fairly thick plate. It's a couple inches thick. And so, the analysis needs to be done.

I asked about it at my testimony. The response I got back was not much. I mean, it did not clarify that issue, in my mind, but I -- the safety significance of it if you lose that plate or

significantly create a bypass between one side of the lower plenum of the steam generator and the other, you no longer can use that generator to steam off to remove energy.

So, if at the same time -- if the event which causes all this would be a seismic event, for example, and you lose offsite power and then you lose your steaming capability of a steam generator, you have a big problem. You really need the steam generators to allow for the ability of the operators to bring in water separately to cool the core.

CHAIRMAN McDADE: Okay. Is it this sort of synthesis of your opinion that it is ill-advised for Entergy to rely on the EPRI report?

DR. LAHEY: If my understanding of the EPRI report is incorrect and they have actually done a shock analysis and they have concluded based on those impulsive loads that it can withstand it, then I'm okay, but I don't see that.

I mean, we talked about the analysis yesterday, I think it was, which had to do with the shock loads on the bolts. The baffle former bolts. And those were not the biggest shock loads you can get by far, because of the way they did it.

So, it's a question what did they really

do? And even though we have raised that in our previous testimony, there has really been no response. So, as far as I'm concerned, you can't really rely on it until you know in detail what was done, what code was used, what break time was used, how strong it was. Is it the maximum strength, or not?

MR. STROSNIDER: Your Honor, Jack Strosnider for Entergy.

CHAIRMAN McDADE: Yes.

MR. STROSNIDER: Two comments that I'm comfortable I can make without getting into proprietary aspects of this. The first is with regard to Dr. Hopenfeld's discussion about severe accidents, I'll point out severe accidents are also known as beyond-design basis accidents, meaning that they are not part of the current licensing basis. They are used in probabilistic risk assessments that go beyond the current licensing basis and beyond the design basis accidents that need to be analyzed under Part 54 under license renewal. So, they're really not within the scope of this discussion.

With regard to the EPRI analysis, the one thing I would point out is that that analysis was done using the design basis loads. And I think I can say that with, you know, that's pretty well known.

And, you know, that document is available for review. And if Dr. Lahey has specific comments on the analysis, which is available for him to look at, then we would want to hear those specific comments, but, you know, big picture they analyzed the design basis accidents in that evaluation. And that's what is, you know, required under Part 54 for license renewals is to maintain that design basis. So, that's what they did all of this, Your Honor, in the interest of safety.

CHAIRMAN McDADE: Okay. Thank you. Dr. Lahey.

DR. LAHEY: Yeah, I -- certainly I did review this document. I have expressed this concern. I have gotten no feedback on what was actually done. And as you know, it -- when you say you did a design basis accident, it matters a lot what sort of technique you used for it.

If you used a code which is a large-volume standard loss of coolant accident code, you certainly do not get the kind of impulsive loads that will really occur.

If you use a separate code like the Westinghouse code we talked about yesterday and you apply the right break size and the right break opening

time, you can get that resolved.

No details were given. In fact, it looked from reading the report, like it was sort of a static load or a quasi-static load.

MR. LOTT: Your Honor, this is Randy Lott for Entergy. I believe that the study that Dr. Lahey is referring to is what's called the EPRI Phase 2 repot, which, again, I believe is Entergy 523.

I'm trying -- I'm struggling to say, I mean, I'm familiar with the report in some -- to some extent and clearly it was taken, first of all, to evaluate the purely hypothetical case of a complete severing of the weld at the top of the -- between the tubesheet and the divider plate.

There's other testimony that we filed that indicates that, A, this is a highly improbable circumstance and that we do not predict that a complete cracking of this would grow along that interface.

Then as was suggested, it was looked at what the effect of opening that gap would be on the leakage through the divider plate, and found that that was acceptable in all cases.

The people that do that study also did consider LOCA forces on the failed -- the divider

plate with the failed weld. And what they determined was that the failure itself actually made the stresses on the -- that would be afforded from the LOCA analysis when it was done, would reduce them due to a smaller Delta-P across the plate and also due to increased flexibility in the system.

So, when they looked at the analysis, they said we do not need to redo the current licensing basis analysis, because what we've already done in the current license base remains the controlling condition, the limiting condition.

So, therefore, as Dr. Lahey -- as we've just demonstrated in our previous testimony on the baffle bolts of other, we certainly understand the way that these LOCA forces are applied in these conditions. And the study simply concluded that there was no need to go through that entire process.

Again, it was just a purely hypothetical study in the first place, because we think that the failure of this weld is highly unlikely. And I'll also suggest that this is a massive structure and it's not going to simply disappear. And there's no evidence that it will simply disappear. So, there's no -- hardly any place for it to go.

MR. DOLANSKY: This is Bob --

CHAIRMAN McDADE: Okay. Thank you, Dr. Lott.

MR. STROSNIDER: Jack Strosnider from Entergy. Just to add one more --

CHAIRMAN McDADE: Before you --

MR. STROSNIDER: Sorry.

CHAIRMAN McDADE: Mr. Dolansky first.

MR. DOLANSKY: Yes. Thank you, Judge. this is Bob Dolansky with Entergy. I just want to kind of take a step back. We're starting to talk about the loads and all that stuff.

EPRI report has many, you know, contains a lot of information. To me, the really important part of the EPRI report is that they've looked at the possibility of this cracking occurring and said it can't.

This issue was originally driven from foreign operating experience. French plants had cracking. They saw the cracking. They did significant amount of work, research and destructive testing on these components after they were removed.

Additionally, EPRI did a lot of work to -- and the result of that work is that this is not a concern. The cracking is not a concern. We can, you know, go further down and discuss the, you know, the

evaluations on whether it will fail or not and all that stuff, but to me the real crux of the matter is, and what New York State 544A really talks about is that this is not a concern, because this isn't going to happen.

And what we thought was happening in France when the issue was first raised, the more research we did and the more destructive testing they actually did on some of the steam generators that had this that they took out of service and actually destructively removed the metal and did the testing, it turned out that there was no cracking going through the wall. It was just in a very shallow, cold work surface. So, to me, that's the whole issue.

And as a slight aside, I just -- Dr. Lahey says that he's concerned about safety and I understand that. And I just want to put it on the record that I'm very concerned about safety, too. I work at that plant every day.

CHAIRMAN McDADE: Okay. I think that's --

MR. DOLANSKY: I care about safety a great deal. And to imply that he's worried about it because of safety, and I'm not worried about safety, that's not the case. I care about safety as much as anybody else and I want to make sure that we do the safe thing

at the plant.

CHAIRMAN McDADE: Okay. I certainly nave not interpreted the testimony of Dr. Lahey in any way as questioning the commitment to safety on the part of Entergy as a company or on the witnesses who have presented testimony on behalf of Entergy. The question just simply is interpreting the data, whether or not the data supports the thesis that you have.

And in this regard, and I think it was clear from the record and I didn't ask a lot of questions about it, of what Entergy views as the significance of that report.

And what I wanted to just make sure I understood is why Dr. Lahey believed that reliance on that report is, in his view, not warranted, as I understand it, based on a lack of data in the report with regard to the shock loads that were present and the -- some of the methods that were used; is that correct, Dr. Lahey?

DR. LAHEY: Yeah. I, you know, all these comments are things you can see in the report. That doesn't really answer my primary concern. What I'm interested in is when they say it can survive LOCA loads.

How did they get those LOCA loads? If you

don't do it right, you can say you ran a LOCA, but the pressure difference versus time is not impulsive, you know. It's a different sort of loading of the plate. And a two-inch plate with secure welds should handle that very nice.

If you do a shock load, however, that's what remains to be done. And if -- then if the welds are weakened by stress corrosion cracking and things of this nature, that's an additional thing that needs to be studied.

I haven't seen that data. So, until I see that data, I can't be really comfortable that that's been done.

CHAIRMAN McDADE: Okay. Do you have any follow-up on this?

JUDGE WARDWELL: Not really.

MR. STROSNIDER: This is Jack Strosnider for Entergy. The one other comment I wanted to make earlier very briefly is when you talk about the hypothetical problem that Dr. Lott described in terms of the size of crack that was evaluated, that crack would be easily visible for anybody doing any kind of work in the channel head. It wouldn't require any of these advanced methods. It's a very, very large crack.

So, just to reemphasize, very unlikely it's going to happen in the first place. If a crack did form, it would be seen during inspections well before it got to the size that's been evaluated. So, I just wanted to give that practical perspective on this.

CHAIRMAN McDADE: Okay. Thank you. I'd like to move on to some issues with regard to the timing of the inspections with regard to Indian Point 2 within ten years of the PEO, with Indian Point 3 at the first refueling outage. These generators were put into service, Indian Point 2 in 2000, Indian Point 3 in 1989.

So, these steam generators will be in place for a significant period of time prior to the beginning of the period of extended operation for Indian Point 3 and already the period of extended operation for Indian Point 2.

How is it determined that these would be appropriate times for the inspection? I believe Dr. Duquette suggests that, you know, it would be good engineering practice or necessary engineering practice to have a baseline inspection prior to the start of the period of extended operation, you know.

Here, we have these occurring afterwards

and significantly into the life of the steam generators. How are these periods for inspection arrived at and what's the basis behind them?

MR. AZEVEDO: Your Honor, this is Nelson Azevedo for Entergy. Let me just start by saying that these locations, excuse me, are inspected every time we go into the primary side. That's every other refueling outage there is a visual inspection.

It's not the EVT1, it's not the detailed visual inspection that we're talking about, but they are visually inspected. So, if there were gross issues going on, those would be picked up.

As far as the EVT1 and the schedule of that inspection, that was really based on the work that the French have done and the EPRI have done that basically concluded this is not an issue, you know. These are flaws that are very shallow, have no -- essentially no structural impact, and they pose no safety significance. So, that's why that time frame was chosen.

CHAIRMAN McDADE: Mr. Cox.

MR. COX: Yeah, one other factor. This is Alan Cox for Entergy. The operating experience in the industry for this type of material under these temperatures and operating condition shows that it

takes a number of years for this to develop.

If you inspected a steam generator after 20 years of operation, just based on the industry experience with this you would not expect to see any kind of -- you would not expect that time frame to have been long enough to develop stress corrosion, cracking.

CHAIRMAN McDADE: Okay. What are the lifespans of these generators, the anticipated lifespan of the generators?

For example, Indian Point 2 went into service in 2000.

MR. AZEVEDO: This is Nelson Azevedo for Entergy. Is the, you know, for 60 years, if I understand your question correctly. These generators are anticipated to be good for the remainder of the life of the plant.

CHAIRMAN McDADE: Okay. And for Indian Point 2 -- Three, rather, that went into service in 1989, likewise you would anticipate that that generator would be used for the full period of extended operation.

MR. AZEVEDO: That is correct, Your Honor.

MR. DOLANSKY: I'd just like to add that I'm the program owner for the steam generators. We go

into those steam generators, as Mr. -- this is Bob Dolansky for Entergy -- every other outage, effectively, every four years. And both generators -- all four generators at both units, both the tubing and the tube-to-tubesheet, you know, the channel head, and the secondary side, we do inspections on all those areas and they are all in very, very good shape. We see no problem with them reaching the end of the period of extended operation.

CHAIRMAN McDADE: Okay. The IP2 steam generator was replaced in 2000. What, if any, relevance do the reasons of why that was replaced have to what we're considering now?

MR. DOLANSKY: I think the relevance is that both the IP3 and IP2 steam generators were replaced because of the tube material that they had. The tube material was degrading. And that was mill-annealed Alloy 600. Both steam generators were significantly upgraded.

Unit 2, IP2, has thermally-treated Alloy 600, which is a very good material. And Unit 3, even though it's older, it has thermally-treated Alloy 690. And that's really -- I would say that's the best material for steam generator tubes. So, the significant upgrade in tube material after they were

replaced is the reason.

CHAIRMAN McDADE: Okay. And can you exp0lain just very briefly what is the difference between mill-annealed tubing and the thermal-treated?

MR. GORDON: Your Honor, this is Barry Gordon for Entergy. Mill-annealed was the original type of heat treatment to -- for Alloy 600. It was a wide range of temperatures and each mill essentially did it different ways and it didn't have an optimized microstructure as the thermally-treated tubes are.

Thermally-treated ones also have a subsequent heat treatment at a lower temperature that diffuses it. What you want to do in Alloy 600 is have chromium carbides on the grain boundaries. And with thermally-treated Alloy 600 has is a subsequent heat treatment at various temperatures and times that will produce a more uniform, homogenous, distribution of chromium around the grain boundary. So, it's not quite as depleted.

And the results, the testing results of the actual operating experience with this material has been outstanding, actually.

CHAIRMAN McDADE: With both the 600 TT and the 690 --

MR. GORDON: Well, 690 is --- has

absolutely a perfect record. There is no --- well, since first introduced in the field, there has been absolutely no operating experience degradation of Alloy 690 with higher chromium.

CHAIRMAN McDADE: Okay. We've had significant testimony about the experience with the French reactors and their steam generators.

Do we know what the material was that these -- that experienced the observable cracking there? Was it mill-annealed, or was it the 600 or 690 TT?

MR. GORDON: It was mill-annealed Alloy 600 by and large.

DR. DUQUETTE: Duquette, New York. Just to clarify the record a little bit, I'm not sure if there's some confusion here, perhaps not, but the divider plate, which is where the cracking has been observed, is, as far as I know, always mill-annealed 600 in both the French reactors and the reactors at Indian Point.

690 versus 600 is the tube material. And I don't think at the present time the tube material except when we talked about the tube-to-tubesheet welds, I don't think the tube material is an issue right at the moment.

And so, if we back off to what the divider plate cracking is and what the French experience is, that was an Alloy 600, not 690. To my knowledge, the French haven't seen any cracking in their 690 either. And so, those are two different issues.

I don't know if it's appropriate now or not if the Board wants to entertain it, but there were several comments by Entergy about the French experience that perhaps this is the time to share and --

CHAIRMAN McDADE: Well, let me just ask one thing before we get to that, Dr. Duquette.

DR. DUQUETTE: Of course.

CHAIRMAN McDADE: And in the testimony that was provided by Entergy when you discuss the divider plates, you indicated that they were made of Alloy 600 both at -- and I believe both at the IP2 and IP3; is that correct?

MR. DOLANSKY: Yes.

CHAIRMAN McDADE: And was this the 600 TT, or the mill-annealed 600; do you know? I don't believe it's specified in the testimony.

MR. GORDON: This is Barry Gordon from Entergy. I would assume it's -- I think they assume it's the mill-annealed Alloy 600. The more

susceptible material.

CHAIRMAN McDADE: Okay.

MR. DOLANSKY: To go to what Dr. Duquette said really when we're talking about mill-annealed and thermally-treated, we're talking about the tubes, not so much the divider plates. And the tube -- what -- the tube material really comes into the discussion when we're talking about the tube-to-tubesheet weld.

CHAIRMAN McDADE: Okay. Thank you. Dr. Duquette.

DR. DUQUETTE: I think I agree with that. I think that's what I said. Until we --

CHAIRMAN McDADE: Okay. Dr. Duquette --

DR. DUQUETTE: -- talk about the tube-to-tubesheet weld --

CHAIRMAN McDADE: Excuse me. Dr. Duquette --

DR. DUQUETTE: -- the tubes are not --

CHAIRMAN McDADE: Okay. When you're talking, you're talking to us. We're not having the witnesses talk back and forth to each other. It's sort of, you know, in follow-up we'll talk to the other potential witnesses.

DR. DUQUETTE: I apologize.

CHAIRMAN McDADE: Anyway, Dr. Duquette,

you thought that you wanted to raise with regard to the French experience that you felt is relevant that we should --

DR. DUQUETTE: Well, the French experience --

CHAIRMAN McDADE: -- take into consideration?

DR. DUQUETTE: -- is brought up as a trivial problem. Number one, I have done a lot of other consulting in other kinds of plants. If I saw cracks of that nature in almost any component in any plant that I inspected, I would certainly be concerned.

But in the French experience, they noted, and I think they were correct, that the cracking took place in the cold work -- in the thin cold work skin that was on their divider plates.

CHAIRMAN McDADE: And actually I wanted to get into that. Before we go further, can you explain what cold warping is --

DR. DUQUETTE: Oh, surely.

CHAIRMAN McDADE: -- and why it's significant?

DR. DUQUETTE: If you roll a plate, for example, at room temperature or near room temperature,

it's called cold rolling. And so, there are two -- there are several ways to process materials.

There's hot rolling, which would mean that you would roll it at relatively hot -- high temperatures. And cold rolling usually means at near room temperature you process the material. It could be wire drawing, it could be cold rolling to make plate.

There are lots of ways to cold roll materials. And so, cold rolling usually strengthens the material. And when you do that, you usually loose some ductility in the material.

CHAIRMAN McDADE: Okay. And am I correct that the -- in the French experience, the only observed cracking was in cold rolled material?

DR. DUQUETTE: The French plates seemed to have been preferentially cold rolled. That is they had more cold rolling in the surfaces than they did in the body of the material. And that can happen if you do a light amount of cold rolling or grinding on the surface, something that deforms the surface preferentially.

Many plates are cold rolled heavily. The automobile you're driving, for example, will have been cold rolled right through the entire steel that's in

it so that the entire steel has the same properties.

And so, cold rolling -- surface cold rolling, which is what the French reported, could have come from grinding, it could have come from machining the plate, it could have come from doing a light cold roll at the end of the process for making the plate, but the experience is that cold rolling decreases the immune -- I won't say immunity. It increases susceptibility to primary water stress corrosion cracking. That's well established.

And the problem with Indian Point is we have no idea what the condition of those plates are whether they're heavily cold rolled, or lightly cold rolled, or completely annealed or cold rolled at all. We just don't know anything about them, as far as I know, or at least we haven't seen any evidence from the original manufacturer having supplied them as to what their condition is.

Under the worst of cases, the last pass that they were -- when they were made into plate, they were heavily cold rolled, and it's quite possible that they're cold rolled from the surface right through the body of the plate. That's not unusual for lots of cold rolling operations. In fact, it's quite commonly done to get uniform properties across plate.

I would like to be able to say that the Indian Point situation has no cold rolling at all or that it's only a skin effect as the French saw, but we don't have any evidence of that yet. And until we look, we don't really know whether it's cracking or not and whether or not it's cold rolled or not.

And so, my argument would be that in the absence of knowledge we have to assume -- we don't have to assume, but I'm going to assume that there's a possibility that the plate that was provided by the manufacturer of the plate and put in place was heavily cold rolled. I have no way of knowing that it is not.

CHAIRMAN McDADE: Okay. Now, the SG tubes themselves, the 3,000 whatever tubes in each generator, are thermally treated, either 600 or 690 thermally treated. That would suggest that there's no cold rolling with regard to the tubes and is it your issue that this is only -- your view that this is only an issue with regard to the divider plate?

DR. DUQUETTE: Not quite. Again, I'm not sure what we can say about the 2014 report or the 2012 interim report that EPRI provided, but they laid out some scenarios for what I'll call destroying the pressure boundary by the cracks that form in the

divider plate progressing into the tube-to-tubesheet welds by cracking the cladding that's on the tubesheet itself.

And so, there's a path that could be followed for a stress corrosion crack that would begin in the divider plate and then progress into other parts of the steam generator eventually perhaps compromising the pressure boundary.

CHAIRMAN McDADE: Okay. And in here, the part of the pressure boundary we're talking about are the SG tubes themselves.

DR. DUQUETTE: Would be the -- pressure boundary would be compromised by a crack that would occur in the tube-to-tubesheet welds. Because once you do that, you expose the inside of the -- independent of the cold expansion of the tubes into the tubesheet once you've cracked the tube-to-tubesheet weld, you have a path for compromising the pressure boundary.

And I would argue that some discussion made earlier about allowable leaks if you broke enough of the welds in the pressure boundaries, I think you would probably exceed the ability for one tube to provide the leaking, which I think was the analysis that was done.

That is if one tube-to-tubesheet weld were compromised, then the leak would be acceptable. If 20,000 of them were compromised, I'm not so sure that would be correct, not that I'm suggesting that there would be 20,000 compromised all at the same time.

CHAIRMAN McDADE: Okay. If you could continue talking about the French experience and part of that I would also like you to address, I believe, Entergy has suggested that the lessons to be learned from the French experience are somewhat limited because you have differences with regard to the water chemistry programs, the thermal impact, the cyclical loading so that the concerns that you observed from the French experience would not be necessarily applicable to the Indian Point experience.

Have I misstated Entergy's position at all?

MR. DOLANSKY: No, Your Honor.

CHAIRMAN McDADE: Okay. Dr. Duquette.

DR. DUQUETTE: I can't disagree with that. There is certainly differences from the French experience, and I know something about that, and the US experience.

It's also a fact, and it has to be accepted, that only about 20 percent -- I believe the

number is about 20 percent of the French reactors showed cracking in the divider plates. They saw it at Chinon. They saw it at Gravelines. They saw it in a number of places, but they certainly didn't see it in all of their steam generators.

And I believe that my understanding is that they now inspected all of their steam generators. So, it's not a problem that goes through the entire French fleet. I suspect it will not be a problem throughout the entire United States fleet or anyone else's fleet, as far as that goes, but the fact of the matter is that they did see cracking, they did identify with cold work, and I know I've said this, but we have no way of knowing what the cold work situation is at Indian Point 2 or 3. And so, I think there's some concern in that area.

I would like to see regular inspections. And that doesn't mean every other month, but regular inspections to be sure that if any cracks form there aren't growing. And if they're growing, they're not growing to eventually compromise the pressure boundary.

And so, I'm not suggesting we decommission the --

CHAIRMAN McDADE: I don't know if this is

a good time for you to address it. I don't want to lose your train of thought, but --

DR. DUQUETTE: Okay.

CHAIRMAN McDADE: -- you just raised the issue of the timing of inspections. We had had the discussion earlier from Entergy, their explanation as to why the timing that they proposed, which is, you know, not until after the beginning of the period of extended operation and I believe about 22 years into the operation of IP2, and 28 years into the operation of IP3, you know.

Do you disagree with their explanation that inspecting earlier would be unnecessary because there is no basis to believe that cracking would occur that early in the operation given the nature of the materials?

DR. DUQUETTE: Well, the Indian Point 3 reactor that was put in place in 1989 has been in service for quite some time.

And so, if there are cracks -- and I don't think anyone has looked at this point, at least have not seen any evidence in that. If there are cracks in those divider plates, I think we'd like to know that. And if we do see them, I think we'd like to know; A, are they growing, or are they so large that we have to

do something about them?

And if they're growing --

CHAIRMAN McDADE: But do you disagree with the underlying premise that you would not expect -- there would be no reason to believe that cracks would be -- would either originate or propagate early in the period of operation by the steam generator?

DR. DUQUETTE: I don't have an answer to that. The problem we've had with the inspections that have been so far by the French primarily, is that it's like a snapshot in time.

They saw cracks in the reactors. They did, in some cases, come back in and look a few years later. I think the first cracks were identified in about 2007. And I think some five years later they looked again and the cracks that they had seen in 2007 had not grown in their case.

And I'm not surprised at that if it's only growing in a thin, cold warp layer, then it sort of ran out of steam in that cold warp layer.

I would certainly like to get into the 1989 unit and see if there's anything there. It's been a long period of time that it's been in place. And if there's nothing there, I certainly would feel more comfortable about the unit that was put in place

in 2000.

I don't see any -- I think Entergy has said that they have the capability of doing the inspections. Perhaps I don't know the economics of the situation, but I don't know why they wouldn't do them. I don't know why they would rely on an analytical process to eliminate the possibility when they could, in fact, look at them and indicate that they have the capability to do that. I'm not sure why the pushback on it.

CHAIRMAN McDADE: Okay. Well, let me go back. I believe Mr. Dolansky indicated that there is inspection that is done, a visual inspection at each outage that would demonstrate any gross abnormality, but what the inspections they're talking about pursuant to the license commitment has to do with the EVT1, the more detailed inspection.

And so, is the concern that you just raised not alleviated by the testimony of Mr. Dolansky as to the, you know, the sort of gross inspection on a periodic basis during refueling outages as opposed to the specific inspections, you know, identified, you know, in the license commitment, which would be, you know, not until the first outage after the start of extended operations for Indian Point 2, meaning

basically 28 years into the life of a steam generator?

DR. DUQUETTE: Surely. I certainly would feel a lot more comfortable if someone from Entergy were to stand up and say that in their visual inspections that they do on a regular basis that they look specifically for cracks in the divider plate.

If they tell me that they've done that, have looked and have been very judicious about it knowing that they might be there, I might feel better about having to do a more detailed inspection.

I haven't heard that and I certainly haven't seen it in their written testimony or anything that was provided to me before this. So, to my knowledge, the visual inspection that they do in that area isn't looking specifically at the -- at least as far as I know, isn't looking specifically for the possibility of small, initiated cracks in the divider plate near the weld area.

I don't know if you would like Entergy to comment on that or not, but I'm not sure the visual inspection would see it unless you had someone who was qualified to look for the kind of cracking that we're talking about.

CHAIRMAN McDADE: Mr. Dolansky, do you wish to comment on that?

MR. DOLANSKY: This is Bob Dolansky with Entergy. We have not done an EVT1 on the divider plate looking specifically for cracking. Our position is that if there were -- the size of the flaw to become structurally significant would be very large.

The examinations -- the visual inspections that we do are general visual inspections of the entire bowl area, including the divider plate. And when we perform those inspections if there were gross, you know, large flaws, gross abnormalities, they would be seen.

Additionally, if there were cracking that got through to a low alloy steel, that got through the cladding, we would expect to see evidence of that in the form of rust color or something like that. And that would definitely be seen in the general inspections that are performed every time we go into the steam generator bowls.

CHAIRMAN McDADE: Okay. Thank you. Dr. Duquette.

DR. DUQUETTE: Dr. Duquette, New York State. I think I understood that answer to mean unless it's a gross defect, it either wouldn't be picked up or wouldn't be recorded or no one would be very concerned about it.

Stress corrosion cracks start small and they can grow fairly rapidly in Alloy 600 if they haven't breached the cladding on the tubesheet yet. And I think the comment was if they had breached the cladding on the tubesheet, they would have seen some corrosion from the tubesheet through the crack in the cladding.

That certainly makes me feel better about where we are, but it doesn't tell me anything about whether there are cracks in the divider plate now, how big they are, where they're going or whether they would have started into the cladding on the tubesheet without actually having reached the carbon steel underneath.

My concern about stress corrosion cracks is they're not a single -- they don't just occur and they're there and they break something or don't break something. They grow as a function of time, and small ones will grow into big ones if they're growing at all.

And so, my concern would be that if there's a small crack now that can be seen, I certainly would like to know that. And I certainly would like to know what its direction is going to be. And I'm sure we'll talk about this later, but I'd like

to know what's going to be done about it if one is identified.

I think I heard this morning that if one is identified, it will go through some standard remediation process without defining what that remediation process is. So, that's another area of concern if you do find cracking.

I don't understand why as an engineer, I don't understand why having seen cracking in similar structures, a significant number of them, that they -- there wouldn't be some concern about at least identifying them and finding out if they're going to be a problem.

I certainly think an examination of both steam generators at this point to allay the problem, put it aside and say we don't see any cracking at all, I certainly would then feel better about delaying a second inspection. But to have the first inspection well into the relicensing period seems, to me, to be -- I just don't think it's good engineering practice if you know that the component, it has shown cracking.

And, again, it's not a single steam generator in France. It was -- I think it was 18 or 20 percent of the steam generators showed cracking in them. They explained the cracking, they indicated why

they didn't see any expansion of it, but, again, we don't know what the condition of the divider plate is at Indian Point in either one of the steam generators.

I just would feel better if we had a baseline or a thorough examination of that area had been taken. If no one had ever seen a crack in a divider plate anywhere in the world, I'd say probably they're proceeding as they should be. But there are just too many of them in steam generators where the -- we don't know what the condition is in our case.

And I'm not suggesting we cut samples out of a divider plate. I just think there should be a thorough inspection of the divider plate and should be a thorough and visual -- not just a visual inspection, but one at some magnification to see if the cracking is there. It's a comfort level, perhaps, more than anything else.

I don't think we're near disaster in any of them, or we probably would have seen it somewhere else in the US fleet, but I think it's just good engineering practice.

CHAIRMAN McDADE: Okay. I believe you testified that the rate of propagation of such cracks could be rather rapid. And I try to just sort of focus on what "rather rapid" means.

You've heard the testimony from Mr. Dolansky with regard to what the inspections are at each outage. What is the period between outages?

MR. DOLANSKY: 24 months.

CHAIRMAN McDADE: Thank you, Mr. Dolansky. 24 months. So, these --

MR. DOLANSKY: This is Bob Dolansky. Let me just clarify. We go into the steam generators typically every two cycles. So, we would go into the steam generator bowl area roughly every 48 months, every four years.

CHAIRMAN McDADE: Okay. Thank you.

DR. DUQUETTE: Everyone in the stress corrosion cracking field talks about rapid crack growth. For us, that can be a fairly slow crack growth compared to what most people might look at.

We do know, for example, that the history of problems in the PWRs due to stress corrosion cracking hadn't been identified in -- I believe the first numbers that were reported were probably 10 or 12 years after the steam generators were put in place with the mill-annealed tubes.

And Mr. Gordon has a very nice table which I can show if you wish to, but I think it's included in the testimony I provided, indicating the number of

problems that have occurred with stress corrosion cracking in various components in the steam generators. Some weren't identified until the 1990s and the steam generators had been in place for a very long time.

The whole steam generator issue for those of us who have done stress corrosion cracking for -- I've done work for EPRI, for example, on stress corrosion cracking in some of their alloys. They take a long time in terms of numbers of years.

We do know, however, that once they initiate, they grow exponentially. Not a very high exponent, but they -- the rate of acceleration increases with time. So, they can take a very long time to initiate. They will also be slow to propagate initially. And as they get larger, will propagate faster.

So, I think if we saw no cracking whatsoever in a reasonably recent inspection of the steam generator divider plates and we saw no cracking at all, again, I would feel more comfortable with what we're seeing, but we don't know. We don't know what's there at all.

I'm not going to suggest that the cracks will grow over days or over months. It's certainly

going to be over years. But if we do see some, I think the first thing one would want to do is come back in a few years and see what the growth rate has been hoping that they haven't grown catastrophically.

If we came back for a second inspection and saw no growth whatsoever or no new cracks, you probably want to stop right there. You probably wouldn't have to go beyond that point.

But I think -- there's an old German saying that one data point is worse than no data points. And I think that's probably true in this case. I think I'd like to see what's happening as a function of time.

Maybe get a baseline in the next year or two. Five years from now come back in and look at it again and see where we are.

CHAIRMAN McDADE: Okay. What we're trying to determine is whether or not the proposed inspection schedule provides reasonable assurance. And what we have from Mr. Dolansky is that this is looked at in a -- perhaps not the right word, but gross fashion on at least a 48-month. And that they then have this detailed inspection scheduled for Indian Point 3, the 1989 reactor, I believe it will be in 2017. That they suggest that given the rate of propagation of these

cracks in order for a crack to pose any issue, it would be identifiable in these periodic inspections and that you would be able to identify even a much smaller crack in the inspection that they propose for IP3 in 2017. And that given the rate of propagation, you would not expect a crack to cause any problem in the interim period.

Do you disagree with that? And if so, why?

DR. DUQUETTE: I'm very comfortable with the -- if they do a detailed crack analysis in 2017, I'm very comfortable with that. And I would like to see a second inspection at some time in the future.

Again, the testimony I think I've heard is there is a visual inspection of the bowl area. I think when I asked specifically if anything was done to look specifically at the divider plate, I'm not sure that I understood the answer, but I don't think anyone has looked specifically at the place where the French had observed cracking.

And if you look at the reports that are both public and in the EPRI reports, the cracks that were observed in the French reactors initially had to be looked at in something more than a visual manner. They're pretty small.

Now, when they looked at the crack itself, there were fairly large cracks from a microscopic point of view. And there's some beautiful pictures that they produced, but visually they would have been very difficult to see without some other indication.

And so, the 2017 period, I think it's a great period. I'd like to see them both done in 2017. I think the earlier we identify no problem would make everyone -- would certainly make me more comfortable about the possibility of the cracks growing up into the cladding and possibly to the tube-to-tubesheet welds where they would possibly compromise the pressure boundary.

CHAIRMAN McDADE: Okay. Are there any provisions for follow-up inspections under the licensing commitment? In other words, if we have the inspection in 2017 as far as EVT1, is that going to be repeated?

MR. AZEVEDO: Your Honor, this is Nelson Azevedo for Entergy. That depends on what we find. If we find --

CHAIRMAN McDADE: Assuming you find no cracks in 2017 given the license commitment, there's no provision for follow-up inspection.

MR. AZEVEDO: There are currently no plans

to go back if we find nothing. That's correct.

CHAIRMAN McDADE: Okay. And can you explain the justification for that?

MR. DOLANSKY: This is Bob Dolansky with Entergy. Again, to me the justification would be the French experience. I mean, the fact that the French saw cracking, they didn't actually do anything about it. They left it in service.

Then they removed steam generators from service for other reasons, did destructive testing. Turned out that the cracking was non-consequential. So, if we go out and inspect and see nothing, I would see no reason why we would need to go out again.

There's nothing that would drive me to feel that that's required or necessary, to be honest.

CHAIRMAN McDADE: Okay. But the inspection you would be doing -- and let's focus just on Indian Point 3 right now -- would be approximately 28 years into the life of that steam generator, correct?

MR. DOLANSKY: Correct. 1989 to 2017, yes.

CHAIRMAN McDADE: Okay. And is it your position that if there was given the EVT1 inspection in 2017, 27 or so years into the life of that, you

would have no reason to expect that there would then be cracking in -- during the continued -- cracking of any significance during the continued operation of that steam generator during the period of extended operation?

MR. DOLANSKY: That is correct, Your Honor.

CHAIRMAN McDADE: Okay. Dr. Duquette, do you --

MR. COX: This is Alan Cox. Let me add one thing to that. Mr. Dolansky indicated that we share Dr. Lahey's concern for safety. And one aspect of that is the safety of the people at the plant that are doing the work.

So, we've got an EPRI report that says that the investigation concluded that a crack running the full length and depth of the weld is not a safety concern, you know. So, I think the decision that we'd have to make at the plant is, do we want to spend the dose, I mean, if you do this inspection, you're putting people at some risk by the radiation exposure they're going to incur during the inspection. And if you've got a situation where there is no safety concern, it's hard to justify from a management safety perspective why you would subject people to that

additional dose to go do that inspection. That's another consideration that would come into play in making the decision.

In the 2017, that is the -- that's the next available opportunity for doing an inspection. The unit -- that's the next outage, next refueling outage that will come up on IP3.

MR. STROSNIDER: And this is Jack Strosnider for Entergy and I just want to expand briefly on what Mr. Cox just said with regard to the -- we had some discussion earlier about this very large flaw that was demonstrated in the EPRI analysis did not impact the safety analysis.

You don't need to do an enhanced visual examination to see a flaw that size. Examinations that they're doing every 48 months when they go in and they look, you would see that kind of a flaw long before it got that big. So, you don't have to rely on the enhanced visual to maintain safety.

MR. AZEVEDO: Your Honor, this is Nelson Azevedo. May I add one additional point? The reason why this issue even came up was because of operating experience. In this case, overseas.

We will continue to monitor operating experience so if things were to change in the future,

it would -- we evaluate that and determine whether it would be appropriate to go back and do inspections. So, I just wanted to point that out.

CHAIRMAN McDADE: Okay. Thank you. Dr. Duquette, do you see a need for continued inspections after, for example, IP3 after the 2017? And at what period and why?

DR. DUQUETTE: I have to back off on the safety issue as far as the personnel are concerned and what they can do. I think if you're going to do an inspection in 2017, that team will have had experience on how to do it and what they're doing.

And if I'm only suggesting one more inspection, say, five or eight years later, I don't think that the total dose that that team is going to see is going to be very much more. And so, I think I'm having a problem wrapping my arms around the fact that this is a safety issue for the people who are doing the inspection, because you're going to be doing one in 2017 anyway.

Looking at some more steam generators, I don't think it's going to expose people to that, but that's not my area of expertise. And so, I'll have to back away from there.

But the fact of the matter is the French

experience is brought up both by me and by Entergy and Entergy is absolutely correct. The French explained why their cracking stopped where it did. I know I've said this, and I don't want to be too repetitious, but we don't know what the condition of the divider plates are or the welds or anything else in the machines that we have now.

In addition to that when they talk about not being able to see a small flaw, I'm not sure how much experience the people who are testifying have on identifying cracks in Alloy 600, but one comment that came up is correct.

If you penetrate through the cladding on the tubesheet and you begin to corrode the carbon steel underneath, you'll see that, but fine cracks in welds are really, really difficult to see visually.

So, if you get a crack on a weld or in a heat-affected zone, you're not going to see it visually unless you do something more than that in most situations especially in the welds. They're just very difficult to identify unless you've got really experienced people and somewhat of a more advanced technique.

So, I don't think that 48-month visual inspections are going to detect very much unless

they've got -- and they're right -- a massive crack. But the -- when they -- when it was said just a few minutes ago that the EPRI report indicated there was no problem, that isn't quite true.

The EPRI report laid out several scenarios. They did indicate that they probably were not likely, but they -- it was a thorough enough report, I was very impressed with it, to point out that there is a scenario for a crack, for example, to progress up into the Alloy 600 cladding on the tubesheet, progress across that cladding and then intersect at least one or more of the tube-to-tubesheet welds. And if that happens, you have the risk of compromising the pressure boundary. It's as simple as that.

And I would argue that there's no way that a team that's looking at it visually is going to see the fine cracks that I have seen in stress corrosion cracking situations without doing something more than that.

I've analyzed thousands of cracks in my career and typically I have to use some technique other than just looking at it unless it's such a massive crack that I can drive a truck through it.

CHAIRMAN McDADE: Well, perhaps not to

drive a truck through it, but as I understand the position of Entergy is that well before the time that these cracks would become an issue, they would be observable through their periodic inspections. And that these inspections, I guess, for Indian Point 3 in 2017, for Indian Point 2 probably in 2023, approximately ten years after the period of extended operation begins, that these more detailed EVT1 would be sufficient to ensure that these cracks would not, could not propagate undetected to the point where they would raise an issue as to the continued function.

Do you have a problem with that position and --

DR. DUQUETTE: As I indicated just a few seconds ago, yes, I do. My own personal experience is you can have very long cracks that are virtually invisible to the naked eye. I've seen them in paper mills, I've seen them in power plants and a number of other places where we had to do something more than just look at them to see that there were cracks present.

And so, I disagree that a visual examination in the kinds of structures you're looking at here will necessarily show you whether you have a crack that has to be dealt with. And at some point we

should talk about "dealt with" as well, but I disagree that you necessarily would not -- that you would necessarily see a crack that was close to compromising the situation.

The cracks we're talking about are growing in welds, they're growing in welded material on the tubesheets, and they're progressing if they're going to compromise the pressure boundary by breaking the pressure boundary at the tube-to-tubesheet welds, you're again looking at welded materials where cracks are very difficult to see because of the structure of the weld itself.

CHAIRMAN McDADE: Well, let me go back and showing my ignorance, perhaps, of the process, but we're talking about the divider plate and the capacity for cold working on the divider plate. We're talking about the tubes where I concede there's no cold working given the nature of the particular product.

Is cold working an issue with regard to the welds? And if not, would welds be susceptible to cracking in the same way the divider plate would be or a cold-worked piece of metal would be?

DR. DUQUETTE: Cold-worked and mill-annealed Alloy 600 will accelerate the cracking problem. But Mr. Gordon testified just a little while

ago, and he's correct, Alloy 600 that is mill-annealed is susceptible all by itself. And the weld material that you use to weld Alloy 600, which is about the same composition, is also susceptible.

Cold working will accelerate the process. You'll get earlier initiation and more rapid propagation, but that doesn't mean that you won't get propagation through welded Alloy 600 -- it's actually called Alloy 182, but you certainly will get cracking in that alloy. It just is not as rapid as it would be in a cold work material.

Cold work material, the numbers I've seen in a number of places, I think, including in the EPRI report, and they're out in the public. So, it's not anything that's secret. Cold working increases the crack propagation rate by about a factor of four, but there is a finite crack propagation rate. It's just that it goes four times -- about four times faster into material that's cold worked.

CHAIRMAN McDADE: Okay. It's after noon and I'm wondering if it may be a good time for us to break for lunch. I propose to break and come back at one o'clock.

Does that pose problems for anybody? Is that sufficient time? Does the staff need any

additional time?

MR. HARRIS: No, Your Honor.

CHAIRMAN McDADE: Entergy.

MS. SUTTON: That's fine, Your Honor.

MR. SIPOS: Your Honor, the State would request 75 minutes. An hour and 15 minutes.

CHAIRMAN McDADE: Okay. Now, I've got to -- let's see. 75, 60, okay. So, we're talking about 1:15?

MR. SIPOS: Yes.

CHAIRMAN McDADE: Okay. That's -- we'll stand in recess then until 1:15.

(Whereupon, the proceedings went off the record at 12:05 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:15 p.m.)

CHAIRMAN McDADE: Okay. Please be seated. We're ready to proceed. Mr. Sipos, it looks like you might have something before we get started.

MR. SIPOS: Yes. I just actually for clarity of the record, I think there was a couple of homework assignments for Dr. Lahey. And I just -- I thought it would be helpful for the record if I just read the exhibits and their titles so that they are all in one place for the parties and the Board as they look back at it subsequent to the hearing. Would that be --

CHAIRMAN McDADE: Yes, please.

MR. SIPOS: Okay. So, the first exhibit, I believe, is Entergy Exhibit Entergy R681. And that is WCAP-17199-P, Rev 2 November 2015.

The next one is Entergy R689. That's WCAP-12191, Rev 5. And the cover page has an October 2015 date.

Then the third one is Entergy Exhibit 727. And that is CN-PAFN-09-21, Rev 4 also with a November 2015 date. I believe those are the three documents that you have discussed with Dr. Lahey.

CHAIRMAN McDADE: Okay. Thank you, Mr.

Sipos.

Okay. The question is whether we continue on 38, or go back to Dr. Lahey. We had talked about, you know, some matters that you wanted to bring up, Dr. Lahey. Why don't we get that out of the way now before we proceed on?

DR. LAHEY: Thank you, Your Honor. The -- there's two basic things. One homework assignment or break assignment that you gave me on to look at thermal couple processing, signal processing. And the other one has to do with the discussion that we had yesterday, which was my self-imposed homework for last night because I was told that the answer to my question was in Entergy 681.

So, I -- all these documents, incidentally, I have seen before. I just don't carry numbers in my head, but they were not new documents to me. So, anyway, if you don't mind, I would just like to resolve the thing we talked about, clarify the record with the thing we talked about yesterday, which, just to remind you, we had discussed some problems with the heat transfer coefficient modeling in the WESTEMS code.

And I showed you a couple of areas in terms of thermal boundary layer effects and

nodalization where if you get non-conservative results, these are two independent things that can lead to non-conservative results.

So, I was -- as I understood the testimony of Mr. Gray, I believe it was, which maybe I didn't, but it sounded like he said that you don't really need to worry about that, because we specify the transients and we adjust the duration of them so that we get the maximum stresses.

So, and he -- and when I ask -- or when you ask on my behalf where was all this documented, I was told 681. So, when I went back last night and went through 681, there was a lot of work shown in determining the transients. Some of them are more complicated than others such as the in-surges and out-surges of the pressurizer.

And then there were other components as well, but basically it was determining what is the temperature and the flow transients and the number of the various transients, but my question had to do with the thermal hydraulic analysis of these transients which lead to the stresses.

And in the document it was very clear, and in all other documents that I've read on this subject, it's very clear that once you have the transients, you

then put them into this thermal hydraulics model that we talked about yesterday and you then determine what the stresses may be. So, it really doesn't resolve my concerns at all.

And so, my shock yesterday that I expressed, I mean, if we don't have to worry about heat transfer coefficients, what's the code for? It looks like they are indeed using the code. They break up various components into zones and pick constant heat transfer coefficients in the various zones. They don't have to be the same. And they try to pick ones that they believe are conservative.

But what I showed yesterday, these fully developed heat transfer coefficients cannot be conservative because of these two effects that I discussed. So, that's one thing I wanted to resolve and it might be I just misunderstood Mr. Gray, but it sounded pretty clear that's what they were saying.

So, that's all I have to say about that issue. And if you would like Mr. Gray to respond, we can do it, or do you want me to go on to the other --

CHAIRMAN McDADE: Why don't you go on, Dr. Lahey?

DR. LAHEY: Okay. The other issue is sort of a longstanding concern I've had and I've put it in

previous testimony that I've submitted and it never was resolved to me is, how do you handle the thermal coupled measurements? Because you heard this morning even they make some measurements and infer the fluid temperatures from this in terms of stratification or the possibility of thermal striping and various others.

And the problem is the documents that I was given to review, which I have and I had previously seen these, is Entergy 689 and 727, they use the transients, but there's no indication at all in how they are processed. And I want to just remind you as to the concern and this is something that I've got a lot of experience with.

If you have an instrument in the fluid, a thermal couple resistance temperature detector or any other thing, there's a certain amount of heat capacity in this. There's inertia in it.

So, it will measure the temperature of the fluid and at steady-state you get a very -- if it's calibrated, you get a very nice result. But during a transient when it's changing with time, there's a lag. It takes a while for the device to come up to the temperature of the fluid. Either go down, or go up depending what the fluid is doing.

And so, what you have to do, there's really two fundamental ways to treat it. One, you just write down the differential equation, which is the energy balance on the center itself, and it amounts to numerically differentiating the data. And you may know that's a noisy affair and you have to do it very carefully in order to get a reasonable answer.

The other way is to solve for the step solution or the impulse solution, which is the derivative of that, get what the stress people like to call the "Green's function" and then you convolute it by integrating -- it's called the Duhamel theorem, you integrate all these step solutions by what's going on in your signal and you get what the real temperature is, but you can't just take the temperature from the reading and use that as the temperature and nowhere do they talk about that at all.

And when I ask the question and I got a response in testimony from Entergy, I believe, it was we take care of it. We know about thermal couple lag.

I don't see anything like that and it's important.

JUDGE KENNEDY: Dr. Lahey, this is Judge Kennedy. As I understood it yesterday, they were taking peak and minimum values from the transient

data.

Does that eliminate some of the concerns about the thermal lag effect in the thermal couples?

DR. LAHEY: If you're measuring what the peak and the minimum is, you need to make the correction to know what the real peak is and what the real minimum is.

JUDGE KENNEDY: What is the effect of calibrating the thermal couple? Is that an attempt to --

DR. LAHEY: You need to --

JUDGE KENNEDY: Would that not consider that effect?

DR. LAHEY: Sir, you need to calibrate your temperature sensor for sure, but during transients it has a certain inertia. So, it's like if you take a piece of metal and drop it in boiling water, it doesn't instantly come to the temperature of the boiling water. It takes a while because of its heat capacity, mass times the specific heat to heat up.

And depending on what the temperature sensor is and how massive it is, the more the inertia is. But in any event, you just don't get the right answer unless you make corrections.

JUDGE KENNEDY: I mean, would you not get to the correct temperature? I mean, eventually it's going to reach the right temperature at some point.

DR. LAHEY: For steady-state. Yeah, if you go up and reach a steady state, you wait a while until it's all settled out, you can get a result, but there's all kinds of different transients that they're looking at. It's not just that particular one that was discussed in terms of the surge line.

JUDGE KENNEDY: Well, since my memory is failing me, maybe someone from Entergy could help us understand how the thermal couple data is used and whether it's adjusted for some of the effects that Dr. Lahey is concerned with.

MR. GRAY: This is Mark Gray for Entergy. Yes, there are -- one important aspect of understanding this is it's understood that there is a lag in the thermal couple. And it's also understood that the thermal couples were calibrated and the readings in the plant computer are used for operating the plant. So, they're pretty reliable temperature measurements, number one.

Number two, these transients don't happen in milliseconds. These transients happen in the actual plant data over minutes, in reality. The

design transients are very conservatively estimated to occur over seconds. So, the bottom line is this -- you're correct in saying that if there's any difference between where I started and where I ended, we are capturing the whole history of the transient. We're capturing that whole temperature history. So, that's not an instantaneous thing that happens.

And so we can, number one, be confident for the rate of these transients that we're getting a good reading as far as, again, what matters to stress. And what matters to stress is not the absolute temperature. What matters to stress is the change in the temperature.

And as long as we've looked at the whole excursion of the temperature range we have the Delta-T that we need. And that was -- that's Step 1, but the only thing that we discussed yesterday is the fact that that is not the temperature history that's being used in the stress analysis.

These results -- and that's what is discussed in the calc note reference that I gave you. These results are then binned according to severity so that every transient that's tracked as far as its overall Delta-T goes is not analyzed for its actual Delta-T. It's binned in a higher Delta-T.

For example, everything that's counted between a Delta-T of 320 degrees and, say, 300 -- I'm making this up, because I'm not looking at the calculation, would all be assigned a Delta-T of 320 degrees in the stress analysis. And, again, the key here is, is that the stress range is a function of the temperature change. So, these conservatisms are sufficient to account for a small lag in a thermal couple reading.

JUDGE KENNEDY: All right. Dr. Lahey, response.

DR. LAHEY: Go ahead.

JUDGE KENNEDY: No, I --

DR. LAHEY: Well, my understanding of that, I, you know, I'm filtering it down to we don't do anything. And, you know, I'm used to whole international meetings dealing with the inverse problem. There's textbooks on, you know, and the entire purpose of the textbook is how to treat the inverse problem. And I'm hearing we didn't do that, I mean, even though we're well aware of the lag.

So, if you just forget about data to benchmark your prediction and you just use some sort of prediction and then put all that through your WESTEMS code, which they're apparently doing, it's

really getting pretty far from reality. I mean, why not -- why not at some point benchmark your result?

I'm -- what I was trying to show yesterday with the nodalization is it's very unlikely that they're tracking sharp temperature change fronts. And if you're not, you're not predicting the right kind of thermal stress.

JUDGE KENNEDY: I need to do a memory check again. Dr. Lahey, I thought yesterday in this discussion of the analysis of the transients, the thermal hydraulic analysis of the transients --

DR. LAHEY: Right.

JUDGE KENNEDY: -- that you agreed that the methodology they were using to capture the transient, again, from an analysis standpoint, that that methodology was okay and that that data was then transferred into the WESTEMS code and the stress analysis performed, but I didn't hear yesterday that you had any concern with the thermal hydraulic analysis that developed the transient data.

Did I mishear you yesterday?

DR. LAHEY: All these documents are associated with specifying the transients. All right. And what I'm talking about is making measurements of the transients to verify or disprove what you're

predicting. And you need to do the inverse problem in order to do that.

JUDGE KENNEDY: I think I'm losing focus here. We started with the thermal couple data --

DR. LAHEY: Yes.

JUDGE KENNEDY: -- which, as I understood it, was your concern over their use of plant data to characterize the transient that was of interest. In that case, it was the pressurizer surge line nozzle, I guess. So, we -- it appeared we tried to address that.

This seems to be branching back to where we were under Contention 26 about thermal hydraulic methods.

DR. LAHEY: I'm trying to clarify the record on Contention 26, yes.

JUDGE KENNEDY: In regard to what, sir?

DR. LAHEY: In regard to my concern over how they measure -- on this particular question, how they measure the fluid temperature as a function in time because you heard just now, yeah, we're aware of the lag, we take care of it.

JUDGE KENNEDY: Do you have a problem with them using the peak steady-state values, both the peak and the minimum? Is that what you're saying?

DR. LAHEY: If they know for sure what the peak and the minimum is, if it's taken during a transient with no correction, I have a serious problem. If it's for a long period of time and they know for sure what it is, that seems okay.

JUDGE KENNEDY: I'm going to ask Mr. Gray to verify this, but I understood him to say they take all of the transient data under consideration during the event.

Mr. Gray, can we go back to the transient data again?

MR. GRAY: Um --

JUDGE KENNEDY: The plant data.

MR. GRAY: Okay. The plant data that we get from the plant computer, number one, just to reiterate, we can have high confidence in that data. It's calibrated for the plant to use to run the plant, number one. So, this thermal couple data isn't something that is that much in question.

Number two, if we had an infinite decimal transient that occurred in the fluid, this lag could be a concern. Transients don't happen that way in plants. And this lag will occur in thermal couple, that's true.

But as you have said, if I have the

temperature at the beginning and I have the temperature at the end and this is a transient that occurs over minutes, I will get that -- the maximum temperature change in the fluid.

That's reflected in the thermal couple data. There's nothing wrong with that. That's standard practice in interpreting the plant data. If I was trying to solve a fluids problem and I wanted very precise numbers, then I might do something more sophisticated.

We're trying to solve a stress problem and we're trying to use inputs that are comparable to the inputs that we use in our current licensing basis calculations to get stress. So, these are the temperature changes, for example, that you see at the regenerative heat exchanger outlet temperature.

These are used to run the plant. They're also sufficient for us to look at the temperature change, because it's the temperature change that influences the stress analysis.

When you do stress analysis, that's what you're concerned about. That stress range, that's a function of the change in the temperature. So, we haven't done anything abnormal or anything that's not typically done in the industry to calculate a linear

elastic stress range according to the ASME code, number one.

Number two, I think there's still a misunderstanding of how the different pieces of the program were used. And the only thing that the thermal hydraulic model was used for was to process this temperature sensor data and to characterize it into bins of maximum Delta-Ts. That's all.

After that, those cycles that were counted with those maximum Delta-Ts were applied conservatively to the stress model, which includes various zones in the model that see different temperatures. That's done with a transfer function approach to get the stress in the component.

That stress is also then a function not only of the actual temperature differences for every cycle that was noted in the history that we got from the plant data, but all of those cycles that occur over a certain Delta-T range are all assigned a Delta-T of the highest range in that bin.

This is a very conservative way to do analysis. And this gives you maximum stress ranges that, in turn, are used in the fatigue usage calculation.

JUDGE KENNEDY: All right. Thank you.

Dr. Lahey, I'll allow you to respond if you'll limit your response to --

DR. LAHEY: How long?

JUDGE KENNEDY: -- the use of thermal couple data --

DR. LAHEY: Yes, Your Honor.

JUDGE KENNEDY: -- in the manner that Mr. Gray just described.

DR. LAHEY: Sure. And the essence of the disagreement with one of his statements is we're trying to solve a stress problem, not a fluids problem, all right.

The problem is you can't decouple them. If you get your thermal hydraulics forcing function wrong, you get your stress result wrong. You just can't simply be sloppy in one and precise in the other. You have to be precise in both. So, that's the essence of the disagreement.

JUDGE KENNEDY: Does this take us back to the disagreement we had yesterday about the bulk temperature to surface temperature Delta-T, or is it more complicated than that?

DR. LAHEY: Well, one of the non-conservatisms is, in fact, how they treat their heat transfer coefficient and not including the developing

part of the thermal boundary layer and the nodalization that they use.

I mean, the data that he's talking about, the process data has lags right in it. I mean, it's not really what the transient is. If it's a very slow transient, it's not bad. If it's a very rapid transient, it's terrible.

JUDGE KENNEDY: Would you like to put a time frame on very slow and very rapid, please? What would very rapid be to you?

DR. LAHEY: In seconds.

JUDGE KENNEDY: What would very slow be then?

DR. LAHEY: Very slow. Hours, I mean, you know, things that go on for a long time. Everything reaches equilibrium. If you go through a lot of the kind of transients that give you the biggest loading, you know, from the thermal hydraulics point of view, they're fairly fast transients.

JUDGE KENNEDY: What would be an event that would operate on the seconds time frame? What sort of accident will we be talking about?

DR. LAHEY: What sort of accident, you're asking?

JUDGE KENNEDY: Is it a loss of coolant

accident? is it a reactor coolant pump trip? Is it a steam line break? Is it a --

DR. LAHEY: Well, you -- a number of things can happen fairly rapidly. Scrams happen rapidly. So do breaks, if you're interested in that, but I'm more interested here in the kind of -- they have a whole bunch of different transients that they analyze to come up with the net fatigue of a particular component.

So, if you're looking at, for example, the coarse spray line nozzle, then these events, they go on and off. Every time you're changing the pressure, you want to reduce the pressure, the spray will go on. And then if that's under control, it goes off and you go back and forth. And those are fairly rapid events.

JUDGE KENNEDY: All right. Thank you. Just one for clarification, the discussion that we just had about the thermal hydraulics calculation in, I assume, the WESTEMS code, is that the discussion that we had yesterday about the boundary layer in the front?

DR. LAHEY: Yes, sir.

JUDGE KENNEDY: So, we've taken a lot of testimony yesterday on this topic.

DR. LAHEY: But I wanted to clarify the

record, because it sounded like at the end that we were told that don't worry about all this heat transfer stuff, you know, that isn't really the way we do it. But when I look back at all the documents that they quoted, that's the way they do it. On top of it, they get in there and specify what the transients are.

JUDGE KENNEDY: I'm sorry, is there something wrong with them specifying the transients?

DR. LAHEY: No.

JUDGE KENNEDY: Oh, okay.

DR. LAHEY: You have to determine the transients. I don't have any problem with that. I have a problem with saying that takes care of the issues that I had raised. It does not.

JUDGE KENNEDY: Okay. I just want to make sure I understood what you meant. Thanks.

MR. AZEVEDO: Your Honor, this is Nelson Azevedo. May I add just one additional point?

JUDGE KENNEDY: I'll take one more, sure.

MR. AZEVEDO: The primary load for the pressurizer surge line for the pipe is the Delta-T between the top of the pipe and the bottom of the pipe.

So, even if you were to assume that these RDDs lag by, say, a few seconds, you wouldn't expect

that to have any measurable impact on the Delta-T from the top of the pipe to the bottom of the pipe. Because whatever the lag is for one, should be the same -- roughly the same for the others.

So, again, the primary load is the Delta-T between the top of the pipe and the bottom of the pipe, which introduce a bending moment, and I just don't see how this will have any measurable impact on that parameter.

JUDGE KENNEDY: All right. Thank you, Mr. Azevedo.

MR. GRAY: Your Honor, may I add one thing, too? This is Mark Gray for Entergy.

JUDGE KENNEDY: One last remark.

MR. GRAY: Okay. I think it's still very important to understand and I don't think it's fully understood how these things are being used, but the temperature load that's used in the stress analysis is not the identical temperature that's read from the plant computer data. It's more severe, it's more like a design transient, it still uses conservative heat transfer coefficients barring the other discussion, which I won't go back to.

And so, the bottom line is we are not using the actual temperature measurements in time that

are gathered from that to feed that thermal hydraulic model to load the stress analysis. That's just not true. We are using something more conservative in these Delta-T bins.

JUDGE KENNEDY: And where does that Delta-T come from?

MR. GRAY: The Delta-T is what we get by binning the read temperatures. So, it's the temperature change that's important here.

JUDGE KENNEDY: The plant data.

MR. GRAY: And it doesn't occur -- these are not scrams. These are not, you know, high-rate transients, for example, in the charging line. This is a heat exchanger.

I turn off the letdown, the charging temperature responds -- it's a heat exchanger curve. We all have seen those and it's not fast. It's relatively slow. It's not seconds even though it is then analyzed in seconds.

JUDGE KENNEDY: All right. Thank you.

CHAIRMAN McDADE: Okay. Thank you. I think that takes care of our discussion there. Getting back to 38, I've got a question, Dr. Duquette.

I don't want to get into a discussion of the steam generator AMP. That's been handled by a

joint stipulation which I should note was Entergy Exhibit 700, but there are some questions that I had.

You indicated that at Indian Point steam generators with a number of plugged tubes may be more susceptible to PWSCC than French reactors. But in the 15 years of operation, the steam generator at Indian Point had only 48 out of approximately 13,000 tubes blocked.

Why would this be of a consequence? How would this affect the susceptibility to PWSCC?

DR. DUQUETTE: It's certainly not going to affect the susceptibility of PWSCC in the divider plate. It has to do with whether or not the crack will progress to the interface between the -- well, the diluted weld, the tube-to-tubesheet weld is the area that would be affected most.

And I was not aware of those statistics. And having heard them, I probably would back away from my testimony on that issue.

CHAIRMAN McDADE: Okay. Thank you. Just to clarify in that discussion, the discussion of AVB wear and TSP wear, Entergy, could you explain to me just very briefly what AVB wear and TSP wear is?

MR. DOLANSKY: This is Bob Dolansky with Entergy. Just to make sure it's very clear, that's

Alpha Victor Bravo, AVB. And Tango Sierra Papa, TSP.

CHAIRMAN McDADE: Yes.

MR. DOLANSKY: AVB stands for anti-vibration bar. At the top of the tubes they bend over their U-tubes. So, at the top in the U-bend area they go through a final support plate. And then in the U-bend area they're not supported by a support plate. Instead they are supported by anti-vibration bars, which are inserted between the tubes to make sure that they don't vibrate too much.

TSP is tube support plate. So, as you go up from the tubesheet up the straight length of the tubes on both the hot and cold side of the steam generator, it goes through tube support plates. Those plates are placed every so often to provide support to the tubes. So, that's how the straight portion of the tube is kept from vibrating, and the AVB is how the U-tube portion of the tube is kept from vibrating.

CHAIRMAN McDADE: Okay. Thank you.

Dr. Hopenfeld.

DR. HOPENFELD: Can I make a comment with respect to just the last sentence before I forget?

CHAIRMAN McDADE: I'm sorry, Dr. Hopenfeld. You've got to move to the microphone. I couldn't hear you.

DR. HOPENFELD: Yeah. Can I make a comment with respect to the vibration that he's talking about, I believe, is under normal operating conditions. I don't believe that the AVBs there can really -- were really designed to withheld the steam line break kind of vibration that you can get.

CHAIRMAN McDADE: Okay. Thank you.

Dr. Hiser, at one point, specifically Question 141 of your testimony, NRC 161, you used the term "verification inspection." I just want to make sure I understand what you mean by the term "verification inspection."

(Pause.)

CHAIRMAN McDADE: This is on Page 81 of your pre-file testimony, Question 141 -- or Answer 141, fourth line down. You use the term "verification inspection."

And, again, it's just I want to make sure I understand is that a term of art or how exactly is that used?

DR. HISER: Actually, I believe it's Page 61.

CHAIRMAN McDADE: Page 61, yes.

DR. HISER: Okay. The verification inspection is just an inspection to verify the

effectiveness of the water chemistry program. So, it's not really a term of art. It's just the way that we laid the words out in that response.

CHAIRMAN McDADE: Okay. Thank you. Okay. Dr. Lahey, you submitted testimony that was critical of the inspection methodology acceptance criteria and corrective action criteria for divider plates.

In light of the testimony you've heard so far, is there anything you wish to say to elaborate on that testimony?

DR. LAHEY: Your Honor, I'm more concerned with the tube-to-tubesheet welds. The issue that I was concerned with is the safety issue, which we talked about before. And it has to do with the -- how the impact loads are calculated. We never get any information on that and it's very important how they do that.

CHAIRMAN McDADE: Okay. Dr. Kennedy, do you have some questions of Dr. Hopenfeld?

JUDGE KENNEDY: Yes, I have a couple questions, just loose ends that are dangling around on 38. I'm going to address the first question to Entergy, but it's really a Dr. Hopenfeld question.

In the supporting testimony for Contention 38, Dr. Hopenfeld asserts that the scope of metal

fatigue analysis should be extended into the steam generator. And I guess first I'd like to ask Entergy, is metal fatigue a concern in the steam generator components internal? I'm assuming you mean its internals. And if not, why not?

MR. AZEVEDO: This is Nelson Azevedo for Entergy. Yes, Your Honor, the steam generators were analyzed for fatigue. In fact, there are fatigue locations in our reports.

JUDGE KENNEDY: So, they were analyzed.

MR. AZEVEDO: Yes.

JUDGE KENNEDY: So, they are -- does that mean they're within the scope of the fatigue monitoring program?

MR. AZEVEDO: They are within the scope of the fatigue monitoring program. Let me just remind you, though, that the secondary side does not see primary coolant. So, the Fen issue that we've been discussing does not apply to the secondary side.

JUDGE KENNEDY: So, you wouldn't apply the Fen factor to the secondary side components.

MR. AZEVEDO: That's correct, because that's a primary water side issue.

JUDGE KENNEDY: All right. Dr. Hopenfeld, this is the extension into the steam generator, the

metal fatigue calculations.

DR. HOPENFELD: Sir, I would like to have an opportunity, also make a comment regarding the H factor because it's extremely important maybe later on, just the H factor that was just discussed a few minutes ago.

JUDGE KENNEDY: Can we close out this item and --

DR. HOPENFELD: Yeah, okay.

JUDGE KENNEDY: Do you have any additional concerns about metal fatigue in the steam generator and whether --

DR. HOPENFELD: Well --

JUDGE KENNEDY: -- it's being managed for aging?

DR. HOPENFELD: Yes, because metal fatigue has been experienced in a feed line break. It has been experienced in tubes on the top, the U-bands. And obviously those tubes sit in water. They don't sit in air. So, the same correction factor has to be applied.

The fact that the water is not radioactive is completely immaterial. What affects the ASME code does not take in effect of the environment, doesn't take effect in water.

So, that's what the NRC in 1996 or whatever came up with the recommendation or with the requirement that they include correction for the environment. Why not do it to the secondary side where this is the most important part of the plant safety wise?

Most of the accidents we have, they were initiated in the secondary side. Most of the damages that we -- or leaks that we have on the secondary side.

JUDGE KENNEDY: So, your concern -- is your concern with the need to apply Fen factors to --

DR. HOPENFELD: Absolutely.

JUDGE KENNEDY: -- the secondary side?

DR. HOPENFELD: That's my whole thing. They have to apply that. Otherwise this is not a fatigue program. This is something else, but it's not a fatigue program.

JUDGE KENNEDY: I guess --

DR. HOPENFELD: I would just want you to understand there's absolutely no reason to -- just the fact that the water is radioactive in one side and the other one isn't, that's just has nothing to do with crack propagation or leakage or anything.

JUDGE KENNEDY: Well, let's see what we

can find out here. I see the NRC in front of us. Your recommendation was to apply the Fen factors to the metal fatigue calculations.

Why are they not applied -- or should they be applied to the secondary side components?

MR. STEVENS: This is Gary Stevens of the NRC staff. Our guidance is clear that the Fen evaluations are limited to reactor coolant pressure boundary components.

JUDGE KENNEDY: So, is it the fact that the function is pressure boundary components, or the fact that they are subjected to a water environment that's on the primary side of the reactor coolant system?

MR. STEVENS: It's reactor coolant pressure boundary.

JUDGE KENNEDY: That is a pressure boundary.

MR. STEVENS: Correct.

JUDGE KENNEDY: So, in the case that Dr. Hopenfeld mentioned about the U-tube region of the steam generator tubes, would that constitute a reactor coolant system pressure boundary?

MR. STEVENS: This is Gary Stevens of the staff. I'm going to defer to one of my colleagues,

because I'm not a steam generator expert.

MR. AZEVEDO: Your Honor, may I correct something I said before? I've been corrected. The Fens have been applied to all CUFs. I misspoke before.

JUDGE KENNEDY: Both primary and secondary?

MR. AZEVEDO: That is correct.

CHAIRMAN McDADE: Thank you, Mr. Azevedo.

JUDGE KENNEDY: Let's go to Mr. Hopenfeld then. Dr. Hopenfeld.

DR. HOPENFELD: I would like to understand that. I haven't seen any Fen correction into the secondary side. Would you please provide us with some reference to it?

There are references on the primary side, but there was nothing on the secondary side. They kept repeating in the testimony, this is brand now. they kept repeating in the testimony that they're not doing the secondary side.

JUDGE KENNEDY: Let's give Mr. Azevedo a chance to respond to that.

MR. GRAY: This is Mark Gray on --

JUDGE KENNEDY: Or Mark Gray.

MR. GRAY: -- behalf of Entergy. In the

process of addressing the RAIs on the environmental fatigue, Entergy did do a screening process to determine limiting locations. And that was applied to all of the CLB locations that had a fatigue usage calculation.

So, even though I agree with Mr. Stevens that the regulation does not apply to secondary side components, because these had a CLB, Entergy also included those steam generator locations that had a CUF calculation in the screening process to determine the limiting locations for environmental fatigue.

JUDGE KENNEDY: Is there an exhibit within the testimony that --

MR. GRAY: Yes.

JUDGE KENNEDY: -- you would point to for that?

MR. GRAY: As soon as I put my glasses on. Wait a second. That's Entergy 683.

JUDGE KENNEDY: All right. Thank you. Dr. Hopenfeld --

DR. HOPENFELD: Yes.

JUDGE KENNEDY: -- did you hear the citation?

DR. HOPENFELD: I'm sorry?

JUDGE KENNEDY: Did you hear the citation

that Mr. Gray gave?

DR. HOPENFELD: No, I didn't. I heard what he said that they did the CUFs for the secondary side.

JUDGE KENNEDY: Entergy 683 is what he's referring to.

DR. HOPENFELD: I don't -- I'll have to check. I don't --

JUDGE KENNEDY: I understand.

DR. HOPENFELD: I don't have it in my mind. But what I would like to say that I brought up this issue of effect of geometry change and the stress concentration. This is more important on the secondary side, because it's all over, because it is subjected to FAC.

And those of you that were at the FAC hearing, you saw what kind of surfaces we have there, what kind of geometry changes we have there. So, I haven't seen any calculation to indicate that that was taken in account.

Now, when the plant was designed, they didn't have any geometry changes on the secondary side.

JUDGE KENNEDY: I guess I'll turn to Entergy. I thought I heard either earlier today or

yesterday in regard to stress concentration factors that geometry changes were the major consideration in the application of this concentration package.

Is that still true?

MR. AZEVEDO: Well, yeah. I think we're talking about different geometry changes, though. The geometry changes that I was talking about was going from a thin section to a thick section, for example. That's a geometry change.

I believe the geometry change that's being discussed now is changes from the way the plant was to what it is currently. So, the thicknesses changed over time perhaps as a result of phenomena like flow accelerator corrosion or some other phenomena. I believe that's what's being discussed right now.

JUDGE KENNEDY: Would that be a situation where the stress concentration factors would be applicable?

MR. AZEVEDO: Well, let me just say that the -- if we are talking about flow accelerator corrosion, which I don't know that we are, but if we are, first of all, this was discussed during the flow accelerator corrosion issue, but that is only applicable to balance-of-plant piping. And that piping was not designed to the same requirements as

the piping that we've been discussing, the components we've been discussing.

So far the fatigue calculation that we've been discussing are mandated by ASME Section 3. The balance-of-plant piping that would be susceptible to flow accelerator corrosion, that's designed to a P31.1 code, which is totally different, does not require an explicit fatigue analysis. Fatigue cycles are handled differently by stress reduction factors and that is a totally different type of analysis.

JUDGE KENNEDY: I appreciate that, Mr. Azevedo. I was presuming we were talking about metal fatigue.

Dr. Hopenfeld, were you addressing that in regard to metal fatigue?

DR. HOPENFELD: Yeah, I was addressing metal fatigue. I'll give you an example so maybe you can see where I'm coming from. Let's say just off the top of my head, let's say that the J-tube, that would be a good example, because the flow comes in there high velocity and turns around and it starts eroding around the band.

So, you have high erosion and you have very abrupt changes in the --- around the band in the surface in the thickness. These are concentration

factors that has to be taken in account.

Another affect, which I didn't know until we had the meetings last -- two years ago, that some of the components they have, have extremely huge imperfection on the surface. I think it was called dilation, but they were huge, which we were told that they accept -- they escaped the initial screening and they were in the plant.

Because when I brought up the question of that this was a result of corrosion, say, no, that's the way that we got it from the factory. We just didn't catch it in time. NRC didn't catch it either, but there wasn't one component. There were several.

Now, these are concentration factors. You have to take into account when they designed the plant, they didn't know that they had all these components with dilation to them.

JUDGE KENNEDY: Are these components within the scope of license renewal, Dr. Hopenfeld?

DR. HOPENFELD: Well, they're on the secondary side.

JUDGE KENNEDY: Are they within the scope of license renewal?

DR. HOPENFELD: I think anything that is metal fatigue, wouldn't that be a scope or a license

-- anything metal fatigue, in my mind, is a scope -- within the license renewal.

JUDGE KENNEDY: I'm not sure, but I think Entergy knows. Mr. Azevedo, let's just take the J-tubes. Would they be within the scope of license renewal for Indian Point? Do you have J-tubes?

MR. AZEVEDO: Your Honor, this is Nelson Azevedo. Yeah, we do have J-tubes. They are part of the steam generator. So, I would consider part of license renewal.

JUDGE KENNEDY: So, they're within the scope.

MR. AZEVEDO: Yes.

JUDGE KENNEDY: Do you have a response to Dr. Hopenfeld's concern about these factors?

MR. AZEVEDO: The only thing I can say is, you know, the J-tubes are part of the secondary side of the steam generators. They're managed by the steam generator program. We do, do periodic inspections. We have no indication there was any significant degradation going on. And I'm not sure what else I can say.

JUDGE KENNEDY: What sort of aging mechanisms are accounted for in the steam generator program? What sort of effects are looked for?

MR. COX: This is Alan Cox. The typical aging effect for the secondary side where you don't have to deal with the effects of radiation would be loss of material and cracking due to various mechanisms.

JUDGE KENNEDY: All right. Thank you.

DR. HOPENFELD: Can I make one comment here?

CHAIRMAN McDADE: Dr. Hopenfeld.

DR. HOPENFELD: I hear that the answer is that this is managed by a different program. Stress corrosion cracking is managed by a different program. Metal fatigue is a different program. These programs are related. They are not completely unrelated. A crack doesn't know whether it's stress corrosion was designated in one program or fatigue in another program.

The same thing, the J-tube doesn't know that they have been divided. It's a system. It's a management kind of thing that you have to look at the whole entire plant, not just in pieces here and there. That's why things falling in between the cracks.

MR. DOLANSKY: Judge Kennedy, this is Bob Dolansky.

JUDGE KENNEDY: Mr. Dolansky.

MR. DOLANSKY: Can I just state something, please?

JUDGE KENNEDY: Go ahead.

MR. DOLANSKY: Bob Dolansky for Entergy. I'm not sure about the metal fatigue part, but I can tell you like if we talk about J-tubes in the steam generators, this last outage at each steam generator we went into the secondary side of the steam generator, we performed video inspections of the inside of the J-tubes on a representative sample of the J-tubes, and we did not see any evidence of any kind of corrosion or erosion or any evidence of any cracking in the J-tubes.

JUDGE KENNEDY: Okay. Thank you.

CHAIRMAN McDADE: Dr. Lahey, you had an issue?

DR. LAHEY: Yes. While we're talking about steam generators and fatigue, New York State 000559 is a -- and Table 4.3-10, that's a part of the Indian Point license renewal application. And in this table, the -- for IP3 the CUF, it's not designated as CUFen, but it's the CUF, is 1.0 for the main feedwater nozzle.

Now, it's our understanding that when the -- when something reaches 1.0, then action has to be

taken, but we have heard nothing more about this. And so, it's not clear to us where that stands. And it's an important thing, because it can induce all kinds of other problems if it breaks.

MR. COX: This is Alan Cox for Entergy. I just want to point out that the CUF, the C-U-F, has not reach 1.0. If every transient that's counted and considered in that analysis reached its assumed value, then you would reach 1.0. You still would not have exceeded 1.0, but that -- if that was to happen at all, it would be very near the end of the PEO and we're monitoring the number of those transients to ensure that they don't exceed those numbers.

CHAIRMAN McDADE: Okay. Dr. Hopenfeld, go ahead.

DR. HOPENFELD: You have one. It's physically impossible that it's not going to be at least 10001 if we put -- if you put the correction factor.

If you look at the equation I have somewhere, the CUFen, the corrected CUF, it is multiplied by Fen, which is always more than one. So, if you look at that one, it's, you know, it's all probably two or three.

MR. AZEVEDO: Judge Kennedy, may I step in

for a second?

JUDGE KENNEDY: Please.

MR. AZEVEDO: I don't have the exhibit here in front of me, but I can tell you for the feedwater nozzles, what we did was we calculated -- the feedwater nozzles are different from the other components. What controls is the number of hours in standby where you're at aux feedwater, you have the cold feedwater going in and the hot feedwater coming out. And so, that number that you talked about gave us the allowable number of hours, which we now track.

So, that gives us the allowable number of hours that we can operate in Mode 2. So, obviously if we approach that, we will have to redo the calculation, but that's the reason why you'll see a high CUF to give us the highest number of allowable hours.

JUDGE KENNEDY: Just going back to the testimony yesterday, and I guess this -- I don' want to get into a discussion about whether it's 1.001 or -- but yesterday the testimony was that all CUFs in the plant are less than one.

I mean, I don't know if your -- I guess what I'm curious is what does that mean in the context of now in covering a component with a CUF of one, are

there others that are higher?

And I do recognize that we're not at the end of life yet, but --

MR. AZEVEDO: I, you know, the allowable is 1.0 or less. So, 1.0 would still be accepted. Again, I don't have the actual list in front of me, but I believe the feedwater nozzle is the special case.

JUDGE KENNEDY: Yeah, I guess I'm just being a little sensitive to yesterday we heard a couple of individuals quote numbers that all CUFs for Indian Point 2 and 3 are less than one. And I'm just wondering how we reconcile that with this.

MR. O'NEILL: Your Honor, this is Mr. O'Neill. Is there any way we could pull this exhibit up just so the witnesses could see it?

JUDGE KENNEDY: That's a good point. I'm sure we can.

MR. O'NEILL: I believe this, and Dr. Lahey can correct me if I'm wrong, did you say it was New York State 00559?

DR. LAHEY: Until now, what we have heard is we fight hard to -- as they get darn close to 1.0, to keep below 1.0, because 1.0 is the action point. So, this seems like 1.00.

JUDGE WARDWELL: If I understand you correctly, Mr. Azevedo, are you saying that from this table, 4.3-10, that the way you handle main feedwater nozzle is you set the cumulative use factor to one, calculate out the number of hours that it can be operated, because it is on standby a lot, and then you're tracking those hours to make sure it stays below that number of hours that is designated by the 1.0?

MR. AZEVEDO: Well, yes. The only thing I need, I need to verify is whether we in fact set it to 1.0 or some other number. I will need to verify that, but that's -- in essence, that's correct.

MR. TURK: This is Sherwin Turk. I hope I don't mess this up, but my notes indicate --

CHAIRMAN McDADE: Me too.

MR. TURK: Pardon me?

CHAIRMAN McDADE: Me too.

MR. TURK: Early in the discussion yesterday, I don't know if this is the testimony you're thinking of, but I believe it was Mr. Gray -- or, I'm sorry, Mr. Cox who said the limit is 1.0 and the recalculated number can be up to that number.

MR. SIPOS: Excuse me, Your Honor. This is John Sipos from the State of New York. I have --

I'm going to object to what Mr. Turk is doing right now.

MR. TURK: I'm reading my notes, Mr. Sipos. You can read yours.

CHAIRMAN McDADE: The objection is noted. The objection is overruled. I will allow Mr. Turk to continue.

MR. TURK: I can't speak for the witnesses, Your Honor. There may be some other testimony as well.

CHAIRMAN McDADE: What's your point, Mr. Turk, succinctly?

MR. TURK: I was trying to -- because we don't have daily transcripts here, I was trying to determine what was said actually yesterday.

CHAIRMAN McDADE: Okay. And the witnesses can correct me as --

MR. COX: This is Alan Cox with --

CHAIRMAN McDADE: Judge Kennedy indicated that his recollection is that the testimony was that all of the CUFs were below one. I don't recall what I had heard, but I had recalled seeing this particular table, 4.3-10, and the 1.0.

And whatever was said, what I had heard was that it was one or below. And that's the

testimony of Mr. Nelson Azevedo that you viewed it as 1.0 was within spec.

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

CHAIRMAN McDADE: And I just -- and just to clarify in response to Judge Wardwell's question that this is something that would be monitored, you know, since this is not in use constantly that you would monitor the number of hours that it would be used to make sure that, in fact, those number of hours were not exceeded and, therefore, the CUF did not go above 1.00.

MR. AZEVEDO: That's correct.

CHAIRMAN McDADE: Okay.

MR. O'NEILL: Your Honor, this is Mr. O'Neill. I just think we also need to be mindful of the context in which those discussions may have occurred. This appears to be the original LRA, right? And that number --

CHAIRMAN McDADE: Excuse me.

MR. O'NEILL: Okay.

CHAIRMAN McDADE: You talk to us, and then we'll talk to them.

MR. O'NEILL: Okay. Thanks, Your Honor, but I just want to emphasize that this appears to be the original LRA. And the discussion yesterday may

have been taking place in the context of, you know, re-analyses, CUFen analyses that were done subsequently with respect to a primary side, you know, pressure boundary components and perhaps not secondary side components as addressed in the original LRA.

CHAIRMAN McDADE: I believe it was broader, but I think that the testimony of Mr. Azevedo today clarifies what the position is of Entergy.

So, at this point the Board has basically run out of questions. We have answered those questions that we had, clarified what we thought needed to be clarified, which then brings us back to the question that I posed at the beginning of today's session. And, again, focusing on the limitations that I put there of additional questions to correct or clarify testimony by your own witness that would otherwise be both material and misleading, or to point out testimony of opposing parties' witnesses that was incorrect or misleading and that has not already been inquired into or otherwise addressed by the Board.

With that limited universe, does Entergy have additional questioning that they feel is appropriate at this time?

MR. BESSETTE: Your Honor, we do appreciate the opportunity. We believe the board has

done some thorough interrogation of the witnesses. We would have just a couple of wrap-up questions, but we would suggest if we could just have even just 20 minutes to caucus. We were doing our homework at lunch.

If that would be appropriate, again, I think it would be a matter of minutes.

CHAIRMAN McDADE: Okay. And from New York, what's your view?

MR. SIPOS: All right. This is going to take a little while. John Sipos, State of New York. I'd like to review what has happened in this proceeding with Track 1 and Track 2.

In Track 1 on August 8, 2012, the State of New York filed a motion for cross examination. It was over the objection of the other -- the applicant and the federal regulator. And that was pursuant to Atomic Energy Act Section 274(l).

Your Honors and the Commission allowed limited attorney questioning at Track 1. There was an opportunity for the parties to file a request either under Part 2, or under the Atomic Energy Act, again, Section 274. And 274 is a specific reg for a sovereign state such as New York.

New York did not file such a motion. No

other party filed such a motion. There was even a gentle reminder from the Board in one of the scheduling notes in September, I believe.

So, the State is surprised that at this late time in this Track 2 hearing on the fourth day of the hearing, there is now a suggestion that the parties could conduct cross examination or examination of their own witnesses or follow-up examination of other parties' witnesses. So, the State has a very serious concern and objection as to that.

CHAIRMAN McDADE: Okay. Mr. Sipos, during the Track 1 contentions, the Board allowed basically what I was just suggesting today at the request of New York. And New York not only had no objection, it, in fact, went ahead and did do the questioning as suggested, which the Board found to be helpful to it in reaching its initial decision.

There has been no further discussion from any of the parties with regard to whether the parties wished to ask any questions, present any questions other than in the written presentation of questions that was done by all of the parties.

And my question to you, I guess, at this point is if in the Track 1 contentions this was a procedure that New York requested and utilized, where

is the prejudice to New York in the Track 2 contentions to allow a similar limited questioning that would be available to New York and Riverkeeper to the same degree that it would be available to any other party?

MR. SIPOS: Your Honor, John Sipos for the State of New York. I'd like to respond with a few points.

The motion that was filed on August 8, 2012, was for Track 1 and Track 1 only. It did not extend to other aspects of the proceeding and we were already --we had already split or bifurcated the proceeding. That is my recollection.

Secondly, there was in the scheduling order, or the modified scheduling order, an opportunity for the parties, like there was in Track 1, to so request the opportunity for attorney-initiated questioning of the witnesses. And that deadline came and went, I believe, in the middle of October.

To my knowledge -- well, I can speak for the State of New York. The State of New York in that time did not so avail itself of that opportunity and I am not aware that any other party filed a motion that day seeking that pathway forward.

So, in talking about --

CHAIRMAN McDADE: I understand, Mr. Sipos.

MR. SIPOS: -- the prejudice ---

CHAIRMAN McDADE: I understand. My question -- you had said that before. My question to you is not to repeat what you had said before, but it was specifically to address how if this was a procedure that was requested and utilized by New York in Track 1 for the Board to sua sponte allow this based on the Board's determination that it could potentially be helpful to us, where the prejudice to New York arises.

MR. SIPOS: Yes, I was going to get to that. The prejudice to New York arises from hearing about this for the first time on the fourth day of the hearing. There was no prejudice the last time, because the State moved in a timely, early manner and there were -- there was authorization from the Board and the commissioner.

This -- today is the first time I, as a State of New York representative, heard that there will be this possibility. If I had known in October, if I had known in mid-October/late October, the State would have prepared itself and operated differently in this Track 2 proceeding. So, here's --

CHAIRMAN McDADE: And, Mr. Sipos, again going back to my preface to this, you at least from the standpoint of the board could not have prepared yourself differently because this is not open-ended questioning.

This is questioning that as I've indicated a couple of times now, is very limited. It is based only on the verbal/oral testimony that has come in at this particular proceeding where if you believe that one of your witnesses, and you may well not, but believe that one of your witnesses offered testimony that you believed might be either incorrect or somehow misleading, that you would have the opportunity while the witnesses are here, while we are here, to help correct the record.

Likewise, while your witnesses are here if you believe that there was testimony, verbal testimony, not the written testimony that came in, not the pre-filed testimony, not the exhibits, but the testimony of the witnesses that you believed was either incorrect or somehow misleading that could send the Board in the wrong direction, that you would be given a brief opportunity to make inquiry into that. And, again, based only on what has gone on here in the hearing over the last four days.

So, it doesn't reflect anything with regard to the written testimony where you've had the opportunity to read and to submit written rebuttal and rebuttal testimony, as well as rebuttal statement of position, but it's solely limited to what has gone on here in the hearing.

And the question again in that limited circumstance and, you know, I've got an open mind on this, but I just -- as I sit here right now, I don't see what the prejudice would be to New York to afford you that opportunity that you may or may not take advantage of, but, likewise, to allow Entergy the opportunity, as was explained, for a very few limited number of questions that would serve the purpose, you know, for which I proffer this.

Again, you can choose to take advantage of it, or not, and that's fine. The question then would arise if Entergy chooses to take advantage of it, how is New York prejudiced given the limitations that I have put on their ability to ask questions? How would New York be prejudiced by that?

MS. SUTTON: Your Honor, this is Kathryn Sutton for the applicant.

CHAIRMAN McDADE: Excuse me, Ms. Sutton. Let me just get this from Mr. Sipos first.

MR. SIPOS: Judge, you are probably hearing some frustration on my part. My understanding coming into this proceeding having never been in an NRC proceeding, was that the rules were changed in 2004 and there is the Citizen Action Network decision from the First Circuit. And that before that time there was allowance for attorney questioning along with discovery. And that the 2004 rulemaking in Part 2 changed it.

So, this is -- and New York understands rules change. And as we said eight years ago, as Deputy Attorney General Mylan Denerstein said, we'll play on the court that the NRC provides for us, on the playing field that NRC provides for us.

CHAIRMAN McDADE: Okay. Am I correct, Mr. Sipos, and, again, my recollection is that with Track 1 New York made the request.

MR. SIPOS: Yes.

CHAIRMAN McDADE: We granted the request. The opposing party appealed it and the Commission upheld the ruling of the Board to allow it.

MR. SIPOS: That is correct.

CHAIRMAN McDADE: Now, let me also go back. Ms. Sutton, I'm not quite certain what you wanted to say. I have a strange feeling it might have

been that it's not worth the aggravation.

MS. SUTTON: Sort of along those lines, Your Honor. We were responding to the sua sponte request that you posed today.

CHAIRMAN McDADE: Sua sponte offer, not necessarily a request.

MS. SUTTON: Yes, a request for an answer, an offer. We're willing to withdraw that response and just rest the case.

MR. TURK: Your Honor, may I speak for a moment for the staff?

CHAIRMAN McDADE: Yeah, very briefly. Then we're going to take a quick recess and come back.

MR. TURK: I think the only issue is whether the Board would find it helpful for the parties to do any further questioning perhaps only of their own witnesses if for no other reason than simply to clarify statements that may have been made.

And Mr. Sipos is correct that the rules were changed in 2004. But as he pointed out when he was arguing for the right to cross examination, the rules do permit the board to allow questioning when they find it will help them in reaching their decision.

MR. SIPOS: Is that --

CHAIRMAN McDADE: We are going to take a very brief recess. We're going to recess for about 10 minutes and then we will come back and either have further discussion on this or, you know, recess and close the hearing. So, we're going to stand in recess for 10 minutes.

(Whereupon, the proceedings went off the record for a brief recess at 2:29 p.m. and resumed at 2:38 p.m.)

CHAIRMAN McDADE: Please be seated. Okay. The hearing will come to order. I didn't give Ms. Brancato a chance to be heard on this. Do you wish to be?

MS. BRANCATO: Yes, thank you. First, briefly, prior to the discussion about counsel pursuing clarifying questions, I just wanted to point out I believe Dr. Hopenfeld had indicated he wanted to make a statement and it was put on hold and shelved. So, if you're inclined to give him the opportunity to make one last comment that he had indicated --

CHAIRMAN McDADE: To make a statement regarding what?

MS. BRANCATO: It was about a particular issue that had been discussed. If Your Honors wanted to --

CHAIRMAN McDADE: Dr. Hopenfeld, what is the topic?

DR. HOPENFELD: First, I'd like to comment it's extremely important. I started and I thought I would get another opportunity to talk about it. And it has to do with the -- has to do with the factor of three uncertainty in the Fen calculations.

What the statement was made yesterday, all this was taken in the code. It's absolutely wrong. That Fen isn't uncertainty data. It has nothing to do with the code. As a matter of fact, it's not a factor of three, it's a factor of six, but I just didn't want to get into more detail.

The reason it's a factor of six because the Fen -- and I can go through the numbers with you. The Fen -- but I don't want to get into -- the main thing for the record I want to put in what the gentleman said is absolutely misleading, is incorrect that Fen has nothing to do -- the uncertainty of Fen have nothing to do with the ASME code.

ASME code doesn't know anything about Fen. Fen is something that was devised by the NRC by Argonne. It has nothing to do with the code. Those uncertainties are not -- the table that he was talking about, he was talking about the margins which were due

to the variations in the surface roughness specimen counting loads, but has nothing to do with this, what I was talking about.

You can go through the basic -- the best thing to do, to call the people at Argonne. They developed this. Ask them. That's all.

CHAIRMAN McDADE: And what was the other point, Dr. Hopenfeld?

DR. HOPENFELD: Okay. My other point is maybe -- it will take a little bit more time.

CHAIRMAN McDADE: Excuse me. The other point you said will take some time?

DR. HOPENFELD: Yeah, little bit more time.

CHAIRMAN McDADE: Before you get into the point, just tell me what it is.

DR. HOPENFELD: It has to do with H star.

CHAIRMAN McDADE: With what?

DR. HOPENFELD: The H star, the 19 inches of height which allows -- which assumes that this area is not a safety area and we don't have to get -- we don't have to inspect it or we don't have to inspect it as often.

CHAIRMAN McDADE: Okay. I think, Dr. Hopenfeld, I'm going to cut you off here. That is the

focus of a license amendment. Whether or not that license amendment was appropriately granted or not is outside the scope of this proceeding. So, I think that we have a good understanding of what it is from the testimony, and also from the documents that were presented.

And to a very large degree, that particular issue is outside the scope of this proceeding because it was the subject of a license amendment. But thank you, Dr. Hopenfeld.

MS. SUTTON: Your Honor, Kathryn Sutton for the applicant. Also, with respect to New York 38 prior to the break, Mr. Azevedo made a statement that he would like to correct on the record.

CHAIRMAN McDADE: Okay. Thank you, Ms. Sutton. Mr. Azevedo.

MR. AZEVEDO: Yes, Your Honor. This is Nelson Azevedo. This relates to the answer to Judge Kennedy, I believe it was, whether we applied Fens to the secondary side. And at first I said we did not, and then I corrected myself. Turns out I was right the first time.

The Fen correction factors were specifically specified for the primary side. It's for primary waters, not for the secondary waters. So, we

did not apply those primary water Fens to the secondary side CUFs.

CHAIRMAN McDADE: Okay. Thank you, sir. So, you thought you made your first mistake of your life, and you found out you didn't.

MR. AZEVEDO: I wish it was the first one.

CHAIRMAN McDADE: Okay. Ms. Brancato, do you have any comments on Mr. Sipos' objection?

MS. BRANCATO: Yes. Riverkeeper is generally in support of this position of the State of New York. In the absence of motions in accordance with the Board's scheduling order, we don't particularly think questions from the parties is necessarily appropriate.

CHAIRMAN McDADE: Okay. Thank you.

MS. BRANCATO: And just that Riverkeeper would prefer the alternative that you proposed if we are to ask clarifying questions, that we would compile them, submit them to you, and then you could determine whether such clarifications are needed.

CHAIRMAN McDADE: Okay. I think the situation given your position, given the position stated by Entergy, we are going to sustain Mr. Sipos' objection. And at this point in time, we're going to terminate the evidentiary hearing on the Track 2

contentions.

What we would direct of the parties and if this schedule is not appropriate, let us know, and you can let us know by email, we would ask the parties to get together sometime within the next two weeks and by the close of business, not Thanksgiving week, but the week after that if you could, if possible, come up with a proposed schedule for post-trial briefing, the submitting of proposed findings of fact and conclusions of law, et cetera, that we're not looking to get anything other than just a proposed schedule, which, if possible, you know, if it can be done by agreement between the parties. So, if you can get together and discuss it and, if possible, present a joint suggestion to us.

Mr. Sipos.

MR. SIPOS: And, Your Honor, would that schedule include the possibility for the parties to review the transcript from the court reporter? We did that in Track 1 after the hearings.

CHAIRMAN McDADE: Okay. I'm not really sure what you mean.

MR. SIPOS: Like an errata sheet. The last time -- sometimes there's perhaps typos in the transcript. And I think last time --

CHAIRMAN McDADE: The answer is yes. And I'm sorry I just misunderstood you, but we're not looking for the errata sheet by a week from Friday. All we're looking for is from you to come up with a proposed schedule, you know, realistically by when, you know, can this be done.

MR. SIPOS: Thank you.

CHAIRMAN McDADE: Yes, and any other proposed issues that come up post-trial. Again, what we're looking for is just a proposed schedule.

MS. SUTTON: Yes, understood, Your Honor.

MR. HARRIS: Understood, Your Honor.

CHAIRMAN McDADE: Okay. Is there anything else that the staff believes should be taken up at -- before we close this evidentiary hearing?

MR. HARRIS: No, Your Honor.

CHAIRMAN McDADE: Entergy?

MS. SUTTON: No, Your Honor, other than to -- on behalf of Entergy and Westinghouse to thank the Board and all of the support here at the hearing.

MR. SIPOS: Similarly from the State of New York we'd like to thank Your Honors and your staff for checking up here and spending a week in the Empire State.

MS. BRANCATO: And Riverkeeper thanks you

as well, of course.

CHAIRMAN McDADE: And before we do break, I would like to, you know, first of all very much compliment all of the witnesses. I am extremely impressed with your ability to answer the questions that we have posed.

We've had the opportunity to go through the documents and read them and focus on a particular question. You're sitting there not knowing what questions we're going to ask. So, these questions although you're very familiar with the record, come out of the blue. And your ability to locate the documents that are of reference and to answer the questions is truly impressive and I want to thank you very much.

And I also want to comment with regard to counsel, you know, we have had significant filings both in the preparation of the pre-trial testimony, and also in the preparation of the statements of position that were very helpful. And a lot of work went into that and they were all done in an extremely professional way that made this proceeding much easier for the Board. So, again, I want to thank you very much. We really appreciate -- recognize and appreciate your work in that regard.

This evidentiary hearing on the Track 2 contentions is now closed. Thank you.

(Whereupon, the hearing in the above-entitled matter concluded at 2:48 p.m.)